Institute of Parasitology

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

Biennial Report

A Brief Survey of the Institute's Organisation and Activities

2014–2015

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Structure of the Institute

(*As of 1 January 2016*)

Director
(***Julius LUKEŠ***)

Deputy Director
(***Tomáš Scholz***)

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- **Laboratory of Molecular Biology of Protists** (***Julius Lukeš***)
- **Laboratory of Functional Biology of Protists** (*Alena Panicucci Zíková*)
- **Laboratory of RNA Biology of Protists** (*Zdeněk Paris*)

Fish Parasitology

- **Laboratory of Helminthology** (***Tomáš Scholz***)
- **Laboratory of Fish Protistology** (*Astrid Holzer*)

Folia Parasitologica
(*Tomáš Scholz*)

Evolutionary Parasitology

- **Laboratory of Evolutionary Protistology*** (***Miroslav Oborník***)
- **Laboratory of Environmental Genomics** (*Aleš Horák*)
- **Laboratory of Molecular Phylogeny and Evolution of Parasites** (*Jan Štefka*)

Opportunistic Diseases

- **Laboratory of Veterinary and Medical Protistology** (***Martin Kváč***)
- **Laboratory of Parasitic Therapy** (*K. Jirků-Pomajbíková*)

Supporting Facilities

- **Laboratory of Electron Microscopy** (*Jana Nebesářová*)
- **Animal Facility** (*Tomáš Douda*)
- **Administrative and technical services**

Scientific Council

Miroslav Oborník (Chairman)
Aleš Horák
Petr Kopáček
Martin Kváč
Tomáš Scholz
Alena Zíková
External members
Petr Horák
Ivan Čepička
Ivo Šauman

Tick-Borne Diseases

- **Laboratory of Molecular Ecology of Vectors and Pathogens*** (***Libor Grubhoffer***)
- **Laboratory of Arbovirology** (*Daniel Růžek*)

Biology of Disease Vectors

- **Laboratory of Vector Immunology** (***Petr Kopáček***)
- **Laboratory of Genomics and Proteomics of Disease Vectors** (*Michail Kotsyfakis*)
- **Laboratory of Tick Transmitted Diseases** (*Ondřej Hajdušek*)

* Joint research team of the Institute and Faculty of Science, University of South Bohemia; team leader in bold.

Editorial

It is my turn to write a brief entrée to the biennial brochure (2014–2015) of the Institute of Parasitology, Biology Centre, as I was appointed its director in July 2012. I am happy to say that the Institute is in a good shape, a statement backed by results of the evalution of its scientific production performed in 2015 by an international committee. The four new opened laboratories are strong and kicking. Moreover, five laboratories moved into new space that have been built as a new floor over our animal facility. Another encouraging fact is that the Institute houses have more international community than ever before. The journal published by us – *Folia Parasitologica*, now on-line with open access – is getting a growing number of sound submissions. I believe that the combination of these factors gives the Institute a bright future.

In reaction on the trends of digitalisation, we decided to publish this biennial brochure only online, and plan to do so in the future. I hope that those interested will easily browse through it on the web, while we will save a few trees.

We are trying to be an open, vibrant, dynamic and international group of laboratories and teams, joint by the common interests in all aspects of parasitology. As we are looking forward to new collaborations, students and colleagues, I would like to encourage the reader to contact us in case of her/his interest.

Cheers,

Julius Lukeš

Director

Mission statement

The Institute of Parasitology of the Biology Centre is a research institution of the Czech Academy of Sciences, performing fundamental research on human and animal parasites at the organismal, cellular and molecular levels. The mission of the Institute is to acquire, advance and disseminate knowledge of the biology and host relationships of parasitic protists and related eukaryotic microorganisms, helminths and arthropods. The Institute pursues its mission 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 had an impact on agriculture.

The Institute of Parasitology was established in Prague in 1962, but was relocated to České Budějovice in South Bohemia in 1985. The Institute represents a principal institution devoted exclusively to parasitological research in the Czech Republic. The main research areas encompass protistology, helminthology and medical entomology, including studies on the causative agents of the infections transmitted by arthropods. Investigations into molecular biology of parasitic protists, phylogeny of parasites and their molecular ecology, fish parasites, life-cycles of helminths and parasitic arthropods as vectors of diseases have remained long-term research priorities of the Institute.

Research teams and their activities

1. Molecular Parasitology

1.1. Laboratory of Molecular Biology of Protists

Research scientists:	Prof. RNDr. **Julius LUKEŠ**, CSc. (*head*) RNDr. **Drahomíra Faktorová**, PhD; **Pavel Flegontov** MSc, PhD (part time); **Hassan Hashimi**, MSc, PhD; RNDr. **Eva Horáková**, PhD; **Priscilla Peña Diaz**, MSc, PhD (Venezuela)
PhD students:	**Sameer Dixit**, MSc (India); RNDr. **Eva Dobáková** (Slovakia); **Zhenqiu Huang**, MSc (China); **Binnypreet Kaur**, MSc (India); **Josef Kaurov**, MSc (Russia); **Anna Nenarokova**, MSc (Russia); RNDr. **Tomáš Skalický**; Mgr. **Jiří Týč**
Technicians:	Mgr. **Eva Kriegová**; **Gabriela Ridvanová**; RNDr. **Eva Stříbrná-Černotíková**
Undergraduate students:	Bc. **Vojtěch David**; **Anita Bar** (Austria); **Michaela Boudová**; **Hannah Bruce** (Scotland); **Alexander Haindrich** (Austria); **Sabine Kaltenbrunner** (Austria); **Michaela Uhrová**

Research priorities

Our 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, tagging, overexpressing or knocking-in individual genes, we are trying to establish their function(s). We have focused primarily 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; (iv) mitochondrial processing peptidases; and (v) proteins involved in heme metabolism. We are also interested in evolution and biodiversity of free-living and parasitic kinetoplastid flagellates. Lately, we initiated studies of the diversity of marine diplonemids, a virtually unknown group of abundant and extremely diverse deep-sea planktonic protists, constituting a sister clade to kinetoplastids. We want to alter them into genetically tractable cells, so that they become amenable for functional studies, and attempt cultivation of deep-sea diplonemids, so far completely unknown from the morphological or genomic points of view.

Selected publications

- **David V.**, **Flegontov P.**, Gerasimov E., Tanifuji G., **Hashimi H.**, Logacheva M.D., Maruyama S., Onodera N.T., Gray M.W., Archibald J.M., **Lukeš J.** 2015: Gene loss and error-prone RNA editing in the mitochondrion of *Perkinsela*, an endosymbiotic kinetoplastid. *mBio* 6: e01498-15. [IF=6.975]
- **Flegontov P.**, Michálek J., Janouškovec J., Lai D.-H., **Jirků M.**, Hajdušková E., Tomčala A., Otto T.D., Keeling P.J., Pain A., Oborník M., **Lukeš J.** 2015: Divergent mitochondrial respiratory chains in phototrophic relatives of apicomplexan parasites. *Molecular Biology and Evolution* 32: 1115–1131. [IF=13.649]
- **Huang Z.**, **Faktorová D.**, **Křížová A.**, Kafková L., Read L.K., **Lukeš J.**, **Hashimi H.** 2015: Integrity of the core mitochondrial RNA binding complex 1 is vital for trypanosome RNA editing. *RNA* 21: 2088–2102.

[IF=4.344]

- de Vargas C., Audic S., Henry N., Decelle J., Mahé F., Logares R., Lara E., Berney C., Le Bescot N., Probert I., Carmichael M., Poulain J., Romac S., Colin S., Aury J.-M., Bittner L., Chaffron S., Dunthorn M., Engelen S., Flegontova O., Guidi L., Horák A., Jaillon O., Lima Mendez G., **Lukeš J.**, Malviya S., Morard R., Mulot M., Scalco E., Siano R., Vincent F., Zingone A., Dimier C., Picheral M., Searson S., Kandels-Lewis S., Acinas S.G., Bork P., Bowler C., Gaill F., Gorsky G., Grimsley N., Hingcamp P., Iudicone D., Not F., Ogata H., Pesant S., Raes J., Sieracki M., Speich S., Stemmann L., Sunagawa S., Weissenbach J., Wincker P., Karsenti E. 2015: Eukaryotic plankton diversity in the sunlit ocean. *Science* 348: 1261605. [IF=33.661]
- **Verner Z.**, **Basu S.**, **Benz C.**, **Dixit S.**, **Dobáková E.**, **Faktorová D.**, **Hashimi H.**, **Horáková E.**, **Huang Z.,** Paris Z., **Peña-Diaz P.**, **Ridlon L.**, **Týč J.**, Wildridge D., Zíková A., **Lukeš J.** 2015: Malleable mitochondrion of *Trypanosoma brucei*. *International Review of Cell and Molecular Biology* 315: 73–151. [IF=3.752]

Research projects

- **Characterization of iron-sulphur clusters components in *T. brucei*.** Czech Science Foundation (P305/11/2179; P.I.: J. Lukeš; 2011–2014)
- **RNPnet – RNP structure, function and mechanism of action.** EU – FP7, Marie Curie Actions (GA 289007, FP7-PEOPLE-2011-ITN; P.I.: J. Lukeš; 2011–2015)
- **Characterization of the mitoproteome of the parasitic protist *Trypanosoma brucei* by means of recombinogenic engineering.** Czech Science Foundation (P305/12/2261; P.I.: J. Lukeš; 2012–2014)
- **Post-transcriptional modification of tRNA in *Trypanosoma brucei*.** Ministry of Education, Youth and Sports of Czech Republic, AMVIS (LH12104; P.I.: J. Lukeš; 2012–2015)
- **Trypanosomiases in African great apes – quest for first data from the wild.** Czech Science Foundation (M200961204; P.I.: J. Lukeš; 2012–2015)
- **Diplonemid.** Moore Foundation, USA (P.I.: J. Lukeš; 2015–2016).
- **Mitochondrial genome-wide studies of RNA-binding proteins in trypanosomes.** Czech Science Foundation (P.I.: J. Lukeš; 2015–2017).

1.2. Laboratory of Functional Biology of Protists

Research scientist:	RNDr. **Alena ZÍKOVÁ**, PhD (*head*) Mgr. **Eva Doleželová**, PhD; Mgr. **Ondřej Gahura** PhD; **Brian Panicucci**, BSc (USA); **David Wildridge**, MSc, PhD (United Kingdom)
PhD students:	**Carolina Hierro Yap**, MSc (Spain); Mgr. **Karolína Šubrtová**; **Gergana Taleva**, MSc (Bulgaria); Mgr. **Michaela Veselíková**
Undergraduate students:	Bc. **Zuzana Kotrbová**; Bc. **Jan Martinek**; Bc. **Hana Váchová**; **Michaela Kunzová**

Research priorities

Trypanosoma brucei, a unicellular parasite of human and livestock, is being extensively studied because of its unique biology, its impact on human health and economy, and because of its readiness to genetic manipulation. *T. brucei* is a digenetic parasite that alternates between an insect vector and a mammalian host. In order to survive within the specialised environments of its hosts, this protist has developed a wide variety of unique physiological functions. One example is its mitochondrial energy metabolism that exhibits many unique features and interesting variations to the mammalian system. It is our main interest to understand them and to explore them as promising novel targets for chemotherapeutic intervention.

Mitochondrial bioenergetics of *T. brucei*

As *T. brucei* alternates between its mammalian host and insect vector it must readily adapt its metabolism to utilise the various carbon sources it can scavenge from its environment. In the mammalian bloodstream, this extracellular pathogen relies on the abundant source of glucose for energy production; while in the hemolymph of the tse-tse fly, this flagellated protist must utilise amino acids to synthesise chemical energy in the form of ATP. ATP production in the latter pathway requires oxidative phosphorylation to couple the mitochondrial membrane potential to the synthesis of ATP by the FoF1-ATP synthase. This process is sensitive to inhibitors of the ADP/ATP carrier because this transporter supplies the substrate for the FoF1 in the form of cytosolic ADP. Interestingly, in the infectious stage of *T. brucei*, these same inhibitors significantly lose their efficacy. This is puzzling because while its mitochondrion lacks a cytochrome-mediated electron transport chain, the cell must provide cytosolic ATP to be hydrolysed by the FoF1-ATPase to maintain the mitochondrial membrane potential. This becomes even more intriguing since it has long been thought that the ATP is not created by mitochondrial substrate phosphorylation as the Krebs cycle enzymes are not present during this life stage. Our lab is exploring [IF ADP/ATP carrier is essential in bloodstream cells cells and [IF not, where does the source of mt ATP come from.

Role of ROS signaling in differentiation of *T. brucei*

While focusing on the bioenergetics of *T. brucei*, we have identified an endogenous inhibitor of the FoF1-ATPase, called TbIF1. This peptide inhibits ATPase activity and is lethal in the infectious stage of the pathogen when its expression is induced. We are further characterising

the specific interactions of this natural inhibitor with its complex to ascertain [IF the unique structure of *T. brucei* ATPase provides some species specificity that can be exploited for structure based drug design. Furthermore, we have experimental evidence to suggest that the physiological function of TbIF1 might be to initiate a signaling pathway during the progression of the procyclic stage as the protist transforms from trypomastigotes in the midgut of the insect vector into the epimastigotes and metacyclics that reside in the salivary glands. These latter stages are already preparing their metabolism for the glucose-rich environment they will soon encounter at the next feeding. This requires a dramatic switch from the oxidative phosphorylation to the inefficient use of glycolysis. This is similar to what is reported in cancer cells, where high levels of [IF1 expression inhibits ATP synthesis and creates a ROS signal that triggers this metabolic shift. Determining how TbIF1 is regulated and what is the signalling mechanism are important features of our work.

Mode of action of selected trypanocidal drugs

In collaboration with several international and Czech laboratories we are investigating mode of action of some selected drugs that act on parasites in nanomolar amounts. Importantly, these compounds affect mitochondrial function and physiology. Studying the critical mitochondrial processes (membrane potential, ROS generation, oxygen consumption, activity of respiratory complexes, stability of mitochondrial DNA, protein import, redox metabolism, etc.) we are able to identify putative drug targets followed by their functional validation using RNA interference.

Selected publications

- Gnipová A., **Šubrtová K.**, **Panicucci B.**, Horváth A., Lukeš J., **Zíková A.** 2015: The ADP/ATP carrier and its relationship to OXPHOS in an ancestral protist, *Trypanosoma brucei*. *Eukaryotic Cells* 14: 297–310. [IF=2.946]
- **Šubrtová K.**, **Panicucci B.**, **Zíková A.** 2015: ATPaseTb2, a unique membrane-bound FoF1-ATPase component, is essential in bloodstream and dyskinetoplastic trypanosomes. *PLoS Pathogens* 11: e1004660. [IF=7.003]
- Verner Z., Basu S., Benz C., Dixit S., Dobáková E., Faktorová D., Hashimi H., Horáková E., Huang Z., Paris Z., Peña-Diaz P., Ridlon L., Týč J., **Wildridge D.**, **Zíková A.**, Lukeš J. 2015: Malleable mitochondrion of *Trypanosoma brucei*. *International Review of Cell and Molecular Biology* 315: 73–151. [IF=3.752]
- **Zíková A.**, Oborník M., Lukeš J. 2015: Fancy a gene? A surprisingly complex evolutionary history of peroxiredoxins. *Microbial Cell* 2: 33–37. [IF=not yet]

Research Projects:

- **Comprehensive analysis of FoF1-ATP synthase in parasitic protozoa.** EMBO Installation grant (1965; P.I.: A. Zíková; 2010–2014)
- **Exploitation of the unique characteristics of the *Trypanosoma brucei* FoF1-ATP synthase complex for future drug development against African sleeping sickness.** Ministry of Education, Youth and Sport of the Czech Republic (ERC CZ LL1205; P.I.: A. Zíková; 2013–2017)

1.3. Laboratory of RNA Biology of Protists

Research scientists:	RNDr. **Zdeněk PARIS**, PhD (*head*) Mgr. **Eva Hegedüsová**, PhD (Slovakia); Mgr. **Jitka Kručinská**
PhD student:	**Sneha Sunil Kulkarni**, MSc (India)
Undergraduate students:	**Veronika Běhálková**; **Helmut Stanzl** (Austria); **Rebecca Wolkerstorfer** (Austria)

Research priorities

Our group (established in February 2014) studies various aspects of RNA biology of the protistan parasite *Trypanosoma brucei* and related flagellates. In those early evolved unicellular organisms most genes are post-transcriptionally regulated. Consequently, post-transcriptional processing of RNA becomes of a great importance to regulate complex life cycles of these pathogens. We are mainly interested in processes such as tRNA modifications, nuclear tRNA export and role of the only intron containing tRNA in trypanosomes. Our long-term goal is an identification of unique mechanisms of RNA metabolism. We believe this will help us reveal new drug targets to combat diseases caused by trypanosomatid parasites.

Queuosine biosynthesis in trypanosomes

Transfer RNAs are typical for the large number of post-transcriptional modifications. Most of the tRNA modifications are present in the anticodon loop and have crucial role in proper translation of proteins. Queuosine is one of the most complex tRNA modifications. Despite its omnipresence among bacteria and eukaryotes, role of queuosine tRNA modification is not clear. The main aim of this project is to evaluate the function and subunit composition of the enzyme responsible for queuosine formation in *T. brucei*. Using the RNAi knock-down strategy, we want to address the principal question regarding the role of queuosine tRNA modification with respect to biology and physiology of this protistan parasite.

Role of the only tRNA intron in trypanosomatids

In yeast *Saccharomyces cerevisiae* and other model organisms, 20% of all tRNAs contain introns. Their removal is an essential step in the maturation of tRNA precursors. In *T. brucei*, there is only one intron containing tRNA: $tRNA^{Tyr}_{GUA}$. Since this tRNA is responsible for decoding all tyrosine codons, intron removal is essential for viability. Using molecular and biochemical approaches, several non-canonical editing events were identified within the intron-containing $tRNA^{Tyr}_{GUA}$. The RNA editing involves guanosine-to-adenosine transitions (G to A) and an adenosine-to-uridine transversion (A to U), which are both necessary for proper processing of the intron. We have been obtaining tRNA intron sequences from our collection of newly identified trypanosomatid species. We hope this will help us understand the process of RNA editing and ultimately identify biological function of the presence of the only intron containing tRNA in these organisms.

Nuclear export of tRNAs in trypanosomes

Nuclear tRNA export to the cytoplasm might provide an additional level of regulation of gene expression during the complex life cycle of trypanosomes. However, only a limited set of eukaryotic export factors, conserved in other organisms, can be easily identified in the *T. brucei* genome; thus our knowledge of nuclear tRNA export remains limited. In this project, we employ molecular biology and biochemistry approaches to identify and characterise the nuclear tRNA export machinery in trypanosomes and its role in tRNA maturation, with the general idea of tRNA nuclear export as a regulated step.

Selected publications

- Horáková E., Changmai P., **Paris Z.**, Salmon D., Lukeš J. 2015: Simultaneous depletion of Atm and Mdl rebalances cytosolic Fe-S cluster assembly but not heme import into the mitochondrion of *Trypanosoma brucei*. *FEBS Jornal* 282: 4157–4175. [IF=4.237]
- Sample P., Kořený L., **Paris Z.**, Gaston K.W., Rubio M.A., Fleming I.M., Hinger S., Horáková E., Limbach P.A., Lukeš J., Alfonzo J.D. 2015: A common tRNA modification at an unusual location: the discovery of wyosine biosynthesis in mitochondria. *Nucleic Acids Research* 43: 4262–4273. [IF=9.202]
- Verner Z., Basu S., Benz C., Dixit S., Dobáková E., Faktorová D., Hashimi H., Horáková E., Huang Z., **Paris Z.**, Peña-Diaz P., Ridlon L., Týč J., Wildridge D., Zíková A., Lukeš J. 2015: Malleable mitochondrion of *Trypanosoma brucei*. *International Review of Cell and Molecular Biology* 315: 73–151. [IF=3.752]

Research projects

- **Modbiolin** (GA316304 – Use of model organisms to resolve crucial biological problems on the path to innovations 7FP-EU. (ZP was hired as a head researcher for the years 2014–2015)
- **Queuosine: The role of an essential tRNA modification in parasitic protist *Trypanosoma brucei*.** Czech Science Foundation (15-21450Y; P.I.: Z. Paris; 2015–2017)

2. Evolutionary Parasitology

2.1. Laboratory of Evolutionary Protistology

Research scientists:	Prof. Ing. **Miroslav OBORNÍK**, PhD (*head*) **Heather Esson**, MSc, PhD (Canada); Mgr. **Zoltán Füssy**, PhD; RNDr. **Eva Hajdušková Roubalová**, PhD; RNDr. **Aleš Tomčala**, PhD; **Abduallah Sharaf**, MSc, PhD (Egypt)
PhD students:	Mgr. **Jaromír Cihlář**; Mgr. **Jitka Kručinská**; Mgr. **Jan Michálek**; Ing. **Ivana Schneedorferová**
Research assistant:	Mgr. **Kateřina Jiroutová**, PhD
Undergraduate student:	Bc. **Jan Vazač**

Research priorities

Laboratory of Evolutionary Protistology (LEP) (formerly Laboratory of Molecular Taxonomy) was established in 2000 as a joint laboratory 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 algae.

Genomics of chromerids

Chromerids are phototrophic algae isolated from Australian corals. Two species have been described so far, *Chromera velia* and *Vitrella brassicaformis*, which have been shown to represent the closest known phototrophic relatives to apicomplexan parasites. Chromerid genomes show drastic reduction during transition of a phototrophic ancestor to an apicomplexan parasite. At this stage, over 3 600 genes were lost, while only 80 were retained. This may suggest that phototrophic ancestor already contained most of genes used for parasitism in its apicomplexan descendants.

Reduced respiratory chain in the mitochondrion of *C. velia*

Through investigation of genomic and transcriptomic sequences and those obtained from enriched mitochondrial fraction, we reconstructed respiratory chain of *C. velia*. This respiratory chain is non-canonically reduced, with such reduction not found in the mitochondrion of related *V. brassicaformis*. The respiratory chain is interrupted in *C. velia* forming two functionally independent subchains. The complex III is missing from *C. velia* and its electron transport function is substituted by L- and D- lactate cytochrome c oxidoreductases. Complex I is missing form all chromerids as well as from apicomplexan parasites.

Investigation of tetrapyrrole biosyntheses

Tetrapyrrole synthesis is one of most fundamental pathways in living organisms. We investigated origins of enzymes involved in the heme biosynthesis in chromerids, dinoflagellates with the green plastid, dinoflagellates with the diatom plastid (dinotoms), chlorarachniophytes, cryptophytes, and predicted their localisations in the cell.

Selected publications

- Borovička J., **Oborník M.**, Stříbrný J., Noordeloos M.E., Parra Sánchez L.A., Gryndler M. 2015: Phylogenetic and chemical studies in the potential psychotropic species complex of *Psilocybe atrobrunnea* with taxonomic and nomenclatoral notes. *Persoonia* 34: 11–13. [IF=5.725]
- Flegontov P., **Michálek J.**, Janouškovec J., Lai H., Jirků Milan, **Hajdušková E.**, **Tomčala A.**, Otto T.D., Keeling P.J., Pain A., **Oborník M.**, Lukeš J. 2015: Divergent mitochondrial respiratory chains in phototrophic relatives of apicomplexan parasites. *Molecular Biology and Evolution* 32: 1115–1131. [IF=13.649]
- **Oborník M.**, Lukeš J. 2015: The organellar genomes of *Chromera* and *Vitrella*, the phototrophic relatives of apicomplexan parasites. *Annual Review of Microbiology* 69: 129–144. [IF=10.536]
- Ševčíková T., Horák A., Klimeš V., Zbránková V., Demir-Hilton E., Sudek S., Jenkins J., Schmutz J., Přibyl P., Fousek J., Vlček Č., Lang B.F., **Oborník M.**, Worden A.Z., Eliáš M. 2015: Updating algal evolutionary relationships through plastid genome sequencing: did alveolate plastids emerge through endosymbiosis of an ochrophyte? *Scientific Reports* 5: 10134. [IF=5.228]
- Woo Y.H., Ansari H., Otto T.D., Klinger C., Kolísko M., **Michálek J.**, Saxena A., Shanmugam D., Tayyrov A., Veluchamy A., Ali S., Bernal A., del Campo C., **Cihlář J.**, Flegontov P., Gornik S.G., **Hajdušková E.**, Horák A., Janouškovec J., Katris N.J., Mast F., Miranda- Saavedra D., Mourier T., Naeem R., Nair M., Panigrahi A.K., Rawlings N., Regelado E.P., Ramaprasad A., Samad N., **Tomčala A.**, Wilkes J., Neafsey D., Doerig C., Bowler C., Keeling P.J., Roos D.S., Dacks J., Templeton TJ., Waller R.F., Lukeš J., **Oborník M.**, Pain A. 2015: Chromerid genomes reveal the evolutionary path from photosynthetic algae to obligate intracellular parasites. *eLife* 4: e06974. [IF=8.303]

Research Projects

- **Evolution of tetrapyrrole synthesis in phototrophic eukaryotes.** Czech Science Foundation (P506/12/1522, P.I.: M. Oborník, 2012–2015)
- **Photosynthesis Research Centre.** Czech Science Foundation (P501/12/G055, Co-P.I.: M. Oborník, 2012–2018)
- **A genomic approach to unravelling the biology and evolution of eustigmatophyte algae.** Czech Science Foundation (13-33039S, P.I.: M. Oborník, 2013–2015)

2.2. Laboratory of Environmental Genomics

Research scientists: Mgr. **Aleš HORÁK**, PhD (*head*)
Mgr. **Jana Veselá**, PhD

PhD student: **Olga Flegontova**, MSc (Russia)

Research priorities

Study on biodiversity and biology of uncultivable unicellular eukaryotes using power of next-generation sequencing.

Early stages of evolution of parasitism in Apicomplexa

Apicomplexans are probably the most diverse and successful group of parasitic protists, with millions of dollars spent on the research of the key players (*Plasmodium*, *Toxoplasma*, coccidia, etc.). Yet, we know very little about the early phases of their evolution. Therefore, we are characterising the diversity and the genomes of representatives of several enigmatic apicomplexan clades (archigregarines, blastogregarines and agammococcidians) to reveal the evolution of non-photosynthetic plastid (apicoplast) and composition and evolution of the surface proteins associated with the infection of host. Collaboration: Sonja Rueckert, Edinburgh Napier University (UK).

Diversity and ecology of marine diplonemids

Tara Oceans is an international project of unprecedented scale, which aimed to investigate prokaryotic and eukaryotic planktonic diversity of the world oceans. During 2009–2012, almost 28 thousand samples were obtained from 154 locations of the World Ocean. Preliminary analysis of V9 region of the ssu rRNA gene has revealed that some stations are dominated by diplonemid-like kinetoplastid excavates. We aim to elucidate the role of these mysterious organisms in the global ocean ecosystem. We also aim to analyse the metabarcode V9 data to assess diversity and distribution-pattern of marine excavates. Collaboration: Tara Consortium, namely Colomban de Vargas, Station Biologique de Roscoff (France).

Selected publications

- Lukeš J., **Flegontova O.**, **Horák A.** 2015: Diplonemids. *Current Biology* 25: R702–R704. [IF=8.983]
- Ševčíková T., **Horák A.**, Klimeš V., Zbránková V., Demir-Hilton E., Sudek S., Jenkins J., Schmutz J., Přibyl P., Fousek J., Vlček Č., Lang B.F., Oborník M., Worden A.Z., Eliáš M. 2015: Updating algal evolutionary relationships through plastid genome sequencing: did alveolate plastids emerge through endosymbiosis of an ochrophyte? *Scientific Reports* 5: 10134. [IF=5.228]
- de Vargas C., Audic S., Henry N., Decelle J., Mahé F., Logares R., Lara E., Berney C., Le Bescot N., Probert I., Carmichael M., Poulain J., Romac S., Colin S., Aury J.-M., Bittner L., Chaffron S., Dunthorn M., Engelen S., **Flegontova O.**, Guidi L., **Horák A.**, Jaillon O., Lima-Mendez G., Lukeš J., Malviya S., Morard R., Mulot M., Scalco E., Siano R., Vincent F., Zingone A., Dimier C., Picheral M., Searson S., Kandels-Lewis S., Tara Oceans Coordinators, Acinas S.G., Bork P., Bowler C., Gorsky G., Grimsley N., Hingamp P., Iudicone D., Not F., Ogata H., Pesant S., Raes J., Sieracki M.E., Speich S., Stemmann L., Sunagawa S., Weissenbach J., Wincker P., Karsenti E. 2015: Eukaryotic plankton diversity in the sunlit ocean. *Science* 348: 1261605. [IF=33.661]

- Woo Y.H., Ansari H., Otto T.D., Klinger C., Kolísko M., Michálek J., Saxena A., Shanmugam D., Tayyrov A., Veluchamy A., Ali S., Bernal A., del Campo C., Cihlář J., Flegontov P., Gornik S.G., Hajdušková E., **Horák A.**, Janouškovec J., Katris N.J., Mast F., Miranda-Saavedra D., Mourier T., Naeem R., Nair M., Panigrahi A.K., Rawlings N., Regelado E.P., Ramaprasad A., Samad N., Tomčala A., Wilkes J., Neafsey D., Doerig C., Bowler C., Keeling P.J., Roos D.S., Dacks J., Templeton TJ., Waller R.F., Lukeš J., Oborník M., Pain A. 2015: Chromerid genomes reveal the evolutionary path from photosynthetic algae to obligate intracellular parasites. *eLife* 4: e06974. [IF=8.303]

Research Projects

- **Evolution of surface proteins in transition to intracellular parasitism: case of Apicomplexa.** Czech Science Foundation (P506/12/P931; P.I.: A. Horák, 2012–2014)

2.3. Laboratory of Molecular Phylogeny and Evolution of Parasites

Research scientists:	RNDr. **Jan ŠTEFKA**, PhD (*head*) Prof. RNDr. **Václav Hypša**, CSc.; MVDr. **Jana Kvičerová**, PhD; RNDr. **Eva Nováková**, PhD
PhD students:	RNDr. **Filip Husník**; Mgr. **Marie Krausová**; Mgr. **Anna Mácová**; RNDr. **Jana Martinů**; Mgr. **Jakub Vlček**
Technician:	**Lenka Štifterová**
Undergraduate students:	Bc. **Pavlína Kočová**; Bc. **Michaela Matějková**; Bc. **Lukáš Vejsada**

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.

Evolution of symbiotic bacteria associated with arthropods

We are broadly interested in intracellular symbiotic bacteria and their arthropod hosts. The main goal of our research is complex characterisation of symbiotic systems in several model insect groups. Our main questions involve genome evolution of both the host and its symbionts, their phylogeny and population structure, and host-symbiont-pathogen interactions. For example, the smallest reported bacterial genome belongs to *Tremblaya princeps*, a symbiont of *Planococcus citri* mealybugs (PCIT). *Tremblaya* PCIT not only has about 120 genes, but possesses its own bacterial endosymbiont, *Moranella endobia*. Genome and transcriptome sequencing reveals that the extreme genomic degeneracy of *Tremblaya* PCIT likely resulted from acquiring *Moranella* as an endosymbiont. In addition, at least 22 expressed horizontally transferred genes from multiple diverse bacteria to the mealybug genome likely complement missing symbiont genes. However, none of these transferred genes are from *Tremblaya*, showing that genome reduction in this symbiont has not been enabled by gene transfer to the host nucleus. Our results thus reveal a path to intimate endosymbiosis distinct from that followed by organelles.

Coevolution between Galápagos mockingbirds and their ectoparasites

We are studying the character of coevolution between Galápagos mockingbirds and their parasites. The research focuses on determining the factors responsible for formation of population structure, reconciling the mutual evolutionary history and identifying genes under selection in the hosts. With the use of parallel amplicon sequencing of the MHC class IIB locus, we found evidence for lowered genetic diversity in threatened populations of mockingbirds. Microsatellite study of one of the louse parasites showed decreased heterozygosity and potential inbreeding in louse populations on individual hosts. Such genetic pattern indicates that host individuals of a single species play role in creating population structure of their parasites.

Population genetics, demography and molecular evolution in rodents and their parasites

Adaptive and co-speciation components of host-parasite coevolution are studied in rodents and their parasites. Two rodent groups (voles and wood mice) and their ectoparasites (lice, mites) as well as endoparasites (*Eimeria*) were selected as the model groups. Population structure was analysed using mitochondrial genes and selected nuclear markers. Despite observing lineages with relatively strict degree of host specificity, only limited amount of co-speciation was seen in both parasitic groups. Hence, the adaptive component of evolution seems to be the major driver defining genetic differentiation. Obtained patterns will be validated and explored in further detail using sequences of genes putatively under selection in the hosts (MHC II) and using multilocus and genomic data obtained from both counterparts.

Selected publications

- Bazsalovicsová E., Králová-Hromadová I., **Štefka J.**, Minárik G., Bokorová S., Pybus M. 2015: Genetic interrelationships of North American populations of giant liver fluke *Fascioloides magna*. *Parasites & Vectors* 8: 288. [IF=3.234]
- Duncan R.P., **Husník F.**, van Leuven J.T., Gilbert D.G., Dávalos L.M., McCutcheon J.P., Wilson A.C.C. 2014: Dynamic recruitment of amino acid transporters to the insect/symbiont interface. *Molecular Ecology* 23: 1608–1623. [IF=5.840]
- **Kvičerová J.**, **Hypša V.**, Dvořáková N., Mikulíček P., Jandzik D., Gardner M.G., Javanbakht H., Tiar G., Široký P. 2014: *Hemolivia* and *Hepatozoon*: haemogregarines with tangled evolutionary relationships. *Protist* 165: 688–700 [IF=3.558]
- **Martinů J.**, Sychra O., Literák I., Čapek M., Gustafsson D.M., **Štefka J.** 2015: Host generalists and specialists emerging side by side: an analysis of evolutionary patterns in the cosmopolitan chewing louse genus *Menacanthus*. *International Journal for Parasitology* 45: 63–73. [IF=4.242]
- **Nováková E.**, **Husník F.**, Šochová E., **Hypša V.** 2015: *Arsenophonus* and *Sodalis* symbionts in louse flies: an analogy to the *Wigglesworthia* and *Sodalis* system in tsetse flies. *Applied and Environmental Microbiology* 81: 6189–6199. [IF=3.823]

Research project

- **Population structure and evolutionary relationships of the intracellular parasite *Hemolivia mauritanica* (Sergent and Sergent, 1904).** Czech Science Foundation (P506/11/1738; P.I.: V. Hypša; 2011–2014)
- **Evolutionary hitchhiking: co-evolution of Galápagos mockingbirds and their ectoparasite populations.** Czech Science Foundation (P506/12/P529; P.I.: J. Štefka; 2012–2014)
- **Population genetics, demography and molecular evolution in interspecific associations: comparative study of two complex parasitic/symbiotic systems.** Czech Science Foundation (P505/12/1620; P.I.: V. Hypša; 2012–2015)
- **Evolutionary and ecological factors in genome evolution of bacterial symbionts in insects.** Czech Science Foundation (13-01878S; P.I.: V. Hypša; 2013–2016).
- **Evolutionary factors of speciation and genomic diversification in host-parasite system.** Czech Science Foundation (14-07004S; P.I.: V. Hypša; 2014–2016).
- **Phylogenomics and molecular diversity of Mesozoa.** Czech Science Foundation (15-08717S; P.I.: V. Hypša; 2015–2017).

3. Ticks and Tick-Borne Diseases

3.1. Laboratory of Molecular Ecology of Vectors and Pathogens

Research scientists:	Prof. RNDr. **Libor GRUBHOFFER**, CSc. (*head*) **Nataliia Rudenko**, MSc, PhD (Ukraine) (*deputy head*); **Maryna Golovchenko**, MSc (Ukraine); **Ryan O.M. Rego**, MSc, PhD (India); Mgr. **Ján Štěrba**, PhD (Slovakia)
PhD students:	Mgr. **Jiří Černý**; Mgr. **Tereza Chrudimská**; Mgr. **Václav Hönig**; Mgr. **Martin Selinger**; RNDr. **Jarmila Štěrbová-Dupejová**; Mgr. **Martin Strnad**; **Miray Tonk**, DVM (Turkey); Mgr. **Hana Tykalová-Šťastná**; RNDr. **Pavlína Věchtová**
Research assistant:	Mgr. **Zuzana Vavrušková**
Undergraduate students:	**Alejandro Cabezas Cruz**, DVM (Cuba); **Maria Davidová**; **Karolína Dostálová**; **Eva Dršková**; **Hana Hájková**; **Lisa Hain** (Austria); **Sophie Honeder** (Austria); **Matthias Kalthoff** (Austria); **Nelly Keplová**; **Pavlína Kočová**; **Nikola Ludvíková**; **Hanka Mašková**; **Jaroslav Ondruš**; **Anda Rados** (Austria); **Brian Ringhofer** (Austria); **Felix Samek** (Austria); **Jacob Samek** (Austria); **Hana Slabá**; **Štěpánka Smolenová**; **Lucie Šolcová**; **Lucia Tichá**; **Helene Urlasberger** (Austria); **Hana Zavadilová**
Laboratory worker:	**Zuzana Němcová**

Research priorities

Diversity and evolution of Lyme borreliosis spirochetes

Genetically diverse strains of *Borrelia* are often found within the same tick or same vertebrate host, presenting a wide opportunity for genetic exchange. Our results support the hypothesis that recombination maintains a majority of sequence polymorphism within populations of *Borrelia* spp. due to re-assortment of pre-existing sequence variants.

Population bottlenecks in LB spirochetes infection cycle

We addressed the population dynamics of *B. burgdorferi* throughout its natural infectious cycle. Our results clearly demonstrate that the spirochete population experiences stochastic bottlenecks during both acquisition and transmission by the tick vector, as well as during persistent infection of murine host.

Anti-tick vaccines to prevent transmission of pathogens

Using proteomic and transcriptomic approaches, we identified novel candidates for anti-tick vaccines among tick salivary gland proteins in animal models. Our results will lead to implementation of anti-tick vaccines in public health systems.

Development of tools to study host-pathogen interaction

We have established a fast, preparation-artifact-free and easily attainable correlative cryo-FM and cryo-SEM workflow that has shown that *B. burgdorferi* associates with mammalian nonphagocytic cells, but does not invade them within three hours of co-incubation.

Innate immune response of human neural cell lines against TBEV infection

Two host antiviral proteins, OASL and viperin, are induced in human neural cell lines infected with TBEV. TBEV is able to down-regulate viperin production on protein level by so far unidentified mechanism. Characterization of viperin effectors and analyses of the expression pattern of OASL isoforms in TBEV-infected cells are our current goals.

Selected publications

- Crowder C.D., Carolan H.E., Rounds M.A., **Hönig V.**, Mothes B., Haag H., Nolte O., Luft B.J., **Grubhoffer L.**, Ecker D.J., Schutzer S.E., Eshoo M.W. 2014: Prevalence of *Borrelia miyamotoi* in *Ixodes* ticks in Europe and the United States. *Emerging Infectious Diseases* 20: 1678–1682. [IF=6.751]
- **Rudenko N.**, **Golovchenko M.**, Belfiore N.M., **Grubhoffer L.**, Oliver Jr. J.H. 2014: Divergence of *Borrelia burgdorferi sensu lato* spirochetes could be driven by the host: diversity of *Borrelia* strains isolated from ticks feeding on a single bird. *Parasites & Vector*s 7: 4. [IF=3.234]
- Schnettler E., **Tykalová H.**, Watson M., Sharma M., Sterken M.G., Obbard D.J., Lewis S.L., McFarlane M., Bell-Sakyi L., Barry G., Weisheit S., Best S.M., Kuhn R.J., Pijlman G.P., Chase-Topping M.E., Gould E.A., **Grubhoffer L.**, Fazakerley J.K., Kohl A. 2014: Induction and suppression of tick cell antiviral RNAi responses by 1 tick-borne flaviviruses. *Nucleic Acid Research* 42: 14. [IF=9.112]
- Sprong H., Trentelman J., Seemann I., **Grubhoffer L.**, **Rego R.O.**, Hajdušek O., Kopáček P., Šíma R., Nijhof A.M., Anguita J., Winter P., Rotter B., Havlíková S., Klempa B., Schetters T.P., Hovius J.W. 2014: ANTIDotE: anti-tick vaccines to prevent tick-borne diseases in Europe. *Parasites & Vectors* 7: 77. [IF=3.430]
- **Strnad M.**, Elsterová J., Schrenková J., Vancová M., **Rego R.**, **Grubhoffer L.**, Nebesářová J. 2015: Correlative cryo-fluorescence and cryo-scanning electron microscopy as a straightforward tool to study host-pathogen interactions. *Scientific Reports* 5: 18029. [IF=5.228]

Research projects

- **Tick-borne encephalitis virus-host interaction on the molecular, cellular and organismal level.** Czech Science Foundation (302/12/2490; P.I.: L. Grubhoffer; 2012–2014)
- **ANTIGONE – ANTIcipating the GlobalOnset of Novel Epidemics.** FP7 EU-HEALTH project (278976; Co-P.I.: L. Grubhoffer; 2011–2016)
- **ANTIDotE (Anti-tick Vaccines to Prevent Tick-borne Diseases in Europe).** FP7 EU-HEALTH 2013.2.3.4-1 (Co-P.I.: L. Grubhoffer; 2013–2018)
- **Novel functions of viral and cellular proteins in Tick-borne encephalitis virus infection.** Czech Science Foundation (585410/3220; P.I.: L. Grubhoffer; 2015–2017)

3.2. Laboratory of Arbovirology

Research scientists:	Doc. RNDr. **Daniel RŮŽEK**, PhD (*head*) Prof. RNDr. **Jan Kopecký**, CSc.; RNDr. **Helena Langhansová-Horká**, PhD; Mgr. **Jaroslava Lieskovská**; PhD; **James Jason Valdés**, PhD
PhD students:	Mgr. **Jana Elsterová**; Mgr. **Martin Palus**
Research assistant:	Bc. **Veronika Slavíková** (*maternity leave*)
Technicians:	**Jan Erhart**; **Eva Výletová**
Laboratory worker:	**Lenka Marešová**
Undergraduate students:	**Martina Papajová**; **Veronika Prančlová**

Research priorities

Mechanisms of neuronal injury during tick-borne encephalitis infection in the CNS

Tick-borne encephalitis (TBE), a disease caused by tick-borne encephalitis virus (TBEV), represents one of the most important and serious neuroinfections in Europe and northeastern Asia. Despite the medical importance of this disease, some crucial steps in the development of encephalitis remain poorly understood. In particular, the mechanisms of TBEV-induced injury to the central nervous system (CNS) are unclear. In our laboratory, we study interactions of TBEV with primary human neurons, mechanisms of their injury and antiviral defence, as well as the interaction of the infected neurons with other key cells in the CNS (astrocytes, pericytes, microglia and brain microvascular epithelial cells). We propose that the innate immune response is an important cause of neuron death during the acute infection. This is in contrast to the prevailing hypothesis that neuron loss is mediated solely by virus. The results of this project should provide new crucial data about the neuropathogenesis of TBE.

Role of the host genetic background in the development of tick-borne encephalitis

In humans, TBEV may produce a variety of clinical symptoms from an asymptomatic disease to a fever and acute or chronic progressive encephalitis. This is influenced by a variety of factors, e.g. inoculation dose and virulence of the virus, age and immune status of the host, but also, as our results strongly suggest, by susceptibility based on host genetic background. Here, we study differences in clinical course of tick-borne encephalitis, and its genetical determination. We developed a unique animal model based on BALB/c-c-STS/A (CcS/Dem) recombinant congenic mouse strains showing different severities of the infection in relation to the host genetic background: BALB/c mice showed medium susceptibility to the TBE virus infection, STS mice were resistant and CcS-11 mice were highly susceptible. The resistant STS mice showed lower and delayed viremia, lower virus production in the brain and low cytokine/chemokine mRNA production, but had a strong neutralising antibody response. The most sensitive strain (CcS-11) failed in production of neutralising antibodies, but exhibited strong cytokine/chemokine mRNA production in the brain. We performed transcriptomic profiling that revealed distinct gene-expression patterns in brains of mice differing in susceptibility to TBEV infection. The

susceptible and resistant strains differed in the expression of key cytokines/chemokines, particularly interferon gamma-induced protein 10 (IP-10/CXCL10) and monocyte chemotactic protein-1 (MCP-1/CCL2) in the brain. A linkage analysis of F2 CcS-11 and BALB/c intercross progeny revealed a novel suggestive locus that controls survival after TBEV infection. It is located on chromosome 7 linked to marker D7Nds5. We next sequenced whole genomes of strains BALB/c and STS using next generation sequencing. Analysis of segment covering peak of linkage on chromosome 7 from 36.2 Mb to 74.5 Mb for polymorphisms between BALB/c and STS that change RNA stability and genes' functions revealed 8 candidate genes of host susceptibility to TBE virus infection.

Development and testing of novel perspective antivirals and their prodrug forms active against tick-borne encephalitis virus

Despite the medical importance of tick-borne encephalitis (TBE), there is no specific treatment of this disease. In our laboratory, we identified nucleoside analogues with high antiviral effect against TBE virus (TBEV) observed *in vitro* as well as in TBEV-infected mice (reduction of viral titres in the brain, reduction of clinical signs of neuroinfection, prolonged mean survival time, lower mortality). The main goal of the current project is to modify these effective molecules into prodrug forms with increased therapeutical potential based on efficient crossing the blood-brain barrier and targeted delivery to the central nervous system. We experimentally combine these antiviral molecules with immunomodulatory therapies with the purpose to maximise viral clearance and minimise immunopathology after TBEV infection in the central nervous system. The results should provide new and important data about the possibilities and directions of antiviral and immunomodulatory therapy of TBE.

Selected publications

- Bílý T., **Palus M.**, Eyer L., **Elsterová J.**, Vancová M., **Růžek D.** 2015: Electron tomography analysis of tick-borne encephalitis virus infection in human neurons. *Scientific Reports* 5: 10745. [IF=5.228]
- Eyer L., **Valdés J.J.**, Gil V.A., Nencka R., Hřebabecký H., Šála M., Salát J., Černý J., **Palus M.**, De Clercq E., **Růžek D.** 2015: Nucleoside inhibitors of tick-borne encephalitis virus. *Antimicrobial Agents and Chemotherapy* 59: 5483–5493. [IF=4.415]
- **Palus M.**, Bílý T., **Elsterová J.**, **Langhansová H.**, Salát J., Vancová M., **Růžek D.** 2014: Infection and injury of human astrocytes by tick-borne encephalitis virus. *Journal of General Virology* 95: 2411–2426. [IF=3.183]
- **Palus M.**, Formanová P., Salát J., Žampachová E., **Elsterová J.**, **Růžek D.** 2015: Analysis of serum levels of cytokines, chemokines, growth factors, and monoamine neurotransmitters in patients with tick-borne encephalitis: identification of novel inflammatory markers with implications for pathogenesis. *Journal of Medical Virology* 87: 885–892. [IF=1.998]
- **Palus M.**, Žampachová E., **Elsterová J.**, **Růžek D.** 2014: Serum matrix metalloproteinase-9 and tissue inhibitor of metalloproteinase-1 levels in patients with tick-borne encephalitis. *Journal of Infection* 68: 165–169. [IF=4.441]

Research projects

- **Differences in the clinical course of tick-borne encephalitis and their genetic determination.** Czech Science Foundation (P502/11/2116; P.I.: D. Růžek; 2011–2015)

4. Biology of Disease Vectors

4.1. Laboratory of Vector Immunology

Research scientists:	RNDr. **Petr KOPÁČEK**, CSc. (*head*) RNDr. **Lenka Grunclová**, PhD; RNDr. **Daniel Sojka**, PhD; RNDr. **Radek Šíma**, PhD*; RNDr. **Veronika Urbanová-Burešová**, PhD*
PhD students:	Mgr. **David Hartmann**; RNDr. **Marie Jalovecká***; Mgr. **Jan Perner**
Undergraduate students:	Bc. **Jitka Konvičková**; Bc. **Matěj Kučera**; **Tereza Hatalová**; **Barbora Plačková**

* Also members of the research team of Ondřej Hajdušek.

Research priorities

Molecules involved in the tick innate immunity playing a role at the tick-pathogen interface. Molecular physiology of blood digestion and haem and iron acquisition in ticks as a potential target for efficient anti-tick intervention.

The role of primordial complement system in the tick immunity

The hard tick *Ixodes ricinus* possesses components of primordial complement system such as thioester-containing proteins (TEPs), fibrinogen-related lectins (ixoderins) and putative convertases (Factor C and Factor B/C2). In the years 2014–2015, we focused mainly on RNAi-based functional characterisation of TEPs and putative convertases in the phagocytosis of the model microbes including the Lyme diseases spirochete *Borrelia afzelii*. Detailed qRT-PCR analysis revealed that expression of tick TEPs is mostly tissue-specific and disclosed the importance of trachea-fat body complex as the organ playing a key role in tick immunity. We have also sequenced a transcriptome from hemocytes of *I. ricinus*, the first 'hemocytome' published for any tick species.

Multienzyme degradation of host serum albumin in ticks

We have characterised the role of multi-enzyme digestive network of *I. ricinus* in processing of serum albumin, the second most abundant protein in tick diet. We have used artificial membrane feeding of females of *I. ricinus* on a hemoglobin-free diet to characterise the proteolytic machinery involved in albuminolysis. Morphological comparisons of ticks fed on whole blood (BF) and serum (SF) at microscopic and ultrastructural levels showed that albumin and hemoglobin have different trafficking routes in tick digest cells. Analysis *in vitro* with selective inhibitors demonstrated that albumin is degraded at an acidic pH by a network of cysteine and aspartic peptidases with predominant involvement of cysteine cathepsins having endo- and exopeptidase activities. The cleavage map of albumin and the roles of individual peptidases in albumin degradation were determined. These results indicate that the albuminolytic pathway is controlled by the same proteolytic system that is responsible for hemoglobinolysis.

Acquisition of heme and iron from the tick diet

Mining the genome of *Ixodes scapularis* suggested that ticks are heme auxotrophs lacking the functional heme biosynthesis. Intriguingly, ticks also lack heme catabolism given the absence of heme oxygenase. We confirmed, by membrane feeding, that ticks do not acquire bioavailable iron from hemoglobin-derived haem. However, ticks require dietary hemoglobin as an exogenous source of heme since feeding with hemoglobin-depleted serum led to aborted embryogenesis. Supplementation of serum with hemoglobin fully restored egg fertility. Surprisingly, hemoglobin could be completely substituted by serum proteins for the provision of aminoacids in vitellogenesis. Acquired heme is distributed by hemolymph carrier protein(s) and sequestered by vitellins in the developing oocytes. This work extends, substantially, current knowledge of heme auxotrophy in ticks and underscores the importance of heme and iron metabolism as rational targets for anti-tick interventions. We have further performed a comparative transcriptomic study of guts from BF and SF ticks in an attempt to identify the key molecules regulated by hemoglobin presence in the tick diet.

Selected publications

- Ayllon N., Villar M., Galindo R.C., Kocan K.M., **Šíma R.**, Lopez J.A., Vazquez J., Alberdi P., Cabezas-Cruz A., **Kopáček P.**, de la Fuente J. 2015: Systems biology of tissue-specific response to *Anaplasma phagocytophilum* reveals differentiated apoptosis in the tick vector *Ixodes scapularis*. *PLoS Genetics* 11: e1005120. [IF=6.661]
- Kotsyfakis M., **Kopáček P.** , Franta Z., Pedra J.H.F,. Ribeiro J.M.C. 2015: Deep sequencing analysis of the *Ixodes ricinus* haemocytome. *PLoS Neglected Tropical Diseases* 9: e0003754. [IF=3.948]
- **Urbanová V.**, **Hartmann D.**, **Grunclová L.**, **Šíma R.**, Flemming T., Hajdušek O., **Kopáček P.** 2014: IrFC – an *Ixodes ricinus* injury-responsive molecule related to *Limulus* Factor C. *Developmental & Comparative Immunology* 46: 439–447. [IF=2.815]
- **Urbanová V.**, **Šíma R.**, Šauman I., Hajdušek O., **Kopáček P.** 2014: Thioester-containing proteins of the tick *Ixodes ricinus*: Gene expression, response to microbial challenge and their role in phagocytosis of the yeast *Candida albicans*. *Developmental & Comparative Immunology* 48: 55–64. [IF=2.815]

Research projects

- **Development of a ferritin 2-based vaccine preventing against tick transmitted diseases for veterinary and human use.** Ministry of Industry and Trade of the Czech Republic (FR-TI3/156; Co-P.I.: P. Kopáček; 2011–2014)
- **Development of protocol for obtaining monospecifically infected ticks and their correct application to experimental animals.** Ministry of Industry and Trade of the Czech Republic (FR-TI4/2012; Co-P.I.: P. Kopáček; 2012–2014)
- **Lyme disease transmission model: an essential tool to study vaccine candidates against human borreliosis.** Czech Science Foundation (13-12816P; P.I.: R. Šíma; 2013–2015)
- **The role of hemoglobin in tick metabolism and transmission of tick-borne pathogens.** Czech Science Foundation (13-110435S; P.I.: P. Kopáček; 2013–2017)
- **Multiple tick legumains in blood processing, innate immunity and pathogen transmission.** Czech Science Foundation (14-33693S; P.I.: D. Sojka; 2014–2016)
- **ANTIDotE -Anti-tick vaccines to prevent tick-borne diseases in Europe.** (EU 7FP 602272; coordinator: J.W. Hovius, 2014–2018)
- **Interraction of tick complement with Borrrelia and Babesia.** Czech Science Foundation (15-12006Y; P.I.: V. Urbanová; 2015–2017)

4.2. Laboratory of Genomics and Proteomics of Disease Vectors

Research scientists:	**Michail KOTSYFAKIS**, MSc, PhD (Greece) (*head*) **Alexandra Schwarz**, MSc, PhD (Germany; till February 2014)
PhD student:	Mgr. **Jan Kotál**
Administration associate:	Mgr. **Markéta Kremlová** (till April 2015)
Undergraduate student:	**Lovelyna Eromonsele** (Austria)
Technician:	Ing. **Martina Dědouchová**

Research priorities

Our research maximises the public health benefits from the latest technical developments in molecular biology, genetics, genomics and proteomics; we employed the latest next-generation sequencing and quantitative proteomics methodologies with the ultimate goal of improving our understanding of the genetics underlying tick feeding and pathogen transmission. Given the technical difficulties in sequencing tick genomes, our high-throughput transcriptomic studies have provided new insights into how biological processes such as haematophagy and pathogen transmission are regulated by the underlying genetics, and enabled the first quantitative proteomic project on the tick *Ixodes ricinus*. We are currently developing a publicly available platform to host the sequencing data (and the resulting gene annotations) as a key step to support research on *I. ricinus* and to maximise the long-term value of our research results and datasets.

Our work aims to uncover tick proteins that facilitate the transmission of tick-borne pathogens. Tick-borne diseases are a serious public health concern in the Czech Republic (and Europe/the western world in general). Our results shed light on the molecular mechanisms that mediate transmission and pathogenesis of tick-borne diseases. Our group aims to discover novel gene functions, with an emphasis on describing novel tick salivary anti-proteases. We apply our well-established functional and structural analysis approaches to question whether salivary anti-proteases play an important role in the tick life-cycle. This knowledge will be important for the long-term development of improved tools and applications to control tick-borne diseases. Similar to most emerging and re-emerging infections, tick-borne diseases are thought to be vector-borne and transmitted to humans from animal reservoirs, but much remains unknown about the molecular events that take place at the tick-vertebrate host interface. Part of our work is to investigate the potential effects of various tick *I. ricinus* cysteine and serine protease inhibitors in macrophage, neutrophil and monocyte activation.

Our research advances the frontiers of knowledge in the field of tick-borne diseases. We are one of the few groups worldwide that couple high-throughput molecular and cellular techniques/disciplines to address important questions concerning the transmission life-cycle of ticks. At the same time, our experience in characterising the pharmacological action of salivary anti-proteases in the vertebrate host brings us closer to novel practical applications such as drug and vaccine development that have the potential to better connect science with society (as demonstrated by our patents: 1. Patent number WO2012162611-A1; 2. Patent Number: WO2009017689-A2; WO2009017689-A3; US2010278752-A1).

Selected publications

- Klein M., Brühl T.J., Staudt V., Reuter S., Grebe N., Gerlitzki B., Hoffmann M., Bohn T., Ulges A., Stergiou N., de Graaf J., Löwer M., Taube C., Becker M., Stassen M., Huber M., Lohoff M., Chagas A.C., Andersen J.F., **Kotál J.**, Langhansová H., Kopecký J., Schild H., **Kotsyfakis M.**, Schmitt E., Bopp T. 2015: Tick salivary Sialostatin L represses the initiation of immune responses by targeting IRF4-dependent transcription in murine mast cells. *Journal of Immunology* 195: 621–631. [IF=4.985]
- **Kotsyfakis M.**, Kopáček P., Franta Z., Pedra J.H.F., Ribeiro J.M.C. 2015: Deep sequencing analysis of the *Ixodes ricinus* haemocytome. *PLoS Neglected Tropical Diseases* 9: e0003754. [IF=3.948]
- **Kotsyfakis M.**, **Schwarz A.**, Erhart J., Ribeiro J.M.C. 2015: Tissue- and time-dependent transcription in *Ixodes ricinus* salivary glands and midguts when blood feeding on the vertebrate host. *Scientific Reports* 5: 9103. [IF=5.228]
- **Schwarz A.**, Tenzer S., Hackenberg M., Erhart J., Gerhold-Ay A., Mazur J., Kuharev J., Ribeiro J.M.C., **Kotsyfakis M.** 2014: A systems level analysis reveals transcriptomic and proteomic complexity in *Ixodes ricinus* midgut and salivary glands during early attachment and feeding. *Molecular and Cellular Proteomics* 13: 2725–2735. [IF=6.560]
- Waisberg M., Molina-Cruz A., Mizurini D.M., Gera N., Sousa B.C., Ma D., Leal A.C., Gomes T., **Kotsyfakis M.**, Ribeiro J.M.C., Lukszo J., Reiter K., Porcella S., Oliveira C.J., Monteiro R.Q., Barillas-Mury, Pierce S.K, Francischetti I.M.B. 2014: *Plasmodium* sp. infection induces expression of a mosquito salivary protein (Agaphelin) that targets neutrophil function and inhibits thrombosis without impairing hemostasis. *PLoS Pathogens* 10: e1004338. [IF=7.560]

Research projects

- **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 FP7 Reintegration grant (PIRG07-GA-2010-268177; P.I.: M. Kotsyfakis; 2010–2014)
- **Rickettsial immunity during tick transmission.** National Institutes of Health, USA, R01 grant (1R01AI093653-01A1; P.I.: J. Pedra; 2011–2016)
- **The role of tick salivary protease inhibitors in tick-pathogen-host interactions.** Czech Science Foundation (P502/12/2409; P.I.: M. Kotsyfakis; 2012–2015)

4.3. Laboratory of Tick Transmitted Diseases

Research scientists:	RNDr. **Ondřej HAJDUŠEK**, PhD (*head*) RNDr. **Radek Šíma**, PhD*; RNDr. **Veronika Urbanová-Burešová**, PhD*
PhD student:	RNDr. **Marie Jalovecká***
Undergraduate students:	Bc. **Helena Mondeková**; Bc. **Jiří Ťápal**; **Tereza Pospíšilová**; **Zuzana Zemanová**
Technicians:	Mgr. **Adéla Harcubová**; Ing. **Gabriela Loosová**; MVDr. **Gabriela Štěpánová**

* Also members of the research team of Petr Kopáček.

Research priorities

Laboratory of Tick Transmitted Diseases (founded in 2012) is focused on the molecular interactions between ticks (e.g. iron and heme metabolism pathway, tick immune molecules) and tick-transmitted pathogens and testing of anti-tick vaccines (improvement of the recent vaccine based on Ferritin 2) and vaccines interfering with the pathogen transmission. We have set-up in our laboratory (BSL2) complete transmission model for *Borrelia* infections, which we use for testing of the tick candidate genes implicated in the tick-parasite interactions using method of RNA interference (RNAi) and also vaccines blocking the pathogen transmission. Recently, we set-up a system for testing *Babesia* infections and make an effort to set-up a system for *Anaplasma*. We have developed sensitive molecular methods for testing of tick-borne diseases in humans and animals. The laboratory works in a close collaboration with the Laboratory of Vector Immunology (head: P. Kopáček).

Antigens for a new vaccine against ticks and tick-transmitted diseases

Ticks are blood-feeding parasites and vectors of some of the most devastating viral, bacterial and protozoal diseases known to humans and animals. *Ixodes ricinus* is a common tick in Europe including the Czech Republic, transmitting tick-borne encephalitis (TBE), Lyme disease (borreliosis), anaplasmosis and babesiosis. Immunisation of the hosts using recombinant tick proteins reduces tick feeding and, more importantly, blocks transmission of pathogens from the tick into the host. However, available tick antigens still do not reach sufficient efficacy. We use RNA interference (RNAi) to screen genes of *I. ricinus* potentially involved in the tick iron metabolism and heme acquisition in order to find suitable vaccine candidates affecting tick feeding and development. These candidates will be then tested for their potential to inhibit transmission of the pathogens. We believe that vaccination with these proteins may have a great potential as a control strategy to reduce tick feeding and transmission of pathogens.

Lyme disease and babesiosis transmission models

Lyme borreliosis is an emerging vector-borne disease of temperate climates with a concurrent distribution spanning North America and Eurasia. It is caused by spirochetes of the *Borrelia burgdorferi* sensu lato complex, which are transmitted through the *Ixodes* ticks. Although Lyme

borreliosis is one of the best studied tick-borne zoonosis, the annual incidence leads over other vector-borne diseases with a continuous increase. There is currently no vaccine available to prevent Lyme disease in humans. One of the promising strategies to break *Borrelia* transmission development is a vaccine affecting basic tick physiological processes. Development of a promising vaccine against Lyme borreliosis would be greatly facilitated by a reproducible vector-host transmission model. Our aim is to implement such model to find a molecule with proven anti-borrelial effect.

Babesiosis is a tick-borne malaria-like disease of mammals. Because of the global environmental changes and continuous expansion of tick range, importance of babesiosis as an emerging zoonosis is increasing. Interplay between the parasite, tick and vertebrate host represents a complex system of multiple molecular interactions. To date, only a limited number of molecules have been identified to play a role in this system. Our research is focused on the identification and characterisation of molecular mechanisms of *Babesia* persistence within the tick vector and its transmission to the vertebrate host. We are currently working on the setting of the *Babesia microti* transmission model in our laboratory and use of this model for testing the tick immune genes in infection with *Babesia* spp. by RNA interference and vaccination.

Selected publications

- Ayllón N., Villar M., Galindo R.C., Kocan K.M., **Šíma R.**, López J.A., Vázquez J., Alberdi P., Cabezas-Cruz A., Kopáček P., de la Fuente J. 2015: Systems biology of tissue-specific response to *Anaplasma phagocytophilum* reveals differentiated apoptosis in the tick vector *Ixodes scapularis*. *PLoS Genetics* 11: e1005120. [IF=6.661]
- Golovchenko M., **Šíma R.**, **Hajdušek O.**, Grubhoffer L., Oliver J.H. Jr., Rudenko N. 2014: Invasive potential of *Borrelia burgdorferi sensu stricto* ospC type L strains increases the possible disease risk to humans in the regions of their distribution. *Parasites and Vectors* 7: 538. [IF=3.234]
- **Urbanová V.**, **Šíma R.**, Šauman I., **Hajdušek O.**, Kopáček P. 2015: Thioester-containing proteins of the tick *Ixodes ricinus*: gene expression, response to microbial challenge and their role in phagocytosis of the yeast *Candida albicans*. *Developmental and Comparative Immunology* 48: 55–64. [IF=3.620]

Research projects

- **Lyme disease transmission model: an essential tool to study vaccine candidates against human borreliosis.** Czech Science Foundation (13-12816P; P.I.: R. Šíma; 2013–2015)
- **Proteins of the tick iron metabolism pathway – antigens for a new vaccine against ticks and tick-transmitted diseases.** Czech Science Foundation (13-27630P; P.I.: O. Hajdušek; 2013–2015)
- **ANTIDotE – Anti-tick vaccines to prevent tick-borne diseases in Europe.** FP7 HEALTH project 602272 (P.I.: J. Hovius, 2014–2018)

5. Fish parasitology

5.1. Laboratory of Helminthology

Research scientists:	Prof. RNDr. **Tomáš SCHOLZ**, CSc. (*head*) RNDr. **František Moravec**, DrSc. (*researcher emeritus*) RNDr. **Jan Brabec**, PhD; RNDr. **Anna Faltýnková**, PhD; **Aneta Kostadinova**, MSc, PhD (Bulgaria); RNDr. **Roman Kuchta**, PhD; Mgr. **Miroslava Soldánová**, PhD Temporary contracts from projects: **David González-Solís**, MSc, PhD (Mexico); **Olena Kudlai** (Ukraine), **Edgar F. Mendoza-Franco** (Mexico); RNDr. **Mikuláš Oros**, PhD; **Jesus Hernández-Orts**, MSc, PhD (Mexico); **Aneta Yoneva**, MSc, PhD (Bulgaria)
PhD students:	**Simona Georgieva**, MSc (Bulgaria – defence in February 2015); **Carlos A. Mendoza-Palmero**, MSc (Mexico – defence in November 2014); Mgr. **Kateřina Leštinová**; Mgr. **Jana Roháčová-Zikmundová**
Research assistants:	Ing. **Radmila Řepová** (part time); Ing. **Blanka Škoríková**
Technician:	**Martina Borovková**
Laboratory worker:	**Alena Widnerová**
Undergraduate students:	Bc. **Lenka Čapková**; Bc. **Eliška Panáčková** (University of Ostrava); Bc. **Ivana Pokorná**; **Lucie Uhrová**; **Tereza Vyhlídalová**

Research priorities

Systematics & phylogeny of parasitic flatworms, life cycles & ecology of trematodes, taxonomy of nematodes, diversity of fish helminths, and fish-borne parasitic diseases (broad fish tapeworm).

Diversity of helminths parasitising teleost fish

Morphological and taxonomic evaluation of parasitic flatworms (Cestoda, Digenea and Monogenea) and nematodes (Nematoda), parasites of freshwater and marine fish, enabled us to revise several helminth groups and provide new data on their diversity, host associations and interrelations. Studies have been focused on hot spots of teleost diversity in freshwaters (Amazonia) and seas off Africa, North America and South Asia.

Systematics and evolution of basal tapeworms (Cestoda)

Based on collaborative effort supported by a NSF-PBI funded project, global diversity of tapeworms has been assessed using morphological and molecular evaluation of newly collected and museum materials. Data on the diversity, morphology, host-associations and phylogenetic relationships of nine cestode orders have been compiled for a monograph that would provide a most comprehensive survey of the current knowledge of this group of helminth parasites.

Integrative taxonomy approaches to trematode diversity and life-cycles

A series of studies focused on species delimitation using integrated molecular, morphological and ecological evidence provided reliable estimates of the diversity and/or information on the life histories of the digenean trematodes (families Diplostomidae and Echinostomatidae) in natural host populations in Europe and Africa.

Selected publications

- Blasco-Costa I., **Faltýnková A.**, **Georgieva S.**, Skirnisson K., **Scholz T.**, **Kostadinova A.** 2014: Fish pathogens near the Arctic Circle: molecular, morphological and ecological evidence for unexpected diversity of *Diplostomum* (Digenea: Diplostomidae) in Iceland. *International Journal for Parasitology* 44: 703–715. [IF=4.242]
- **Brabec J.**, Waeschenbach A., **Scholz T.**, Littlewood D.T., **Kuchta R.** 2015: Molecular phylogeny of the Bothriocephalidea (Cestoda): molecular data challenge morphological classification. *International Journal for Parasitology* 45: 761–771. [IF=4.242]
- Horák P., Mikeš L., Lichtenbergová L., Skála V., **Soldánová M.**, Brant S.V. 2015: Avian schistosomes and outbreaks of cercarial dermatitis. *Clinical Microbiology Reviews* 28: 165–190. [IF=16.187]
- **Kuchta R.**, Serrano-Martinez M.E., **Scholz T.** 2015: Pacific broad tapeworm *Adenocephalus pacificus* as a causative agent of globally reemerging diphyllobothriosis. *Emerging Infectious Diseases* 21: 1697–1703. [IF=6.994]
- **Mendoza-Palmero C.A.**, Blasco-Costa I., **Scholz T.** 2015: Molecular phylogeny of Neotropical monogeneans (Platyhelminthes: Monogenea) from catfishes (Siluriformes). *Parasites & Vectors* 8: 164. [IF=3.234]

Research projects

- **A Survey of the Tapeworms (Cestoda: Platyhelminthes) from the Vertebrate Bowels of the Earth.** National Science Foundation, USA (Planetary Biodiversity Inventory, Co-P.I.: T. Scholz; P.I.: J.N. Caira, University of Connecticut, Storrs; 2008–2015)
- **From fish to man and from water to the earth: evolutionary history of tapeworms parasitizing tetrapods (Cestoda: Diphyllobothriidea).** Czech Science Foundation (P506/12/1632; P.I.: R. Kuchta; 2012–2016)
- **ECIP – European Centre of Ichthyoparasitology.** Czech Science Foundation – centres of excellence (P505/12/G112; Co-P.I.: T. Scholz; P.I.: M. Gelnar, Masaryk University, Brno; 2012–2018)
- **Integrative taxonomy: a powerful tool to unravel hidden diversity of fish parasites in Brazil.** CAPES, Brazil, program 'Ciência sem fronteiras' – visitant researcher modality (No. 135/2012; P.I.: T. Scholz; 2013–2015)
- **Species boundaries and microevolutionary patterns in parasites with high dispersal abilities: a model study of two flatworm systems.** Czech Science Foundation (15-14198S; P.I.: T. Scholz; 2015–2017)

5.2. Laboratory of Fish Protistology

Research scientists:	**Astrid HOLZER**, PhD (Austria) (*head*) **Gema Alama-Bermejo**, MSc, PhD (Spain); RNDr. **Ivan Fiala**, PhD; **Ashlie Hartigan**, MSc, PhD (Australia); RNDr. **Miloslav Jirků**, PhD; RNDr. **Alena Kodádková**, PhD; RNDr. **Martin Kostka**, PhD; Mgr. **Inga Meyer-Wachsmuth**, PhD (Germany); RNDr. **Pavla Sojková-Bartošová**, PhD (Slovakia)
PhD students:	**Sneha Patra** MSc (India); RNDr. **Tomáš Tyml**
Research assistant:	RNDr. **Hana Pecková**
Technician:	**Marie Fučíková** (part time)
Laboratory worker:	**Ivana Reitingerová**
Undergraduate students:	Bc. **Martina Hrabcová**; Bc. **Jiří Kyslík**; **Dariya Baiko**; **Martina Jedličková**; **Kamila Štauberová**; **Tereza Tomková**; **Klára Zítková**

Research priorities

Our focus are eukaryotic microorganisms infecting fish and amphibians, including all aspects of their structure, biology, life cycles, host-parasite relationships, and especially their phylogeny and evolution. More recently, we have initiated a new line of functional research focusing on parasite motility mechanisms and on transcriptomic and proteomic approaches aiming at the characterisation of virulence factors and proteolytic enzymes at the host-parasite interface. Our main group of interest is the Myxozoa but we carry out research into a range of protists, some of which create economic and health consequences for the aquaculture industry, in collaboration with various academic and commercial partners worldwide.

Myxozoa

Increasing numbers of sphaerosporid blood stages in cultured common carp in Central Europe encouraged us to study the species composition and the involvement of different taxa in a serious pathological condition, Swim Bladder Inflammation (SBI) in carp. Using molecular methods, we determined that *Sphaerospora molnari* produces the highest percentage of blood stages, that these are present all year round and contribute to SBI but also pathologies in other organs (Holzer et al. 2014). Follow-on studies are focusing on identifying the mechanisms and function of the unique 'dancing' motility of these stages and on their transcriptomic and proteomic analysis during massive proliferation in the host blood.

Evolutionary studies currently aim at better understanding the coevolution of myxozoans and their invertebrate and vertebrate hosts. Kodádková et al. (2015) determined that myxozoans first invaded evolutionary older cartilaginous fish before their massive radiation in bony fish and multiple invasions of terrestrial and semi-terrestrial vertebrate hosts. In this study, these events were timed, using molecular clock analyses for the first time in myxozoans. Further biodiversity, phylogenetic and evolutionary studies focused on malacosporeans (Bartošová-Sojková et al. 2014) and the newly established genus *Ceratonova* (Fiala et al. 2015).

Other protists

Investigations of amoebae form a fundamental part of the research in the lab and, during 2014/15 it focused on an enigmatic group of marine amobae with cytoplasmic and perinuclear symbionts that branch deeply in the gammaproteobaceria (Schulz et al. 2015) as well as a new *Vermistella* species (Tyml et al. 2015). Applied approaches were performed in a commercially funded project (Skretting Aquaculture Research Centre), which aims at the development of amoeboicidal in-feed diets for Atlantic salmon suffering from Amoebic Gill Disease. Another important research line concentrates on amphibians, and we investigated *Perkinsea* infections in tadpoles from a variety of geographic locations around the globe (Chambouvet et al. 2015), which may be related to the global decline of these hosts. Epicellular apicomplexans of fish were of particular interest for studying the evolution of host-parasite interactions, using ultrastructure and transcriptomic analyses (Bartošová-Sojková et al. 2015).

Selected publications

- **Bartošová-Sojková P.**, Oppenheim R., Soldati-Favre D., Lukeš J. 2015: Epicellular apicomplexans: parasites „on-the-way-in". *PLoS Pathogens* 11: e1005080. [IF=7.003]
- Chambouvet A., Gower D.J., **Jirků M.**, Yabsley M.J., Davis A.K., Leonard G., Maguire F., Doherty-Bone T.M., Bittencourt-Silva G.B., Wilkinson M., Richards T.A. 2015: Cryptic infection of a broad taxonomic and geographic diversity of tadpoles by *Perkinsea* protists. *Proceedings of the National Academy of Sciences of the United States of America* 112: E4743–4751. [IF=9.423]
- **Holzer A.S.**, **Hartigan A.**, **Patra S.**, **Pecková H.**, Eszterbauer E. 2014: Molecular fingerprinting of the myxozoan community in common carp suffering Swim Bladder Inflammation (SBI) identifies multiple etiological agents. *Parasites & Vectors* 7: 398. [IF=3.430]
- **Kodádková A.**, **Bartošová-Sojková P.**, **Holzer A.S.**, Fiala I. 2015: *Bipteria vetusta* n. sp. – an old parasite in an old host: tracing the origin of myxosporean parasitism in vertebrates. *International Journal for Parasitology* 45: 269–276. [IF=4.242]
- Schulz F., **Tyml T.**, Pizzetti I., Dyková I., Fazi S., **Kostka M.**, Horn M. 2015: Marine amoebae with cytoplasmic and perinuclear symbionts deeply branching in the gammaproteobacteria. *Scientific Reports* 5: 13381. [IF=5.228]

Research projects

- **A new approach for the comparative study of the life cycle of Myxozoa - Identification of genes and cellular components Important for proliferation of parasites.** AS CR Program for international collaboration (M200961205; P.I.: A.S. Holzer; 2012–2014)
- **ECIP - European Centre Ichtyoparazitology.** Centre of Excellence, Czech Science Foundation (505/12/G112; Coordinator: M. Gelnar, Masaryk University, Brno; I. Co-P.I.: A.S. Holzer; II. Co-P.I.: I. Fiala; 2012–2018)
- **MODBIOLIN - Use of model organisms to resolve Crucial biological problems on the path to innovations.** European Commission (FP7-REGPOT-2012-2013-1; Coordinator: F. Sehnal, I. Co-P.I.: A.S. Holzer, II. Co-P.I.: I. Fiala; 2013–2015)
- **Identification of agents of gill disease in northern European Atlantic salmon and experimental trials using selected antiparasitic substances.** Financed by Skretting Aquaculture Research Centre R & D (P.I.: A.S. Holzer; 2014–2015).
- **ParaFishControl - Advanced tools and research strategies for parasite control in European farmed fish.** European Commission, RIA - Research and Innovation action, H2020 SFS-2014-2 Sustainable Food Security (project reference 634429, Coordinator: A. Sitjá-Bobadilla; 2015–2020).

6. Opportunistic diseases

6.1. Laboratory of Veterinary and Medical Protistology

Research scientists:	Doc. Ing. **Martin KVÁČ**, PhD (*head*) Prof. MVDr. **David Modrý**, PhD (part time) RNDr. **Bohumil Sak**, PhD
PhD students:	Ing. **Šárka Čondlová**; Ing. **Michaela Horčičková**; Mgr. **Michaela Kotková**, DiS; MVDr. **Jitka Prediger-Poláková**; Ing. **Veronika Prantlová-Rašková**; Ing. **Pavla Wagnerová**
Research assistants:	Ing. **Lenka Hlásková**; Ing. **Nikola Holubová-Hromadová**; RNDr. **Dana Květoňová**
Undergraduate students:	Bc. **Pavel Barvíř**; Bc. **Nikola Havrdová**; Bc. **Jana Ježková**; Bc. **Klára Kellnerová**; Bc. **Vladimír Kural**; Bc. **Anna Mynářová**; Bc. **Eva Myšková**; Bc. **Radek Pokorný**; Bc. **Vendula Tomanová**; **Tomáš Douda**; **Anna Hořická**; **Zuzana Reifová**; **Nicole Šímová**; **Veronika Tomancová**

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) patients and animals.

Microsporidia, *Cryptosporidium* and *Giardia* in orangutans

We conducted a monitoring of microsporidia, *Cryptosporidium* and *Giardia* infections in both Bornean orangutan (*Pongo pygmaeus*) and Sumatran orangutan (*P. abelii*) at different stages of the habituation process in Gunung Leuser National Park (*P. abelii*) and from Sabangau National Park, Tuanan, Orangutan Care and Quarantine Centre, and Tanjung Puting (*P. pygmaeus*). We detected *E. cuniculi* genotype III, *E. bieneusi* genotypes D and novel Pongo 2, *G. intestinalis* B subtype MB6, *C. muris* and *C. parvum* Type A and B.

Microsporidiosis caused by different genotypes of *Encephalitozoon cuniculi*

The course of infection caused by *E. cuniculi* genotype II (ECII) and III (ECIII) in SCID and BALB/c mice was studied. While infection caused by ECII showed a gradual increase of positive organs within five weeks, infection caused by ECIII had more progressive course affecting all organs within one week post inoculation. Paradoxically, mice with ECII infection died significantly earlier than those these with ECIII infection in which more than ten times higher burden of parasites was detected.

Highly divergent 18S rRNA gene paralogs in cryptosporidia

Phylogenetic relationships among eukaryotes are frequently inferred from sequences of 18S rDNA. Most genomes have multiple 18S rDNA copies arranged in tandem on a single chromosome, which evolve in concert because of frequent gene conversion and unequal

crossover events. Our phylogenetic analyses showed the co-occurrence of two 18S rDNA types, Type A and Type B, within chipmunk genotype II sharing less than 93% sequence similarity. The findings of our study have implications for the use of 18S rDNA sequences to infer phylogenetic relationships of cryptosporidia.

Hedgehog and human cryptosporidiosis – *Cryptosporidium erinacei* sp. n.

We described the morphological, biological and molecular characteristics of *Cryptosporidium* hedgehog genotype and proposed the species name *C. erinacei* to reflect its specificity to hedgehogs. This new species was also identified as the causative agent of the diarrheal disease cryptosporidiosis in an immunocompetent man.

Selected publications

- **Kváč M.**, Hofmannová L., **Hlásková L.**, **Květoňová D.**, Vítovec J., McEvoy J., **Sak B.** 2014: *Cryptosporidium erinacei* n. sp. (Apicomplexa: Cryptosporidiidae) in hedgehogs. *Veterinary Parasitology* 201: 9–17. [IF=2.545]
- **Kváč M.**, Saková K., **Květoňová D.**, Kicia M., Wesolowská M., McEvoy J., **Sak B.** 2014: Gastroenteritis caused by the *Cryptosporidium* hedgehog genotype in an immunocompetent man. *Journal of Clinical Microbiology* 52: 347–349. [IF=4.232]
- Li N., Xiao L., Alderisio K., Elwin K., Cebelinski E., Chalmers R., Santin M., Fayer R., **Kváč M.**, Ryan U., **Sak B.**, Stanko M., Guo Y., Wang L., Zhang L., Cai J., Roellig D., Feng Y. 2014: Subtyping *Cryptosporidium ubiquitum*, a zoonotic pathogen emerging in humans. *Emerging Infectious Diseases* 20: 217–224. [IF=7.327]
- **Sak B.**, Petrželková K.J., **Květoňová D.**, **Mynářová A.**, Pomajbíková K., **Modrý D.**, Cranfield MR, Mudakikwa A, **Kváč M.** 2014: Diversity of microsporidia, *Cryptosporidium* and *Giardia* in mountain gorillas (*Gorilla beringei beringei*) in Volcanoes National Park, Rwanda. *PLoS ONE* 9: e109751 [IF=3.534]
- Stenger B.L., Clark M.E., **Kváč M.**, Khan E., Giddings C.W., Dyer N.W., Schultz J.L., McEvoy J.M. 2015: Highly divergent 18S rRNA gene paralogs in a *Cryptosporidium* genotype from eastern chipmunks (*Tamias striatus*). *Infection, Genetics and Evolution* 32: 113–123. [IF=2.591]

Research projects

- **Diversity, biology and phylogeny of *Cryptosporidium* spp. parasiting in rodents.** Ministry of Education, Youth and Sports (KONTAKT LH 11061, P.I.: M. Kváč; 2011–2014)
- **Anti-inflammatory activity of extracts isolated from selected Indonesian plants and their effect on opportunistic parasitoses.** Czech Science Foundation (505/11/1163; P.I.: K. Doležal; Co-P.I.: B. Sak; 2011–2015).
- **Development of scientific team and laboratory for infectious diseases common to humans and great apes.** Ministry of Education, Youth and Sports (CZ.1.07/2.3.00/20.0300, P.I.: D. Modrý; Co-P.I.: M. Kváč; 2012–2015)
- **Clinical, immunological and molecular profile of microsporidiosis and cryptosporidiosis in patients living with HIV in the population of Lower Silesia.** Polish Society for AIDS Research (P.I.: M. Kicia; Contractor: M. Kváč; 2013–2014)
- **Prevalence, genotypic characterization and clinical effects caused by *Blastocystis hominis* in patients with HIV and AID.** Polish Society for AIDS Research. (P.I.: M. Kicia; Contractor: M. Kváč; 2013–2014)
- **The application of molecular methods to identify and characterize microsporidia in immunocompetent and immunosuppressed patients with kidney disease and evaluating the impact of selected drugs on the process of microsporidia invasion in *in vitro* research.** National Science Centre, Poland (P.I. Kicia; Contractor: M. Kváč; 2013–2017)
- **Revealing *Cryptosporidium* diversity: linking genetic variation to parasite biology.** Czech Science Foundation (15-01090S, P.I.: M. Kváč; 2015–2017)

6.2. Laboratory of Parasitic Therapy

Research scientists:	MVDr. **Kateřina JIRKŮ-POMAJBÍKOVÁ**, PhD (*head*)
	RNDr. **Milan Jirků**
Technician:	**Jana Vášová**
Undergraduate students:	**Olinka Hložková**; **Jana Levá**; **Zuzana Lhotská**; **Lucie Řežábková**; **Jiřina Růžková**

Research priorities

Main lines of this laboratory are focused on investigation of an impact of the commensal gut eukaryotes (protists and helminths) on some immune-mediated diseases (IMD). The incidence and prevalence of IMD has increased in Western countries over the past decades. IMDs continues to emerge in new countries as they develop and adopt to Western life-styles and is becoming a global disease. Abundant evidence now suggests that the dysbiosis of gut microbiome (incl. viruses, bacteria, archaea, fungi and eukaryotes) is one of the main risk factors for developing some IMD (e.g. IBD). The increase in IMD incidence is also associated with loss of helminth infection. Very recently, the research has shown that helminths, gut bacterial communities and even commensal protist inhabiting gut may positively influence the health status of individuals suffering from some IMD.

When the Laboratory of Parasitic Therapy opened at the Institute of Parasitology, it was obvious that the fulfilling of the early promise of helminth therapy likely requires widening the scope of investigation to its influence on the gut bacterial microflora and additional organisms (more suitable helminth candidates and protists) and novel therapeutic strategies. Within a very short existence of the laboratory, we have identified two symbionts, one helminth and one protist, as promising candidates for the treatment or prevention of IMD, using animal models and immunological and serological methods. Helminth model shows ability to modulate the immune system of even healthy host organism and it also influences the community composition of gut bacterial populations. Now, we test this candidate for its effect on the induced colitis which reflects Crohn's disease. In case of protist candidate, we established the animal model for the research on its impact on IMD.

Characterisation of the diversity and functional changes of the bacterial microbiota in the intestine using next-generation sequencing is conducted in the collaborative laboratory headed by Laura Wegener Parfrey at the University of British Columbia, Vancouver, Canada.

Selected publications

- Doležalová J., Vallo P., Petrželková K.J., Foitová I., Nurcahyo W., Mudakikwa A., Hashimoto C., **Jirků M.**, Lukeš J., Scholz T., Modrý D. 2015: Molecular phylogeny of anoplocephalid tapeworms (Cestoda: Anoplocephalidae) infecting humans and non-human primates. *Parasitology* 142: 1278–1289. [IF=3.031]
- Flegontov P., Michálek J., Janouškovec J., Lai H., **Jirků M.**, Hajdušková E., Tomčala A., Otto T.D., Keeling P.J., Pain A., Oborník M., Lukeš J. 2015: Divergent mitochondrial respiratory chains in phototrophic relatives of apicomplexan parasites. *Molecular Biology and Evolution* 32: 1115–1131. [IF=13.649]
- Lukeš J., Kuchta R., Scholz T., **Pomajbíková K.** 2014: (Self-) infections with parasites: re-intepretations for the present. *Trends in Parasitology* 30: 377–385. [IF=6.204]

- Lukeš J., Stensvold C.R., **Jirků-Pomajbíková K.**, Wegener Parfrey L. 2015: Are human intestinal eukaryotes beneficial, or commensals? *PLoS Pathogens* 11: e1005039. [IF=7.003]
- Mapua M.I., Qablan M.A., **Pomajbíková K.**, Petrželková K.J., Hůzová Z., Rádrová J., Votýpka J., Todd A., **Jirků M.**, Leendertz F.H., Lukeš J., Neel C., Modrý D. 2015: Ecology of malaria infections in western lowland gorillas inhabiting Dzanga Sangha Protected Areas, Central African Republic. *Parasitology* 142: 890–900. [IF=3.031]

Research projects

- **Introduction of suitable experimental *in vitro* model for gut protist *Blastocystis*.** Student Grant Agency of Faculty of Science, University of South Bohemia (P.I.: Z. Lhotská; 2015)
- **Introduction of suitable experimental *in vivo* model for gut protist *Blastocystis*.** Student Grant Agency of Faculty of Science, University of South Bohemia (P.I.: J. Růžková; 2015)
- **Introduction of model helminth culture and characterization of host immune response.** Student Grant Agency of Faculty of Science, University of South Bohemia (P.I.: O. Hložková; 2015)
- **Interplay of eukaryotic symbionts with gut microbiome and influence on immune-mediated disorders.** Young investigator category, agency: Human Frontiers Science Program Organization (RGY0078/2015, P.I.: K. Jirků Pomajbíková; 2015–2018)

Supporting facility

Laboratory of Electron Microscopy

Research scientists:	Ing. **Jana NEBESÁŘOVÁ**, CSc. (*head*) RNDr. **Marie Vancová**, PhD
PhD students:	Mgr. **Tomáš Bílý**; Ing. **Lucie Kocová** (until March 2015); Mgr. **Jana Schrenková**; Mgr. **Martin Strnad**
Technicians:	Mgr. **Jan Langhans**; **Petra Masařová**; Mgr. **Martina Tesařová**; **Jiří Vaněček**
Undergraduate students:	Bc. **Ayya Tashlieva**; **Christian Grechhamer** (Austria); **Antti Kettunen** (Austria)

Research priorities

Electron microscopy is used to image the structure of molecules, cells and tissues at sub-nanometer resolution. Transmission electron microscopy (TEM) is dedicated for the examination of samples cut into ultrathin sections with the thickness 80–100 nm so that the electron beam can pass through the sample and form an image on the detector. In scanning electron microscopy (SEM), the electron beam is scanned over the small sample area to produce secondary signals carrying information about the specimen surface topography or composition.

The team of the Laboratory of Electron Microscopy (LEM) works closely with several research groups of the Biology Centre but also from other institutions to plan, optimise and implement experiments, producing images that allow scientists to understand their samples at the subcellular level. Members of LEM are experts in preparing, imaging and interpreting a wide range of biological samples. They use a broad spectrum of traditional and novel preparation techniques for optimum preservation of sample morphology and localisation of proteins.

Technical equipment

- **Transmission electron microscopes**
  - JEOL 2100F (2012) equipped for electron tomography, STEM and image recording with CCD camera Orius SC1000 (Gatan)
  - JEOL 1010 (1996) equipped with SSC camera MegaView 3
  - 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 results

- **Bílý T.**, Palus M., Eyer L., Elsterová J., **Vancová M.**, Růžek D. 2015: Electron tomography analysis of tick-borne encephalitis virus infection in human neurons. *Scientific Reports* 5: 10745. [IF=5.228]
- Palus M., **Bílý T.**, Elsterová J., Langhansová H., Salát J., **Vancová M.**, Růžek D. 2014: Infection and injury of human astrocytes by tick-borne enecephalitis virus. *Journal of General Virology* 95: 2411–2426. [IF=3.183]
- Philimonenko V., Philimonenko A., Šloufová I., Hrubý M., Novotný F., Halbhuber Z., Krivjanská M., **Nebesářová J.**, Slouf M., Hozák P. 2014: Simultaneous detection of multiple molecular targets for ultrastructural immunocytochemistry. *Histochemistry and Cell Biology* 141: 229–239. [IF=3.054]
- **Strnad M.**, Elsterová J., **Schrenková J.**, **Vancová M.**, Rego R., Grubhoffer L., **Nebesářová J.** 2015: Correlative cryo-fluorescence and cryo-scanning electron microscopy as a straightforward tool to study host-pathogen interactions. *Scientific Reports* 5: 18029. [IF=5.228]
- **Vancová M.**, **Nebesářová J.** 2015: Correlative fluorescence and scanning electron microscopy of labelled core fucosylated glycans using cryosections mounted on carbon-patterned glass slides. *PLoS ONE* 10: e0145034. [IF=3.057]

Research projects

- **Electron Microscopy.** Programme of the Technology Agency of the Czech Republic to support the development of long-term collaboration of the public and private sectors on research, development and innovations. The project is managed by a consortium of representatives of eight participating organisations – FEI Czech Republic, Delong Instruments, Crytour, Institute of Macromolecular Chemistry of the Czech Agency of Sciences (CAS), Institute of Molecular Genetics of CAS, Institute of Scientific Instruments of CAS, Biology Centre of CAS (LEM), Research and Testing Institute Plzeň; 2012–2019.

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 Tomáš Scholz), is available for comparative studies. It comprises more than 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: **Tomáš Scholz**

Assistant Editors: **Ivan Fiala** (parasitic protists & myxozoans; molecular phylogenetics)
Aneta Kostadinova (ecological parasitology & helminths) (till December 2015)
Jan Štefka (ecology of parasites & parasitic arthropods) (from January 2016)
Tomáš Scholz (helminths & parasitic arthropods)

Editorial Assistant: **Petra Rozkošná**

Folia Parasitologica is an international journal for parasitology, publishing articles written in English. It was founded in 1953 as an annual edition; from 1966 until 2014, it was published four times a year. Since January 2015, the journal has been moved to an Open Access mode, without any hard copies published. Editor-in-Chief and three Assistant Editors from the Institute of Parasitology are aided by an international Board of Editorial Advisors, consisting of 23 highly regarded scientists, overwhelming majority of them being foreign parasitologists. The rejection rate is about 60%. Folia has a wide international authorship: in 2014–2015, around 80% of senior authors of published papers were from abroad. The Impact Factor of Folia was 1.271 in 2015; five-year Impact Factor is 1.351.

Conferences, workshops & teaching courses organised by IPCAS

Cryo CLEM workshop, České Budějovice, 17–18 March 2015

This international workshop focused on the presentation of a new Leica EM Cryo CLEM set was attended by 30 participants from Austria, Czech Republic, Germany and Poland. The practical demonstration of the new Leica system proved its capabilities in correlative light and electron microscopy.

Publication activities

2014

Chapters in monographs

1. **KOSTADINOVA A.**, PÉREZ-DEL-OLMO A. 2014: The systematics of the Trematoda. In: R. Toledo and B. Fried (Eds.), Advances in Experimental Medicine and Biology. Digenetic Trematodes. Springer Science + Business Media, New York, pp. 21–44.
2. **KVÁČ M.**, MCEVOY J., STENGER B., CLARK M. 2014: Cryptosporidiosis in other vertebrates. In: S.M. Cacciò and G. Widmer (Eds.), *Cryptosporidium*: Parasite and Disease. Springer-Verlag, Wien, pp. 237–326.
3. **RŮŽEK D.**, HOLBROOK M.R., YAKIMENKO V.V., KARAN L.S., TKACHEV S.E. 2014: Omsk hemorrhagic fever virus. In: D. Liu (Ed.), Manual of Security Sensitive Microbes and Toxins. CRC Press, Boca Raton, Florida, pp. 193–200.
4. **VÁVRA J.**, LARSSON J.I.R. 2014: Structure of Microsporidia. In: L.M. Weiss and J.J. Becnel (Eds.), Microsporidia – Pathogens of Opportunity. Wiley Blackwell, Oxford, pp. 1–70.

Papers in journals with impact factor

1. BARČÁK D., OROS M., HANZELOVÁ V., **SCHOLZ T.** 2014: Phenotypic plasticity in *Caryophyllaeus brachycollis* Janiszewska, 1953 (Cestoda: Caryophyllidea): does fish host play a role? *Systematic Parasitology* 88: 153–166. [IF=1.336]
2. **BARTOŠOVÁ-SOJKOVÁ P.**, HRABCOVÁ M., **PECKOVÁ H.**, **PATRA S.**, **KODÁDKOVÁ A.**, JURAJDA P., **TYML T.**, **HOLZER A.S.** 2014: Hidden diversity and evolutionary trends in malacosporean parasites (Cnidaria: Myxozoa) identified using molecular phylogenetics. *International Journal for Parasitology* 44: 565–577. [IF=3.872]
3. BARTUREN G., RUEDA A., HAMBERG M., ALGANZA A., LEBRON R., **KOTSYFAKIS M.**, SHI B.-J., KOPPERS-LALIC D., HACKENBERG M. 2014: sRNAbench: profiling of small RNAs and its sequence variants in single or multi-species high-throughput experiments sequence variants in single or multi-species high-throughput experiments. *Methods in Next Generation Sequencing* 1: 21–31. [IF=not yet]
4. **BASU S.**, NETZ D.J., HAINDRICH A.C., HERLETH N., LAGNY T.J., PIERIK A.J., LILL R., **LUKEŠ J.** 2014: Cytosolic iron-sulfur protein assembly is functionally conserved and essential in procyclic and bloodstream *Trypanosoma brucei*. *Molecular Microbiology* 93: 897–910. [IF=4.419]
5. BAZSALOVICSOVÁ E., KRÁLOVÁ-HROMADOVÁ I., **BRABEC J.**, HANZELOVÁ V., OROS M., **SCHOLZ T.** 2014: Conflict between morphology and molecular data: a case of the genus *Caryophyllaeus* (Cestoda, Caryophyllidea), monozoic tapeworms of cyprinid fishes. *Folia Parasitologica* 61: 347–354. [IF=1.147]
6. **BLASCO-COSTA I.**, **FALTÝNKOVÁ A.**, **GEORGIEVA S.**, SKIRNISSON K., **SCHOLZ T.**, **KOSTADINOVA A.** 2014: Fish pathogens near the Arctic Circle: molecular, morphological and ecological evidence for unexpected diversity of *Diplostomum* (Digenea: Diplostomidae) in Iceland. *International Journal for Parasitology* 44: 703–715. [IF=3.872]
7. BORN-TORRIJOS A., **HOLZER A.S.**, RAGA J.A., **KOSTADINOVA A.** 2014: Same host, same lagoon, different transmission pathways: effects of exogenous factors on larval emergence in two marine digenean parasites. *Marine Ecology Progress Series* 113: 545–554. [IF=2.098]

8. BORN-TORRIJOS A., POULIN R., RAGA J.A., **HOLZER A.S.** 2014: Estimating trematode prevalence in snail hosts using a single-step duplex PCR: how badly does cercarial shedding underestimate infection rates? *Parasites & Vectors* 7: 243. [IF=3.430]

9. CABEZAS-CRUZ A., **VALDÉS J.J**. 2014: Are ticks venomous animals? *Frontiers in Zoology* 11: 47. [IF=3.051]

10. *EDITORIAL MATERIAL*: CABEZAS-CRUZ A., **VALDÉS J.J.**, DE LA FUENTE J. 2014: Cancer research meets tick vectors for infectious diseases. *Lancet Infectious Diseases* 14: 916–917. [IF=22.433]

11. CABEZAS-CRUZ A., **VALDÉS J.J.**, DE LA FUENTE J. 2014: The glycoprotein TRP36 of *Ehrlichia* sp. UFMG-EV and related cattle pathogen *Ehrlichia* sp. UFMT-BV evolved from a highly variable clade of E. canis under adaptive diversifying selection. *Parasites & Vectors* 7: 584. [IF=3.430]

12. **ČERNÝ J.**, ČERNÁ BOLFÍKOVÁ B., **VALDÉS J.J.**, **GRUBHOFFER L.**, **RŮŽEK D.** 2014: Evolution of tertiary structure of viral RNA dependent polymerases. *PLoS ONE* 9: e96070. [IF=3.234]

13. DE CHAMBRIER A., **SCHOLZ T.**, **KUCHTA R.** 2014: Taxonomic status of Woodland's enigmatic tapeworms (Cestoda: Proteocephalidea) from Amazonian catfishes: back to museum collections. *Systematic Parasitology* 87: 1–9. [IF=1.336]

14. CHEN G., WANG X., SEVERO M.S., SAKHON O.S., SOHAIL M., BROWN L.J., SIRCAR M., SNYDER G.A., SUNDBERG E.J., ULLAND T.K., OLIVIER A.K., ANDERSEN J.F., ZHOU Y., SHI G.P., SUTTERWALA F.S., **KOTSYFAKIS M.**, PEDRA J.H. 2014: The tick salivary protein sialostatin L2 inhibits caspase-1-mediated inflammation during *Anaplasma phagocytophilum* infection. *Infection and Immunity* 82: 2553–2564. [IF=3.731]

15. **CHRUDIMSKÁ T.**, ČEŘOVSKÝ V., SLANINOVÁ J., **REGO R.O.M.**, **GRUBHOFFER L.** 2014: Defensin from the ornate sheep tick *Dermacentor marginatus* and its effect on Lyme borreliosis spirochetes. *Developmental and Comparative Immunology* 46: 165–170. [IF=2.851]

16. GENOMIC RESOURCES DEVELOPMENT CONSORTIUM, CONTRERAS M., DE LA FUENTE J., ESTRADA-PEÑA A., GRUBHOFFER L., TOBES R. 2014: Genomic resources notes accepted 1 April 2014 – 31 May 2014. *Molecular Ecology Resources* 14: 1095. [IF=3.712]

17. CROWDER C.D., CAROLAN H.E., ROUNDS M.A., HONIG V., MOTHES B., HAAG H., NOLTE O., LUFT B.J., **GRUBHOFFER L.**, ECKER D.J., SCHUTZER S.E., ESHOO M.W. 2014: Prevalence of *Borrelia miyamotoi* in *Ixodes* ticks in Europe and the United States. *Emerging Infectious Diseases* 20: 1678–1682. [IF=6.751]

18. **DORŇÁKOVÁ V.**, SALAZAR-SANCHEZ R., BORRINI-MAYORI K., CARRION-NAVARRO O., LEVY M.Z., SCHAUB G.A., **SCHWARZ A.** 2014: Characterization of guinea pig antibody responses to salivary proteins of *Triatoma infestans* for the development of a triatomine exposure marker. *PLoS Neglected Tropical Diseases* 8: e2783. [IF=4.446]

19. DUFKOVÁ L., PACHLER K., **KILIAN P.**, CHRUDIMSKÝ T., DANIELOVÁ V., **RŮŽEK D.**, NOWOTNY N. 2014: Full-length genome analysis of Čalovo strains of *Batai orthobunyavirus* (Bunyamwera serogroup): Implications to taxonomy. *Infection, Genetics and Evolution* 27: 96–104. [IF=3.051]

20. DUNCAN R.P., **HUSNÍK F.**, VAN LEUVEN J.T., GILBERT D.G., DÁVALOS L.M., MCCUTCHEON J.P., WILSON A.C.C. 2014: Dynamic recruitment of amino acid transporters to the insect/symbiont interface. *Molecular Ecology* 23: 1608–1623. [IF=6.494]

21. DVOŘÁKOVÁ N., **KVIČEROVÁ J.**, PAPOUŠEK I., JAVANBAKHT H., TIAR G., ŠIROKÝ P. 2014: Haemogregarines from western Palaearctic freshwater turtles (genera *Emys*, *Mauremys*) are conspecific with *Haemogregarina stepanowi* Danilewski, 1885. *Parasitology* 141: 522–530. [IF=2.560]

22. FAJFR M., NEUBAUEROVÁ V., PAJER P., KUBÍČKOVÁ P., **RŮŽEK D.** 2014: Detection panel for identification of twelve hemorrhagic viruses using real-time RT-PCR. *Epidemiologie, Mikrobiologie, Imunologie* 63: 232–238. [IF=0.353]

23. **FALTÝNKOVÁ A.**, **GEORGIEVA S.**, **KOSTADINOVA A.**, **BLASCO-COSTA I.**, **SCHOLZ T.**, SKÍRNISSON K. 2014: *Diplostomum* von Nordmann, 1832 (Digenea: Diplostomidae) in the sub-Arctic: descriptions of the larval stages of six species discovered recently in Iceland. *Systematic Parasitology* 89: 195–213. [IF=1.336]

24. FLAHOUA B., **MODRÝ D.**, **POMAJBÍKOVÁ K.**, **PETRŽELKOVÁ K.J.**, SMETA A., DUCATELLEA R., PASMANSA F., SÁB R.M., TODDH A., HASHIMOTOI C., MULAMAJ M., KIANGK J., ROSSIL M., HAESEBROUCKA F. 2014: Diversity of zoonotic enterohepatic *Helicobacter* species and detection of a putative novel gastric *Helicobacter* species in wild and wild-born captive chimpanzees and western lowland gorillas. *Veterinary Microbiology* 174: 186–194. [IF=2.511]

25. GALLUSOVÁ M., QABLAN M.A., D'AMICO G., **OBORNÍK M.**, **PETRŽELKOVÁ K.J.**, MIHALCA A.D., **MODRÝ D.** 2014: Piroplasms in feral and domestic equines in rural areas of the Danube Delta, Romania, with survey of dogs as a possible reservoir. *Veterinary Parasitology* 206: 287–292. [IF=2.460]

26. **GEORGIEVA S.**, **FALTÝNKOVÁ A.**, BROWN R., BLASCO-COSTA I., **SOLDÁNOVÁ M.**, SITKO J., **SCHOLZ T.**, **KOSTADINOVA A.** 2014: *Echinostoma* '*revolutum*' (Digenea: Echinostomatidae) species complex revisited: species delimitation based on novel molecular and morphological data gathered in Europe. *Parasites & Vectors* 7: 520. [IF=3.430]

27. GIBSON D.I., BRAY R.A., HUNT D., GEORGIEV B.B., **SCHOLZ T.**, PHILIP D. HARRIS, BAKKE T.A., POJMANSKA T., NIEWIADOMSKA K., **KOSTADINOVA A.**, TKACH V., BAIN O., DURETTE-DESSET M.-C., GIBBONS L., **MORAVEC F.**, PETTER A., DIMITROVA Z.E., BUCHMANN K., VALTONEN E.T., DE JONG Y. 2014: Fauna Europaea: helminths (animal parasitic). *Biodiversity Data Journal* 2: e1060. [IF=not yet]

28. **GOLOVCHENKO M.**, **ŠÍMA R.**, **HAJDUŠEK O.**, **GRUBHOFFER L.**, OLIVER J.H., **RUDENKO N.** 2014: Invasive potential of *Borrelia burgdorferi* sensu stricto ospC type L strains increases the possible disease risk to humans in the regions of their distribution. *Parasites & Vectors* 7: 538. [IF=3.430]

29. **GONZÁLEZ-SOLÍS D.**, CARRASSÓN M., PÉREZ-DEL-OLMO A. 2014: *Capillostrongyloides morae* sp. n. (Nematoda: Capillariidae) from deep-sea fish (Teleostei, Moridae) in the western Mediterranean Sea. *Folia Parasitologica* 61: 63–68. [IF=1.147]

30. **GONZÁLEZ-SOLÍS D.**, CHAVAN S.P., KANNEWAD P., GYANANATH G. 2014: A new species of *Rhabdochona* Railliet, 1916 (Nematoda: Rhabdochonidae) from cyprinid fishes in the Western Ghats Region, India. *Systematic Parasitology* 87: 273–281. [IF=1.336]

31. GOODMAN K.R., EVENHUIS N.L., **BARTOŠOVÁ-SOJKOVÁ P.**, O'GRADY P.M. 2014: Diversification in Hawaiian long-legged flies (Diptera: Dolichopodidae: Campsicnemus): Biogeographic isolation and ecological adaptation. *Molecular Phylogenetics and Evolution* 81: 232–241. [IF=3.916]

32. GRYBCHUK-IEREMENKO A., LOSEV A., KOSTYGOV A.Y., **LUKEŠ J.**, **YURCHENKO V.** 2014: High prevalence of trypanosome co-infections in freshwater fishes. *Folia Parasitologica* 61: 495–504. [IF=1.147]

33. HASAJOVÁ A., VALENČÁKOVÁ A., MALČEKOVÁ B., DANIŠOVÁ O., HALÁN M., GOLDOVÁ M., **SAK B.**, **KVĚTOŇOVÁ D.**, **KVÁČ M.**, HALÁNOVÁ M. 2014: Significantly higher occurrence of *Cryptosporidium* infection in Roma children compared with non-Roma children in Slovakia. European *Journal of Clinical Microbiology & Infectious Diseases* 33: 1401–1406. [IF=2.668]

34. HASEGAWA H., **MODRÝ D.**, KITAGAWA M., SHUTT K. A., TODD A., KALOUSOVÁ B., PROFOUSOVÁ I., **PETRŽELKOVÁ K.J.** 2014: Humans and great apes cohabiting the forest ecosystem in Central African Republic harbour the same hookworms. *PLoS Neglected Tropical Diseases* 8: e2715. [IF=4.446]

35. HAVRDOVÁ M., POLÁKOVÁ K., SKOPALÍK J., VUJTEK M., MOKDAD A., HOMOLKOVÁ M., TUČEK J., **NEBESÁŘOVÁ J.**, ZBOŘIL R. 2014: Field emission scanning electron microscopy (FE-SEM) as an approach for nanoparticle detection inside cells. *Micron* 67: 149–154. [IF=1.988]

36. HEGER T.J., EDGCOMB V.P., KIM E., **LUKEŠ J.**, LEANDER B.S., YUBUKI N. 2014: A resurgence in field research is essential to better understand the diversity, ecology, and evolution of microbial eukaryotes. *Journal of Eukaryotic Microbiology* 61: 214–223. [IF=3.217]

37. HOFMANNOVÁ L., **SAK B.**, JEKL V., MINÁRIKOVÁ A., SKORIČ M., **KVÁČ M.** 2014: Lethal *Encephalitozoon cuniculi* genotype III infection in steppe lemmings (*Lagurus lagurus*). *Veterinary Parasitology* 205: 357–360. [IF=2.460]

38. **HOLZER A.S.**, **HARTIGAN A.**, **PATRA S.**, **PECKOVÁ H.**, ESZTERBAUER E. 2014: Molecular fingerprinting of the myxozoan community in common carp suffering Swim Bladder Inflammation (SBI) identifies multiple etiological agents. *Parasites & Vectors* 7: 398. [IF=3.430]

39. HORN M., FAJTOVÁ P., ROJO ARREOLA L., ULRYCHOVÁ L., **BARTOŠOVÁ-SOJKOVÁ P.**, **FRANTA Z.**, PROTASIO A.V., **OPAVSKÝ D.**, VONDRÁŠEK J., MCKERROW J.H., MAREŠ M., CAFFREY C.R., **DVOŘÁK J.** 2014: Trypsin- and chymotrypsin-like serine proteases in *Schistosoma mansoni* – 'The Undiscovered Country'. *PLoS Neglected Tropical Diseases* 8: e2766. [IF=4.446]

40. **HUANG Z.**, KALTENBRUNNER S., ŠIMKOVÁ E., STANĚK D., **LUKEŠ J.**, **HASHIMI H.** 2014: The dynamics of mitochondrial RNA-binding protein complex in *Trypanosoma brucei* and its petite mutant under optimized immobilization conditions. *Eukaryotic Cell* 13: 1232–1240. [IF=2.820]

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International activities

Cooperation with foreign research institutions

Research area: Molecular biology of parasitic protists and nematodes & Molecular taxonomy and phylogeny of parasites

- Boston University, Boston, USA (R. Aphasizhev)
- CNRS, Ecole Normale Supérieure, Paris, France (C. Bowler)
- Comenius University, Bratislava, Slovakia (A. Horváth)
- Edinburgh Napier University, Edinburgh, UK (S. Rueckert)
- Mitochondrial Biology Unit, Cambridge, UK (J.E. Walker)
- Natural History Museum, London, UK (V. Smith)
- Ohio State University, Columbus, Ohio, USA (J. Alfonzo)
- Station Biologique de Roscoff, Roscoff, France (C. de Vargas)
- Staten Serum Institute, Copenhagen, Denmark (C.R. Stensvold)
- The State University of New York at Buffalo, Buffalo, New York, USA (L. Read)
- University of Bordeaux, Bordeaux, France (F. Bringaud)
- University of British Columbia, Vancouver, Canada (P.J. Keeling, L.W. Parfrey)
- University of California, Riverside, California, USA (D.A. Maslov)
- University of Edinburgh, UK (A. Schnaufer)
- University of Glasgow, Glasgow, UK (H. de Koning)
- University of Huddersfield, Huddersfield, UK (M.L. Ginger)
- University of Montreal, Québec, Canada (G. Burger)
- University of Zurich, Zurich, Switzerland (L. Keller)

Research area: Biology of disease vectors

- Academic Medical Center, Amsterdam, The Netherlands (J.W.R. Hovius)
- Barcelona Supercomputing Center, Barcelona, Spain (V. Guallar)
- Catholic University Leuven, Belgium (E. de Clercq)
- Dresden University of Technology & University Clinic Carl Gustav Carus, Dresden, Germany (T. Chavakis)
- Georgia Southern University, Statesboro, Georgia, USA (J.H. Oliver, Jr.)
- Hokkaido University, Sapporo, Hokkaido, Japan (K. Yoshii)
- Indiana University, National Centre of Glycomics and Glycoproteomics, Bloomington, Indiana, USA (M.V. Novotný)
- Institute of Bioorganic Chemistry and Fundamental Medicine, Novosibirsk, Russia (S. Tkachev)
- Institute of Virology, Slovak Academy of Sciences, Bratislava, Slovakia (B. Klempa)
- Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovakia (D. Žítňan, M. Kazimírová)
- Johannes Gutenberg University of Mainz, Mainz, Germany (E. Schmitt, S. Tenzer)
- Kagoshima University, Korimoto, Kagoshima, Japan (K. Fujisaki)
- National Institutes of Health, Rockville, Maryland USA (J. Valenzuela, J. Ribeiro)
- Norwegian Institute of Public Health, Oslo, Norway (A. Aase)
- NRC Institute for Biological Sciences, Ottawa, Canada (S. Logan)
- Oklahoma State University, Stillwater, Oklahoma, USA & Instituto de Investigación en Recursos Cinégeticos, Ciudad Real, Spain (J. de la Fuente)
- Parasitological Institute, Slovak Academy of Sciences, Košice, Slovakia (B. Peťko)

- State University of New York, Stony Brook, USA (B.J. Luft)
- University of Arizona, Tucson, Arizona, USA (R. Miesfeld, C. Bender, J. Winzerling)
- University of Granada, Granada, Spain (M. Hackenberg)
- University of Maryland School of Medicine, Baltimore, Maryland, USA (J.H. Pedra)
- University of Neuchâtel, Neuchâtel, USA (P. Guerin)
- University of North Florida, Jacksonville, USA (K. Clark)
- University of Rome La Sapienza, Roma, Italy (B. Arca)
- University of Southern Mississippi, Hattiesburg, Mississippi (S. Karim)
- University of Strasbourg, Illkirch, France (N. Boulanger)
- University of Tampa, Tampa, Florida, USA (N. Belfiore)

Research area: Parasites of fish

- College of Charleston, Charleston, South Carolina, USA (I. de Buron)
- ECOSUR, Chetumal, Mexico (D. González-Solís)
- Fish and Wildlife Research Institute, St. Petersburg, Florida, USA (M. Bakenhaster)
- Hungarian Academy of Sciences, Budapest, Hungary (E. Eszterbauer)
- Mote Marine Laboratory, Sarasota, Florida, USA (K. Main, C. Yanes-Roca)
- Muséum d'Histoire Naturelle, Genève, Switzerland (A. de Chambrier)
- Muséum National d'Histoire Naturelle, Paris, France (J.-L. Justine)
- Natural History Museum, London, UK (D.T.J. Littlewood, A. Waeschenbach)
- Oregon State University, Corvallis, Oregon, USA (J. Bartholomew, S. Atkinson)
- Ross University School of Veterinary Medicine, St. Kitts, West Indies (M. Freeman)
- Parasitological Institute, Slovak Academy of Sciences, Košice, Slovakia (M. Oros, I. Hromadová)
- Skretting Aquaculture Research Centre, Stavanger, Norway (C. McGurk)
- University of Bologna, Bologna, Italy (M.-L. Fioravanti, A. Gustinelli)
- University of Cape Town, Cape Town, South Africa (C.C. Reed)
- University of Connecticut, Storrs, Connecticut, USA (J.N. Caira)
- University of Exeter, UK (A. Chambouveta)
- University of Geneva, Switzerland (D. Soldati-Favre)
- University of Haifa, Israel (T. Lothan)
- University of Iceland, Reykjavik, Iceland (K. Skirnisson)
- University of Malaya, Kuala Lumpur, Malaysia (M. Freeman)
- University of Sydney, Sydney, Australia (J. Šlapeta)
- University of Tasmania, School of Aquaculture, Launceston, Tasmania, Australia (B. Nowak)
- University of Valencia, Valencia, Spain (F. Montero, A. Pérez del Olmo)
- University of Vienna, Austria (M. Horn)

Research area: Parasitic protists of man and animals with special reference to opportunistic parasites

- Canadian Institute for Advanced Research, University of Ottawa, Ottawa, Ontario, Canada (N. Corradi)
- CDC, Division of Parasitic Diseases, Atlanta, Georgia, USA (L. Xiao, V. Cama, E.W. Secor)
- Center for Food Safety, University of Georgia, Griffin, Georgia, USA (Y. Ortega)
- Christchurch Science Centre, Christchurch, New Zealand (E. Moriarty)
- Higher National School of Veterinary, EL Harrach, Algiers, Algeria (A.E. Laatamna, M. Aissi)
- North Dakota State University, Fargo, North Dakota, USA (J. McEvoy)
- Parasitological Institute of Slovak Academy of Sciences, Košice, Slovakia (M. Stanko)

- Wroclaw Medical University, Wrocław, Poland (M. Wesolowska, M. Kicia)
- Wroclaw University, Institute of Genetics and Microbiology, Wrocław, Poland (A. Perec-Matysiak)

Membership in international organisations

Maryna Golovchenko

- Adjunct member of the James Oliver, Jr. Institute of Arthropodology and Parasitology at the Georgia Southern University
- Member of American Society for Microbiology
- Member of European Society of Clinical Microbiology and Infectious Diseases
- Member of European Study Group for Lyme Borreliosis

Libor Grubhoffer

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

Astrid Holzer

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

Petr Kopáček

- International Society of Developmental and Comparative Immunology

Michail Kotsyfakis

- Member of the International Proteolysis Society
- Member of the American Society of Biochemistry and Molecular Biology

Julius Lukeš

- Fellow of the American Academy for Microbiology
- Member of the Faculty of 1000
- President of the International Society for Evolutionary Protistology
- Senior Fellow of the Canadian Institute for Advanced Research
- Vice-President of the International Society of Protistologists

František Moravec

- Honorary Member of the American Society of Parasitologists
- Honorary Member of the Slovak Society of Parasitologists

Jana Nebesářová

- Member of the European Microscopy Society
- President of the Czechoslovak Microscopy Society

Miroslav Oborník

- Member of the International Society for Evolutionary Protistology

Ryan O. M. Rego

- Member of American Society for Microbiology
- Member of European Society of Clinical Microbiology and Infectious Diseases

Nataliia Rudenko

- Adjunct member of the James Oliver, Jr. Institute of Arthropodology and Parasitology at the Georgia Southern University
- Member of American Society for Microbiology
- Member of European Society of Clinical Microbiology and Infectious Diseases
- Member of European Study Group for Lyme Borreliosis

Daniel Růžek

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

Tomáš Scholz

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

Jan Štefka

- Member of the International Society of Phthirapterists

Jiří Vávra

- Member of the International Society of Protistologists

Membership on editorial boards

Acta Parasitologica (Poland): ***F. Moravec***
Acta Protozoologica (Poland): ***J. Vávra***
American Journal of Blood Research (USA): ***M. Kotsyfakis*** (Associate Editor)
American Journal of Infectious Diseases and Microbiology (USA): ***D. Růžek***
BMC Genomics (UK): ***M. Kotsyfakis*** (Associate Editor)
Developmental & Comparative Immunology (UK): ***P. Kopáček***
Epidemiology and Vaccinal Prevention – Scientific and Practical Journal (Russia): ***D. Růžek***
Folia Parasitologica (Czech Republic): ***I. Dyková***, ***I. Fiala*** (Associate Editor), ***A. Kostadinova*** (Associate Editor), ***F. Moravec***, ***T. Scholz*** (Editor-in-Chief), ***J. Štefka*** (Associate Editor), ***J. Vávra***, ***V. Yurchenko***
Helminthologia (Slovakia): ***F. Moravec***
Journal of Agrobiology (Czech Republic): ***M. Kváč***
Journal of Eukaryotic Microbiology (USA): ***J. Lukeš***, ***J. Vávra*** (board of reviewers)
Journal of Fish Diseases (UK): ***A.S. Holzer***
Kinetoplastid Biology and Disease (UK): ***J. Lukeš***
Medical Virology (Russia): ***D. Růžek***
Parasite (France): ***F. Moravec***, ***T. Scholz***
Parasite & Vectors (UK): ***A. Kostadinova*** (Editor-in-Chief), ***M. Kotsyfakis*** (Associate Editor)
Protistology (Russia): ***J. Lukeš***
Systematic Parasitology (UK): ***A. Kostadinova*** (Editor-in-Chief), ***F. Moravec***, ***T. Scholz***
The Scientific World Journal (UK, USA, Egypt): ***D. Růžek***
Ticks and Tick-Borne Diseases (Germany): ***J. Kopecký***
Veterinary Medicine and Animal Sciences (UK): ***A.S. Holzer***
World Journal of Virology (China): ***D. Růžek***

Teaching activities

The principal mission of the Institute of Parasitology is to perform basic research. However, participation of the staff in teaching is an integral part of their activities and 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 and all graduate students and selected undergraduates have part-time contracts at the Institute. Most students are from the University of South Bohemia in České Budějovice, especially its Faculty of Science, but also from other faculties (Faculty of Agriculture; Faculty of Health and Social Studies) and universities, such as Charles University in Prague, Masaryk University in Brno and the University of Veterinary and Pharmaceutical Sciences in Brno.

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.

List of PhD theses

(Faculty of Science, University of South Bohemia unless otherwise stated)

2014

- **Alena Kodádková**: Myxosporean phylogeny and evolution of myxospore morphotypes
  Supervisor: *I. Fiala*
- **Carlos Alonso Mendoza-Palmero (Mexico)**: Species composition and phylogenetic relationships among oviparous monogeneans (Dactylogyridae: Ancyrocephalinae) of catfish (Siluriformes) and other fish of the Amazon River basin
  Supervisor: *T. Scholz*

2015

- **Ana Born-Torrijos**: Trematodes in Mediterranean coastal habitats: transmission, life cycles and detection methods. **Cavanilles Institute of Biodiversity and Evolutionary Biology, University of Valencia**
  Supervisor: *A.S. Holzer*
- **Simona Georgieva (Bulgaria)**: An integrative taxonomic approach to the study of trematode diversity and life-cycles in freshwater ecosystems
  Supervisor: *A. Kostadinova*
- **Karolína Šubrtová**: FoF1-ATP synthase/ATPase in the parasitic protist, *Trypanosoma brucei*
  Supervisor: *A. Zíková*
- **Miray Tonk**: Characterisation and functional analysis of defensins from the ticks *Ixodes ricinus* and *Ixodes scapularis*
  Supervisor: *L. Grubhoffer*
- **Jiří Týč**: Kinetoplastids biology, from the group phylogeny and evolution into the secrets of the mitochondrion of one representative: *Trypanosoma brucei* – the model organism in which new roles of the evolutionary conserved genes can be explored
  Supervisor: *J. Lukeš*
- **Zhenquin Huang**: The dynamics of the MRP1/2 complex and the function of intact MRB1 core for RNA editing in *Trypanosoma*
  Supervisor: *H. Hashimi*

List of Master of Science theses

2014

- **Lenka Čapková**: Monozoic tapeworms of the genus *Monobothrium* (Cestoda: Caryophyllidea) from the Palaeartic and the Neartic zoogeographical region
  Supervisor: *T. Scholz*
- **David Hartmann**: Characterization and function of Factor C from the tick *Ixodes ricinus*
  Supervisor: *P. Kopáček*; *consultant*: *L. Grunclová*
- **Martina Hrabcová**: Biology, life cycle and phylogeny of malacosporeans in fish and bryozoans.
  Supervisor: *A.S. Holzer*
- **Jan Kotál**: Production and functional characterization of tick salivary protease inhibitors
  Supervisor: *M. Kotsyfakis*
- **Zuzana Kotrbová**: Enzymes of purine salvage pathway in *Trypanosoma brucei* and the trypanocidal action of acyclic nucleoside phosphonates
  Supervisor: *A. Zíková*
- **Kateřina Leštinová**: A morphological analysis of the eggs of tapeworms of the order Diphyllobothriidea
  Supervisor: *R. Kuchta*
- **Jan Martinek**: Identifying the mode of action for bisphosphonium salts – potent trypanosomatid inhibitors
  Supervisor: *A. Zíková*
- **Denisa Martykánová**: The new nanoparticles in the ultastructural diagnostics
  Supervisor: *J. Nebesářová*
- **Jana Schrenková**: Localization of the cathepsin L isoforms (IrCL) in the tissues of the hard tick *Ixodes ricinus*
  Supervisor: *P. Kopáček*; *consultant*: *M. Vancová*
- **Martin Strnad**: Localization of Lyme disease spirochetes *Borrelia burgdorferi* in ticks *Ixodes ricinus*
  Supervisor: *M. Vancová*

2015

- **Jitka Konvičková**: Factors regulating expression and activity of digestive enzymes in the tick *Ixodes ricinus*
  Supervisor: P. Kopáček
- **Matěj Kučera**: Influence of dietary components and redox enzymes in intestinal microbiota proliferation in the tick *Ixodes ricinus*
  Supervisor: *P. Kopáček*; *consultant*: *J. Perner*
- **Michaela Matějková**: Co-evolution between small rodents (*Microtus*, *Clethrionomys*) and their ectoparasites on a population level
  Supervisor: *J. Štefka*
- **Helena Mondeková**: Functional analysis of fibrinogen-related proteins (FREPs, Ixoderins) of the tick *Ixodes ricinus* and their function in pathogen transmission
  Supervisor: *O. Hajdušek*
- **Hana Váchová**: Functional analysis of novel F1-ATPase subunit in *Trypanosoma brucei*
  Supervisor: *A. Zíková*
- **Jan Vazač**: Study on the chromosome number in the alveolate alga *Chromera velia* by TSA-FISH
  Supervisor: *M. Oborník*
- **Jakub Vlček**: Variability of MHC class II β gene in Galápagos mockingbirds
  Supervisor: *J. Štefka*

List of Bachelor of Science theses

2014

- **Stepan Demchyshyn**: Further delineation of *Borrelia burgdorferi* restriction modification system and understanding antibiotic resistance in *Borrelia afzelii*
  Supervisor: *Ryan O. M. Rego*
- **Hana Hajková**: Presence of ticks and analysis of tick-transmitted *Borrelia* species in ticks from recreation sites of České Budějovice and nearby areas. Mapping of the prevalence of *B. miyamotoi* in ticks from selected regions of South Bohemia
  Supervisor: *N. Rudenko*; *consultant*: *M. Golovchenko*
- **Sabine Kaltenbrunner**: The Localization of the Mitochondrial Proteins MRP1, KREL2 and LSU1 of *Trypanosoma brucei*
  Supervisor: *H. Hashimi*
- **Nella Keplová**: Analysis of infectious potential of newly described species of borrelia *B. burgdorferi* sensu lato complex, *B. americana* and *B. carolinensis* on laboratory model of infected animals
  Supervisor: *N. Rudenko*; *consultant*: *M. Golovchenko*
- **Adéla Křížová**: Functional analysis of protein MRB8620 of the mitochondrial RNA binding complex 1 of *Trypanosoma brucei*
  Supervisor: *H. Hashimi*
- **Jiří Kyslík**: New phylogenetic markers for the phylogeny of the *Myxozoa*
  Supervisor: *I. Fiala*
- **Štěpánka Smolenová**: Preparation of clonal populations of *Borrelia* from North American isolates in purpose to detect the presence of *Borrelia* species commonly distributed in Europe
  Supervisor: *N. Rudenko*; *consultant*: *M. Golovchenko*
- **Jiří Ťápal**: Functional analysis of TbFis1 protein in *Trypanosoma brucei*
  Supervisor: *H. Hashimi*
- **Lukáš Vejsada**: Parasitism and diversity in MHC genes in small rodents
  Supervisor: *J. Štefka*

2015

- **Lovelyna Eromonsele**: Overexpression of a tick salivary cysteine protease inhibitor in prokaryotic system of protein expression
  Supervisor: *M. Kotsyfakis*
- **Martina Jedličková**: Phylogeny of amoebae of family Flabellulidae
  Supervisor: *M. Kostka*
- **Pavlína Kočová**: Population genetic structure of *Ligula intestinalis*
  Supervisor: *J. Štefka*
- **Kamila Štauberová**: Molecular characterization of selected strains of *Acanthamoeba* species, potential human pathogens
  Supervisor: *M. Kostka*
- **Ivana Vlnová**: Revision of diphyllobothriid tapeworms of reptiles (Eucestoda: Solenophoridae)
  Supervisor: *R. Kuchta*
- **Zuzana Zemanová**: Detection and quantification of tick-transmitted pathogens from the selected localities of the Czech Republic
  Supervisor: *O. Hajdušek*
- **Klára Zítková**: Molecular characterization of selected strains of amoebae of the genus *Naegleria*, potential human parasites
  Supervisor: *M. Kostka*

Stays of foreign researchers

- **Eva Bazsalovicsová**: Parasitological Institute of the Slovak Academy of Sciences, Košice, Slovakia (16.–26. 3. + 19.–30. 11. 2014; *J. Štefka + T. Scholz*)

- **Isabel Blasco-Costa**: Natural History Museum, Geneva, Switzerland (27.–30. 11. 2014; *T. Scholz*)
- **Walter Boeger**: University of Curitiba, Brazil (28.–29. 11. 2014; *T. Scholz*)
- **Magdaléna Bruňanská**: Parasitological Institute, Košice, Slovakia (1. 10.–14. 10. 2014; *J. Nebesářová*)
- **Maite Carrassón**: Autonomous University of Barcelona, Spain (8. 2.–8. 3. 2015; *A. Kostadinova*)
- **Alain de Chambrier**: Natural History Museum, Geneva, Switzerland (11.–23. 5. 2014; *T. Scholz*)
- **Yves Desdevises**: University of Marie Curie, Banyuls-sur-Mer, France; 27.–30. 11. 2014; *T. Scholz*)
- **David González-Solís**: ECOSUR Chetumal, Mexico (15. 5.–30. 9. 2014; *T. Scholz + F. Moravec*)
- **Sabina Havlíková**: Institute of Virology, Slovak Academy of Science, Bratislava, Slovak Republic (May–July 2014; *O. Hajdušek*)
- **Olena Kudlai**: Schmalhausen Institute of Zoology, Kiev, Ukraine + Nature Research Centre, Vilnius, Lithuania (1.–28. 7. 2014 + 20.–27. 11. 2014; *A. Kostadinova*)
- **Tetiana Kuzmina**: (Schmalhausen Institute of Zoology, Kiev, Ukraine; 17.–22. 11. 2014; *R. Kuchta*); Tetiana Kuzmina + Terry Spraker (University of Colorado, Fort Collins, USA (4.–10. 5. 2015; *R. Kuchta*)
- **Yuriy Kvach**: Institute of Biology of the Southern Seas, National Academy of Sciences of Ukraine, Odessa, Ukraine (20.–22. 1. 2015; *T. Scholz*)
- **Olga Lisitsyna**: Schmalhausen Institute of Zoology, Kiev, Ukraine (17.–22. 11. 2014; *T. Scholz*)
- **D. Timothy J. Littlewood**: Natural History Museum, UK (15.–17. 2. 2015; *T. Scholz*)
- **Douniazed Marzoug**: Université d'Oran, Algeria; 10.–20. 9. 2014 + 15.–25. 10. 2015; *A. Kostadinova*)
- **Edgar F. Mendoza-Franco**: Universidad Autónoma de Campeche, Mexico (20. 7.–21. 8. 2015; *T. Scholz*)
- **Katie O'Dwyer**: University of Otago, Dunedin, New Zealand (31. 3.–19. 5. 2014; *A. Kostadinova*)
- **Mikuláš Oros**: Parasitological Institute, Slovak Academy of Sciences, Košice, Slovakia (6. 3.–10. 5. 2014 + 2.–31. 7. 2015; *T. Scholz*)
- **Ana Pérez del Olmo**: Universitat de Valencia, Spain (17. 2.–8. 3. 2014 + 28. 11.–19. 12. 2014; *A. Kostadinova*)
- **Sonja Rueckert**: Edinburgh Napier University (1. 8.–31. 8. 2014, *A. Horák*)
- **Björn Schäffner**: Germany (6. 6.–31. 7. 2014; *R. Kuchta*)
- **Vasyl Tkach**: University of South Dakota, Grand Forks, USA (20.–27. 11. 2014; *A. Kostadinova*; 13.–17. 2. 2015; *S. Georgieva*)
- **Fabiano Matos Vieira**: Universidade Federal Rural de Rio de Janeiro, Brazil (26. 3.–5. 6. 2014; *D. González-Solís + F. Moravec*)
- **Aneta Yoneva**: Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Sofia, Bulgaria (1. 9.–30. 11. 2014 and 31. 8.–30. 11. 2015; *R. Kuchta*)

Stays of foreign students

- **Philippe Vieira Alves**: Universidade Federal Rural de Rio de Janeiro, Brazil (12. 4.–17. 5. 2014 + 31. 7.–30. 9. 2015; *T. Scholz*)
- **Daniel Barčák**: Parasitological Institute of the Slovak Academy of Sciences, Košice, Slovensko (13.–23. 7. 2015; *T. Scholz*)
- **Ana Isabel Born-Torrijos**: University of Valencia, Spain (31. 3.–1. 5. 2014; *A. Hartigan*)
- **Sengjun Choe**: University School of Medicine, Korea (1. 7.–2. 8. 2015; *R. Kuchta*)
- **Sara Dallarés Villar**: Universitat Autònoma de Barcelona, Spain (23. 6.–26. 7. 2014; *R. Kuchta*)
- **Jenna Franco**: University of Arizona, Tucson, USA (May–July, 2015; supervisor *O. Hajdušek*)
- **Wolf Isbert**: Universitat Autònoma de Barcelona, Spain (1. 8.–30. 9. 2014; *D. González-Solís*)
- **Sarah Madache**: Université d'Oran, Algeria (28. 4.–27. 5. 2014; *A. Kostadinova*)
- **Katie O'Dwyer**: University of Otago, Dunedin, New Zealand (31. 3.–19. 5. 2014; *A. Kostadinova*)
- **Felipe Bisaggio Pereira**: Universidade Federal Rural de Rio de Janeiro, Brazil (5. 5.–23. 9. 2014; *D. González-Solís + F. Moravec*)
- **David Pérez i García**: Autonomous University of Barcelona, Spain (October 2014; *A. Kostadinova*)
- **Mohammad Rima**: Algeria (16. 10.–15. 11. 2015; *S. Georgieva*)
- **Berta Rivera Romero**: University of Stirling, UK (2.–12. 6. 2014; *R. Kuchta*)
- **Jessica Schwelm**: University of Duisburg-Essen, Germany (23. 2.–3. 3. 2015; *A. Kostadinova*)
- **Chris Selbach**: University of Essen-Duisburg, Germany (7. 4.–9. 5. 2014; *M. Soldánová*; 23. 2.–5. 3. 2015; *A. Kostadinova*)
- **Ludmila Zvijáková**: Parasitological Institute of the Slovak Academy of Sciences, Košice, Slovensko (16.–26. 3. 2014 + 19.–30. 11. 2014; *J. Štefka + T. Scholz*)

Survey of lectures and courses (2014–2015) (hours/year)[1]

Name	Course	2014	2015
I. Fiala	Field parasitology	-	36
L. Grubhoffer	Biochemistry	60	60
L. Grubhoffer	Biochemistry 1 (CB + Linz)*	65	65
L. Grubhoffer	Biochemistry 2 (CB + Linz)	-	45
L. Grubhoffer	Glycobiochemistry (CB+Linz)	30	30
H. Hashimi	Cell regulation and signalling	39	39
A. Horák	Introduction to Bioinformatics	16	16
A. Horák	Introduction to Genomics	-	16
V. Hypša	Biology of parasitism	26	26
V. Hypša	Biology of marine invertebrates	26	26
V. Hypša	Molecular phylogenetics	26	26
V. Hypša	Biology of parasitic arthropods	-	39
J. Kopecký	Immunology	40	40
J. Kopecký	Immunology (CB + Linz)	-	40
J. Kopecký	Parasite immunology	20	20
J. Kopecký	Cell and tissue cultures	20	20
J. Kopecký	Cell and tissue cultures (CB + Linz)	-	20
J. Kopecký	Parasite immunology	-	10[5]
M. Kostka	Protistology	26	-
M. Kostka	Biology of parasitic protozoa	39	-
R. Kuchta	Special zoology of invertebrates	-	10
M. Kváč	Zoohygiene and prevention of diseases of farm animals	28[6]	28[6]
M. Kváč	Veterinary medicine	46	46
M. Kváč	Animal health	56[6]	56[6]
M. Kváč	Veterinary parasitology	42[6]	42[6]
J. Lukeš	Biology of parasitic protists	-	78
J. Lukeš	Biochemistry and molecular biology of parasites	30	-
J. Nebesářová	Electron microscopy for biologists I	40	40
J. Nebesářová	Electron microscopy	8[2]	4[2]
J. Nebesářová	Electron microscopy	24[5]	-
J. Nebesářová	Electron microscopy	48	48
M. Oborník	Bioinformatics	-	24
M. Oborník	Molecular taxonomy	-	56[6]
D. Růžek	Medical virology	48	48
B. Sak	Cell biology methods	28[2]	282
T. Scholz	Biology of helminths	78	-
T. Scholz	Special zoology of invertebrates	-	3
J. Štefka	Conservation genetics	52[1]	-
J. Štěrba	Advanced biochemistry laboratory	42	42
J. Štěrba	Biochemistry laboratory 2 (CB + Linz)	42	42
J. Štěrba	Xenobiochemistry and toxicology (CB + Linz)	56	56
J. Štěrba	Chemistry seminar for 2 and 3 year	40	40
J. Štěrba	Biochemistry laboratory	56	72
J. Štěrba	Biochemistry laboratory (CB + Linz)	42	42
J. Štěrba	Instrumental methods in biochemistry and biophysics	-	12
J. Štěrba	Introduction to toxicology	36	24
M. Vancová	Electron microscopy for biologists I	20	20
M. Vancová	Electron microscopy	12[2]	12[2]
M. Vancová	Biological electron microscopy I and II	6*	6*

J. Vávra	Biology of parasitic protists	-	39
J. Vávra	Biology of parasitic protists	-	78
A. Zíková	Molecular biology of cell	-	26[1]

[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 (University of South Bohemia, České Budějovice & Johannes Kepler University in Linz, Austria)