

Faculty of Science University of Ostrava



BIODIVERSITY

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BIODIVERSITY

Biodiversity represents the diversity of life. Essentially, it means the richness of life on Earth, the species and shape diversity of plants, animals and microorganisms, including their genes and the complex ecosystems they create all together.

[#biodiversity](#) [#facultyofscience](#) [#insectstrategy](#)
[#crustaceans](#) [#dragonflies](#) [#dipterans](#)
[#sexevolution](#) [#genetics](#) [#genomics](#)
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BIODIVERSITY

The biologists at the University of Ostrava have been involved in a comprehensive study of biodiversity since the establishment of the Department of Biology and Ecology. The research team is made up of twelve researchers whose research directions can be narrowed to six distinct areas that more or less overlap.

„Individual spheres reflect the specialization of their leaders. They are mostly experts on a taxonomic group, it means on a certain type of organisms, or they are specialists in some ecological or evolutionary process,“ doc. RNDr. Petr Kočárek, Ph.D. explains.

In addition to leaders, the team also includes dozens of doctoral students who participate in research, collect and evaluate data and develop the conclusions of their supervisors.

The whole team is primarily interested in the evolution of animals and plants and the reconstruction of their phylogenetic development. They investigate the population characteristics of model groups as well as the trophic networks and try to clarify the relationship between biodiversity and food specialization. They are also interested in the diversity regularities in the environmental gradient, or in general processes that are important for the evolution understanding. Furthermore, they focus on the biodiversity of anthropogenic ecosystems with an emphasis on the ecology of industrial and post-industrial biotopes, which are researches that can be used in management and practical nature protection.

For the research of the biological team of the Faculty of Science of Ostrava, the cooperation with institutions and colleagues from abroad is important. Just there, especially in tropical areas, they have the most appropriate conditions for the

biodiversity exploring. *„For example, we had a three-year project in Brunei, Borneo, where we were with a group of students and focused on the diversity of the tropical rain forest. Field researches are under way e.g. in Papua New Guinea, New Caledonia, China and many other places. Moreover, we are also interested in the most extreme regions, such as the Antarctic or the Arctic where there is not so much species diversity but the local special conditions lead to the development of evolutionarily interesting strategies,“* doc. RNDr. Petr Kočárek says.

The research team of biologists from the University of Ostrava publishes its often very significant discoveries and conclusions in the prestigious biological journals such as Nature, Science, PNAS, Current Biology, Evolution and others. To the present, team members have described over two hundred new species and genera. In addition, thanks to the modern methods, these numbers can be expected to grow further.

„Biology is an extremely dynamic scientific discipline. Our approaches to the biodiversity have evolved and are evolving, and our six main directions have changed during the years. It is common for us biologists to come across something that will absorb us and change our attitudes, or some sub-directions will put down those ones originally considered as the main ones. With the modern approaches, we can study phenomena and processes that we hadn't even dreamed of years ago. And we can answer the questions that we never thought about asking because there were simply no tools for finding answers. New and new universes are opening in front of us, thanks to the new technologies,“ doc. RNDr. Petr Kočárek concludes.

BIODIVERSITY - RESEARCH AREAS

LABORATORY OF INSECT TROPHIC STRATEGIES

The Laboratory of Insect Trophic Strategies (LITS) studies the general patterns of insect diversity, especially how the relationships between the richest group of organisms on the planet and their food have evolved. Most of the research is focused on the relationships between herbivores (herbivorous insects) and their host plants, alternatively on other organisms that enter into that relationship (for example predators or symbiotic organisms living in the relationship with the plants or insects). Research topics include e.g.: why some herbivores closely specialize in one plant while others have a much more varied diet; or, do the insect predators affect the plants defence against herbivorous insects or can the plants defend themselves? In the recent years, the attention has been paid to the placement of individual groups of insects in the tree tops and currently the laboratory is intensively addressing the question how microorganisms of the insect gastrointestinal tract can affect the food intake efficiency and the insect tolerance to the defence substances produced by the plants. Details can be found on the team's website: <http://lits.osu.cz/>.



CRUSTACEOLOGICAL TEAM

The crustaceological team has long been involved in the study of species diversity, ecology and evolution of the selected groups of crustaceans, especially sea-shrimp, crab and mantis shrimp (*Odontodactylus*), but also freshwater crayfish. The team has discovered over 30 new, for the science yet unknown species and described 10 new genera of these animals. The main attention is paid to the symbiotic shrimps of tropical coral reefs that live in cohabitation with corals, sea anemones, echinoderms, alternatively, they inhabit cavities of sea sponges, ascidians and clams, or they are fish cleaners. The team is abundantly using the stereo microscopes and transmission microscopes, electron microscope and molecular laboratory. Through comparative morphological studies and DNA analyses, the team studies the evolutionary relationships of the studied crustacean groups and their body adaptation to the life in such diverse environments. In the last 10 years, the team members have participated in scientific expeditions to the Great Barrier Reef, Papua New Guinea, Islands of Martinique, Corsica, Taiwan and New Caledonia.

ENTOMOLOGICAL TEAMS

Three partial entomological teams focus on the systematics, phylogenesis and ecology of selected insect groups. **The odonatological team** focuses on the study of habitat dynamics of dragonflies, including the assessment of diversity in the environmental gradient. Dragonflies are used as ecological indicators of environmental changes as well as the objects of citizen science, in frame of which the public is involved in obtaining information about their occurrence. The research is also focused on the importance of anthropogenic, especially (post-)industrial biotopes. Ecology of dragonfly populations and their interaction with other organisms is studied, including the influence of predators and parasitoids on dragonfly distribution and quantity. **The Polyneoptera Research Group (PRG)** team deals mainly with ecology, ethology, species protection, phylogenesis and taxonomy of insects from the orders of Orthoptera, Dermaptera, Zoraptera and others. At present, the questions of food and behavioural ecology of groundhoppers (Orthoptera: Tetrigidae), distribution of orthopterans in the industrial landscape and molecular phylogenesis and taxonomy of selected groups of earwigs (Dermaptera) are researched. The team also deals with the reconstruction of phylogenesis and with the evolutionary history of polyneopter insects based on the study of fossils in the amber (more at <http://prg.osu.cz/>). **The dipterological team** focuses mainly on the reconstruction of the phylogenesis of Bibionomorpha insects, using both molecular-phylogenetic approaches and the study of fossils. Members of entomological teams described about 200 new taxa (species and genera) and besides dozens of scientific publications, the entomologists published also 6 scientific and popular-scientific monographs.

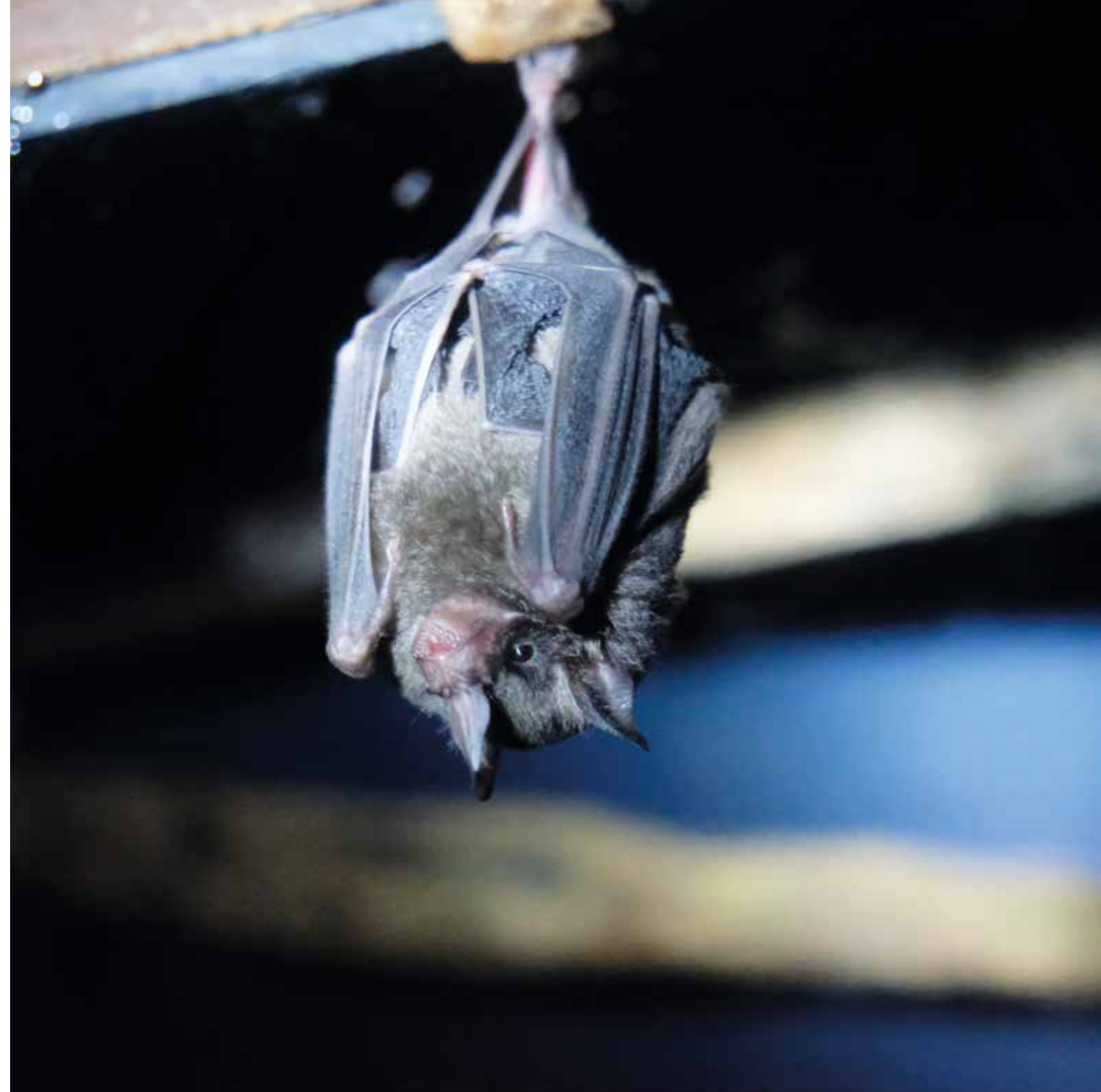
EVOLUTION OF SEX AND OF ALTERNATIVE REPRODUCTIVE STRATEGIES

The team focusing on the evolution of sex and alternative reproductive strategies seeks to answer the basic question, „*What do we really have sex for?*“ Although seemingly trivial, this matter has not been solved despite more than a century of intensive research. Our team concentrates on the evolution of sexual and asexual reproduction using both theoretical approaches (modelling, process simulation) and empirical studies using ecological, physiological and genomic methods. Our model organisms are mainly true loaches that combine both types of reproduction. We are interested in how changing the type of reproduction affects the genome, genes expression, interaction with the environment, and the evolutionary potential of populations. We also study the evolution and adaptation of extremophilic microorganisms, especially of the Arctic and the Antarctic. The clonal reproduction enabled them to develop even in extreme conditions and, among other things, facilitated the colonization of the deglaciated territories. The fieldwork of our research includes the stays in European locations from the Balkan to France, but each year also expeditions to the extreme ecosystems from the polar regions (Svalbard, Greenland, Antarctica) to the glaciers of the tropical mountain ranges (Uganda).



POPULATION GENOMICS

The population genomics team is engaged in the research of the population biology and the evolutionary history of mammals by using various approaches integration including evolutionary genetics and genomics, biogeography, bioacoustics, geometric morphometry and other disciplines. Model groups are particularly highly mobile mammalian species (e.g. bats, insectivores, carnivorans, cetaceans and ungulates), whose populations have a high level of gene flow and often an ecological differentiation plays a role. The methodological procedures of the “omics” era, which is based on technology development and is characterized by a revolutionary increase in data acquisition capacity at all hierarchical levels, are reflected. In the area of ecological and biogeographic approach prevailing in the workplace, in biology it involves e.g. “next generation” genomic approaches, in geography e.g. remote-sensing tools. Among others, processes in small and medium-sized populations such as those we encounter at insular, invasive and domesticated organisms or rescue breeding, and processes associated with the genesis of new species are studied. Many essential evolutionary changes are associated with the demographics of the so-called „bottle-neck effect“ and with models of evolution based on the founder effect. For example, the role of population fragmentation and islands in the Pleistocene phylogeography of some West-Palearctic and African groups has been elucidated. The outputs are widely used also in the applied sphere, especially in the field of conservation biology and restoration ecology.



BRYOLOGICAL LABORATORY

Bryological Laboratory (BRYOLAB: <http://www.bryolab.com/>) is a working group dealing with systematics and ecology of bryophytes. It is intensively involved in solving taxonomic and systematic issues associated with epiphytic mosses of the Orthotrichaceae family. Herbarium items and own bryophyte collections collected during foreign botanical expeditions are used for the research. The field research has been carried out in the last 5 years mainly in China in cooperation with Shanghai bryology laboratory. BRYOLAB researchers and students closely cooperate and publish together with botanists from foreign universities, especially Polish, Chinese and American ones. In addition to systematically focused projects, questions of bioindication properties of bryophytes and of modelling of bryophyte distribution strategies are also addressed. In the collaboration with entomologists, the trophic and host specialization of bryophagous insects, i.e. insects fed on moss such as some beetles or orthopterans, is also studied.



SELECTED SIGNIFICANT PUBLICATIONS

Forister M., Novotny V., Panorska A.K., Baje L., Basset Y., Butterill P.T., Cizek L., Coley P.D., Dem F., Diniz Y.R., Drozd P., Fox M., Glassmire A.E., Hazen R., Hrcek J., Janher J.P., Kaman O., Kozubowski T.J., Kursar T.A. & Lewis, O.T. et al. (2015): The global distribution of diet breadth in insect herbivores. *PNAS*, 112: 442-447.

Horká I., De Grave S., Franssen C.H., Petrusek A. & Ďuriš Z. (2016): Multiple host switching events shape the evolution of symbiotic palaemonid shrimps (Crustacea: Decapoda). *Scientific Reports*, 6: 26486.

Dolný A., Šigutová H., Ožana S. & Choleva L. (2018): How difficult is it to reintroduce a dragonfly? Fifteen years monitoring *Leucorrhinia dubia* at the receiving site. *Biological Conservation*, 218(2): 110-117.

Kočárek P. 2018: The cephalo-thoracic apparatus of *Caputoraptor elegans* may have been used to squeeze prey. *Current Biology* 28(15): 824-825.

Kaspřák D., Kerr P., Sýkora V., Tóthová A. & Ševčík J. (2019): Molecular phylogeny of the fungus gnat subfamilies Gnoristinae and Mycomyinae, and their position within Mycetophilidae (Diptera). *Systematic Entomology*, 44(1): 128-138.

Janko K., Pačes J., Wilkinson-Herbots H., Costa R.J., Röslein J., Drozd P., Iakovenko N., Ridl J., Hroudová M., Kočí J., Reifová R., Šlechtová V. & Choleva L. (2018): Hybrid asexuality as a primary postzygotic barrier between nascent species: On the interconnection between asexuality, hybridization and speciation. *Molecular Ecology*, 27(1): 248-263.

Hulva P., Černá Bolfíková B., Woznicová V., Jindřichová M., Benešová M., Myslajek R.W., ... & Hájková A. (2018): Wolves at the crossroad: Fission–fusion range biogeography in the Western Carpathians and Central Europe. *Diversity and Distributions*, 24(2): 179-192.

Sawicki J., Plášek V., Ochyra R., Szczecińska M., Šlipiko M., Myszczyński K. & Kulik T. (2017): Mitogenomic analyses support the recent division of the genus *Orthotrichum* (Orthotrichaceae, Bryophyta). *Scientific reports*, 7(1): 4408.

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Web links to websites of the sub-teams

Laboratory of Insect Trophic Strategies
<http://lits.osu.cz/>

Bryological Laboratory
<http://www.bryolab.com/>

Polyneoptera Research Group
<http://prg.osu.cz/>

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