

Institute: Institute of Environmental Sciences

Topic: The ecological dynamics of microbiota in Arctic insect communities

Name of supervisor: dr hab. Piotr Łukasik

p.lukasik@uj.edu.pl

Background information:

Insects frequently associate with microorganisms, forming diverse associations that often play major roles in their biology. Through their various fitness effects, symbionts can plausibly influence insects' ability to respond and adapt to environmental challenges, an effect particularly relevant during the times of the accelerating global change. However, our understanding of the microbiome diversity, distribution, transmission patterns and functions across wild insect communities remains very limited. The goal of the proposed project is a comprehensive survey of microbial symbioses across large numbers of diverse insects, and reconstruction of patterns and functions at the level of communities. The investigation will focus on insect communities from Greenland, a relatively species-poor area where we can plausibly sample much of the diversity, and from where historical collections are available. The use of innovative high-throughput sequencing-based approaches, custom bioinformatics solutions, and advanced statistical models will allow us to understand the microbiome composition and transmission across the taxonomic diversity of insects, and to describe the seasonal changes, geographic variation, and the effects of environmental factors on their microbiomes.

The main question to be addressed in the project:

The Ph.D. Student will address a series of questions about distribution and transmission patterns and processes in Arctic insect communities.

Information on the methods/description of work:

The student will initially focus on developing and analysing large-scale marker gene amplicon datasets for diverse Greenland insects, while developing and consolidating their bioinformatics and scientific writing skills. Later, depending on interests, they may participate in field collections, laboratory work, analysis of marker gene datasets, phylogenomics and comparative genomics characterization of broadly distributed microbial clades, or the development and implementation of statistical models. The student will be encouraged to work closely with other team members and Polish and international project collaborators.

Additional information (e.g Special requirements from the student):

The successful candidate will have an M.Sc. degree in a relevant field by July 2023; a demonstrated interest in Evolution, Entomology, Microbiology, and/or Genomics; experience with, or a keen interest in learning, Bioinformatics and Computational Biology; and strong English language, communication, and organizational skills. Previous experience with insect ecology, evolution and especially symbioses, molecular biology, microbiome surveys, phylogenomics and/or comparative genomics, and modelling skills, as well as the willingness to travel, are advantageous.

The Ph.D. student will be involved in a Polish National Science Centre project Opus 22: "Micro-allies during mega-crisis? The role of the microbiome in insect community responses to climate change", no. 2021/43/B/NZ8/03376, and encouraged to apply for a studentship in that project. For more information regarding the project and the research group please check www.symbio.eko.uj.edu.pl

Place/name of potential foreign collaborator:

Tomas Roslin, Swedish Agricultural University
Brandon Cooper, University of Montana, U.S.A.

References:

[1] McFall-Ngai, M. et al. (2013): Animals in a bacterial world, a new imperative for the life sciences. *Proceedings of the National Academy of Sciences of the U.S.A.* 110:3229-3236.

doi:10.1073/pnas.121852511

[2] Perreau, J. & Moran, N. A. (2021): Genetic innovations in animal–microbe symbioses. *Nat. Rev. Genet.* 23:23–39, doi:10.1038/s41576-021-00395-z

[3] Sudakaran S., Kost C., Kaltenpoth M. (2017): Symbiont acquisition and replacement as a source of ecological innovation. *Trends in Microbiology* 25:375-390, doi:10.1016/j.tim.2017.02.014