Institute of Environmental Sciences

Topic: The diversity and evolution of the microbial symbioses of sap-feeding insects

Name of supervisor: dr hab. Piotr Łukasik
                          p.lukasik@uj.edu.pl

Background information (max 200 words):
Microbial symbionts can play critically important roles in the biology of insects. Among the most specialized and biologically significant symbionts are those that provide essential nutrients to insects that feed on imbalanced diets such as plant sap. All sap-feeding species of cicadas, spittlebugs, leafhoppers, treehoppers, and planthoppers (collectively known as Auchenorrhyncha) host such specialized nutrient-producing bacteria and/or fungi. Most of these symbionts have transmitted from mothers to offspring for a very long time – up to 300 million years. But in many auchenorrhynchan lineages, the more ancient symbionts have become replaced or complemented by other microorganisms. We aim to comprehensively describe how often such replacements happen, where the replacing microbes come from, what they do, how they evolve, and how they affect the ecology and evolution of insect hosts. To achieve this, we conduct broad microbiome surveys, host and symbiont genome sequencing and analysis, and advanced microscopy, using large collections of Auchenorrhyncha from around the world.

The main question to be addressed in the project:
The Ph.D. Student will reconstruct the symbiont co-diversification and replacement patterns across the taxonomic diversity of Auchenorrhyncha.

Information on the methods/description of work:
The student will primarily work on the bioinformatic analyses of next-generation sequencing data (marker gene amplicons, metagenomes) for diverse auchenorrhynchan insects and their microbial symbionts. The student will also be encouraged to participate in the collection and characterization of insects in Poland and abroad, and molecular work (automated DNA extraction, next-generation sequencing library preparation). Depending on interests and skills, they may use advanced microscopy, conduct archival work (a reinterpretation of existing microscopy data) and experiment with live insects. They will work closely with other team members, and be encouraged to collaborate with external project participants.

Additional information (e.g Special requirements from the student):
The successful candidate will have an M.Sc. or similar degree in a relevant field by September 2020. They will have 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 research experience in insect ecology, evolution and especially symbioses, hemipteran taxonomy, molecular biology, microbiomes, phylogenomics and/or comparative genomics are an advantage.

In addition to the doctoral scholarship, the student may be supported by a 48-month research stipend from the National Science Centre Sonata Bis research grant, starting at 3000 PLN per month, which will be awarded in a separate competition.

For more information about the project and the Symbiosis Evolution Research Group check https://symbio.eko.uj.edu.pl

Place/name of potential foreign collaborator:

Gordon Bennett, University of California - Merced

Brian Fisher, Madagascar Biodiversity Centre

References:

McCutcheon J.P., Boyd B.M., Dale C (2019): The life of an insect endosymbiont from the cradle to the grave. Current Biology 29(11): R485-R495.
https://www.sciencedirect.com/science/article/abs/pii/S0960982219303306

Bennett G.M., Moran, N.A. (2015): Heritable symbiosis: The advantages and perils of an evolutionary rabbit hole. PNAS 112(33):10169-10176.
https://www.pnas.org/content/112/33/10169

Łukasik P., Nazario K., Van Leuven J.T., et al. (2018): Multiple origins of interdependent endosymbiotic complexes in a genus of cicadas. PNAS 115(2):E226-E235.
https://www.pnas.org/content/115/2/E226