Institute of Environmental Sciences

**Topic:** The diversity and evolution of the microbial symbioses of Auchenorrhyncha

**Name of supervisor:** Dr. Piotr Łukasik (Prof. Wiesław Babik)
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**Background information (max 200 words):**
Among the most specialized and biologically significant symbiotic microorganisms are heritable endosymbionts that provide essential nutrients to insects that feed on imbalanced diets such as plant sap. The goal of the National Science Centre (NCN) Sonata Bis project "The evolutionary dynamics of the symbioses of Auchenorrhyncha" is to comprehensively describe the evolutionary processes and patterns related to nutritional symbioses in a clade of sap-feeding hemipteran insects that includes cicadas, spittlebugs, leafhoppers, treehoppers, and planthoppers. All of them host specialized bacteria and/or fungi that have been transmitted from mothers to offspring for a very long time – up to 300 million years. But in many Auchenorrhyncha lineages, these ancient symbionts have become replaced or complemented by other microorganisms. We will describe the incidence and nature of these symbiont replacements, the origins of the replacing microbes, their genomic evolutionary patterns, their current biological roles, and the effects of the replacements on the ecology and evolution of hosts. We will achieve this through microbiome screens and reconstructions of the symbiont replacement patterns across auchenorrhynchan diversity, followed by phylogenomic, comparative genomic, and microscopy-based analyses of symbionts in clades that have experienced the replacements.

**The main question to be addressed in the project:**
The Ph.D. Student will reconstruct the endosymbiont co-diversification and replacement patterns across the global taxonomic diversity of Auchenorrhyncha through microbiome surveys and phylogenomic analyses of the host-symbiont relationships.

**Information on the methods/description of work:**
The student will primarily focus on the bioinformatic analyses of next-generation sequencing data (amplicons, metagenomes) for diverse auchenorrhynchan insects and their microbial symbionts. They will also be involved in preparing insect specimens (potentially, including fieldwork in Poland and abroad) and the molecular work on these specimens (automated DNA extraction, next-generation sequencing library preparation). Depending on interests and skills, they may use microscopy and conduct archival work (reinterpretation of existing microscopy data), as well as conduct comparative genomics analyses of selected symbionts. They will work closely with other team members, and be encouraged to collaborate with external project participants, including Dr. Gordon Bennett (University of California - Merced), Dr. Anna Michalik (Jagiellonian University), and Insect Biome Atlas consortium members in Sweden.

**Additional information (e.g Special requirements from the student):**
The student will be supported by a research stipend (48 months), starting at not less than 3000 PLN per month and increasing up to 4500 PLN per month during subsequent years. This stipend may be combined with the Ph.D. program scholarship. Because the stipend recipient will be selected in a separate competition, the applicants interested in this project are asked to contact Dr. Piotr Lukasik (p.lukasik@gmail.com) directly, as soon as possible.
The successful candidate will have 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, as well as willingness to travel are advantageous.
For more information on the project and the research group please check [www.symbioses.pl](http://www.symbioses.pl).

**Place/name of potential foreign collaborator:**
Fredrik Ronquist, Swedish Museum of Natural History Gordon Bennett, University of California - Merced

**References:**
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., Campbell M.A., Meyer M., Michalik A., Pessacq P., Simon C., Veloso C., McCutcheon J.P. (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>