

Institute: W. Szafer Institute of Botany, Polish Academy of Sciences

Title: Symbiotic interactions in the lichen holobiont and their role in the evolution of biodiversity of lichenicolous fungi in tropical mountain forests

Name of potential supervisor: dr. hab. Adam Flakus, prof. IB PAS

Background information:

The ability to develop symbiotic relations is an essential factor driving the evolution of contemporary biodiversity. One of the iconic examples of symbiosis is lichenization, a mutualistic relationship of fungi with algae or cyanobacteria. The ability to develop lichen symbioses has repeatedly appeared in the course of evolution, providing several evolutionary innovations that have increased the metabolic capacity of fungi and allowed them access to new ecological niches. The characteristic longevity of lichens additionally favors the development of specific lichen-associated microbiome, which plays a vital role in lichen biology. The goal of the study is to understand better the factors affecting distribution patterns, morphological adaptations, and evolutionary radiation of biological diversity of fungal lichen-microbiome and their interaction with the abiotic environment. The research will be conducted in Bolivian tropical Andes, which is one of the richest centers of lichen biodiversity. The outcome of the study will allow us to understand better the mechanisms of evolution of multi-species symbiotic systems in tropical mountain forests.

The main question to be addressed in the project:

How do morphological adaptations affect symbiotic interactions and species divergence? What role does adaptation to distantly related evolutionary lineages play in shaping biodiversity? How do the interactions between symbionts change along an environmental gradient?

Information on the methods/description of work:

The research will be based on data collected in Bolivia, in humid Andean mountain forests, and during complementary field studies. Laboratory work will consist of DNA extraction and sequencing (Sanger or NGS methods), culture depending methods, analysis of morphological states (light or FISH microscopy) and ultrastructures (TEM microscopy), statistical analysis by bioinformatics tools, preparation of scientific publications and results presentations at scientific conferences.

Additional information (e.g., special requirements from the candidate):

The candidate should have a master's degree (or equivalent) in biology, microbiology or bioinformatics, experience working in a molecular laboratory, knowledge of the R program or other software for phylogenetic analyzes and ecological modeling (or be determined to learn them), speak and write in English fluently (better if documented by a scientific publication), travel availability, be self-motivated and independent, organized and able to multitask effectively, and willingness to learn new skills.

Place/name of potential collaborators:

dr. Pamela Rodriguez de Flakus, W. Szafer Institute of Botany, Polish Academy of Sciences.

References:

- Adam Flakus, Javier Etayo, Jolanta Miadlikowska, François Lutzoni, Martin Kukwa, Natalia Matura & Pamela Rodriguez-Flakus. 2019. Biodiversity assessment of ascomycetes inhabiting *Lobariella* lichens in Andean cloud forests led to one new family, three new genera and 13 new species of lichenicolous fungi. *Plant and Fungal Systematics* 64(2): 283-344.
- Asunción de los Ríos & Martin Grube. 2000. Host-parasite interfaces of some lichenicolous fungi in the Dacampiaceae (Dothideales, Ascomycota). *Molecular Research* 104(11): 1348-1353.
- Martin Grube, Joseph Seckbach & Lucia Muggia. 2017. *Algal and Cyanobacteria Symbioses*. World Scientific Publishing Europe, London.