**Institute** of Environmental Sciences**:**

**Topic :** Polyphenism in insects: effect of environmental condition during larval period on development different life strategies in adult individuals

**Name of supervisor:** dr hab. Marcin Czarnołęski, prof. UJ

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**Background information (max 200 words):**

In most organisms a genotype can produce many different phenotypes. The exact phenotype that is expressed depends on the environment in which the organism develops or lived during a certain period of their life. Of particular interest is how one genotype is able to produce two or more distinct phenotypes. This phenomenon, referred to as polyphenism, is widespread among many organisms [1]. Polyphenism is the major reason for the success of insects, as it allows them to partition life history stages from the larva and pupa to the adult stage and to adopt different phenotypes during seasonal environmental conditions or upon unpredictable environmental changes, e.g., degradation due to overcrowding. The most familiar and spectacular examples of polyphenism are provided by eusocial insects [2]. The reproductive and non-reproductive castes, i.e., the queens and workers, typically exhibit divergent morphologies as well as behaviour and physiology. Moreover, in eusocial insect, there is also polyphenism between the workers, which can differ between themselves in the anatomy, behavior and physiology[3]. This project will include research on evolution of polyphenism in the honeybee, an insect whose biology we know very well and who is a model species in many studies.

**The main question to be addressed in the project:**

The main question is how the environmental conditions (e.g. temperature, presence of the queen, availability of food) impact on life strategy in adult honeybee workers (including anatomy, behavior and physiology) - a model species in many studies during larval period on both the biology of social insects and pollinators, including evolution of kin selection and polyphenism.

**Information on the methods/description of work:**

The project will determine how the environmental condition impact on life strategy in adult honeybee workers. For this reason, the PhD student will have to work in both apiary as well as laboratory. The first phase of experiments (all experiments) will cover the preparation of honeybee colonies for the experiment, raising the workers in differ condition (different temperature, presence of queen, or different availability of food) and conducting behavioural research on these workers. The research will be done in the experimental apiary of the Institute of Environmental Sciences (Jagiellonian University, Cracow, southern Poland). The next phases of the project will be related to laboratory work. The collected and frozen workers will be dissected and anatomical parameters will be estimated (e.g. number ovariole, size of selected glands). The laboratory part will also include biochemical analyses of some important hormones and measurement of metabolism rate. The last phase of each experiment will contain creating a database, performing statistical analyses and writing the manuscripts.

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

In experiments will be using honeybees and for this reason I expect that the PhD candidate will not be afraid to work with these animals. Earlier experience working with bees, would be most welcome. Additionally, the successful PhD candidate should have research experience in evolutionary biology and behavior of insect, should be interest in working on social insects and will have very good oral and written communication skills in English.

**Place/name of potential foreign collaborator:**

Direct foreign collaboration is not planned at this stage, but it is possible.

**References:**

* West-Eberhard M. 2003 *Developmental plasticity and evolution*. New York: Oxford University press.
* Wilson E. 1971 *The Insect Societies*. Cambridge, MA: Belknap Press.
* Hodin J. 2009 She shapes events as they come: plasticity in female insect reproduction. In *Phenotypic plasticity of insects: mechanisms and consequences* (eds D Whitman, T Ananthakrishnan), pp. 65–80. Enfield: Science Publishers.