Description of research topic

Institute: W. Szafer Institute of Botany of the Polish Academy of Sciences (IB PAS).

Title: The origin and evolution of fungal symbioses in freshwater mountain ecosystems and their resilience to climate change.

Research carried out as part of the OPUS 22 project financed by the National Science Center No. NCN 2021/43/B/NZ8/02902, led by Dr. P. Rodriguez de Flakus, conducted at the W. Szafer Institute of Botany of the Polish Academy of Sciences.

Scientific discipline: Biological sciences

Name of potential supervisor: Dr. hab. Adam Flakus (IB PAS); a.flakus@botany.pl

Background information: The ability of organisms to develop symbiotic relationships is an important driver of the evolution of the major part of the biodiversity known today. A good example of symbiosis is lichens, mutualistic interactions of fungi with algae or cyanobacteria, which enabled the colonization of a variety of aquatic and terrestrial habitats, hardly available to other organisms. The proposed position for a doctorate student will emphasize the study of evolutionary processes on freshwater fungal symbioses divergence from their common terrestrial ancestors and the potential acquisition of ancestral adaptations strategies at a genomic level, that enable their development in the freshwater environments that led to the expansion of this highly specialized group to the streams worldwide. It also will attempt to determine the potential impact of climate change on their communities.

The doctoral scholarship is funded within the framework of the scientific scholarship in the project No. NCN 2021/43/B/NZ8/02902.

The main question to be addressed in the project: This project focuses on high-altitude freshwater lichens, a widely distributed and strongly specialized ecological group of lichen-forming fungi, considered to be the iconic model of mutualistic symbiosis. It aims to 1) resolve the origins of high-altitude freshwater lichen-forming fungi within the Leotiomyceta and provide insights into their evolutionary adaptations to aquatic habitats; 2) identify the abiotic and biotic factors shaping the composition of lichen symbioses in the glacier forelands and determine the potential impact of

climate change on their communities, and 3) reveal the underlying historical mechanisms driving current wide-ranging distribution patterns of aquatic lichens.

Information on the methods/description of work: The project activities consist of 1) field sampling and ecological data acquisition, 2) genomic DNA isolation from biological material including culturing of bionts, 3) molecular laboratory procedures including Sanger sequencing, amplicon-based and whole-genome shotgun sequencing, 4) statistical and bioinformatic data processing and analyses, 5) dissemination of results, through publication in high IF journals, international conferences, and outreach. The sampling will be completed in South and North America, and Europe. DNA will be isolated from freshly collected material. The data will be analyzed at intraspecific and interspecific levels to interpret the evolutionary processes at different scales.

Additional information (e.g., special requirements from the candidate): 1. Master's degree (or equivalent) in bioinformatics, biology, biotechnology, genetics or related fields; 2. Knowledge of standard statistical and bioinformatic approaches used in evolutionary biology or similar fields; 3. Interest in learning molecular or microbiological laboratory, how to analyze and interpret genetic data; 4. A strong interest in systematics, molecular evolution or biogeography/ecology of microorganisms (algae, cyanobacteria, fungi or lichens); 5. Proficient in spoken and written English; 6. Availability, and readiness for business trips; 7. Strong motivation for scientific work, the ability to multitask, and enthusiasm to acquire new skills, ability to work independently and as part of a team.

Place/name of potential collaborator: Dr. Pamela Rodriguez de Flakus (IB PAS).

References:

1. Hawksworth DL. 2000. Freshwater and marine lichen-forming fungi. Fungal Divers. 5: 1–7.
2. Leavitt S.D. & Lumbsch T. 2016. Ecological Biogeography of Lichen-Forming Fungi. In: Druzhinina IS & Kubicek CP (eds.) Environmental and Microbial Relationships Volume IV of the series The Mycota, Edition. Springer International Publishing, pp.15–37.
3. Hoopen P., Finn R. D., Bongo L., Corre E., Fosso B., Meyer F., Mitchell A., Pelletier E., Pesole G., Santamaria M., Willassen N., Cochrane G. The metagenomic data life-cycle: standards and best practices, GigaScience, Volume 6, Issue 8, August 2017, gix047, https://doi.org/10.1093/gigascience/gix047