„Thermogenesis, feeding matrix and parental care in carrion beetle *Necrodes littoralis* L. (Silphidae): spatio-temporal patterns, determinants, mechanisms and fitness effects of heat production in the matrix”

Animals, particularly insects, frequently benefit from the heat that is present in the environment. Less frequently, however, they transform the environment to enhance, focus or use thermogenesis. **This project focuses on thermogenesis in the feeding matrix formed on carrion by *Necrodes littoralis* L. beetles** (Silphidae). The feeding matrix on carrion is a complex microenvironment that is formed at the interface between the beetles and carrion tissues. It has been hypothesized that the matrix facilitates digestion, suppresses meat decay, masks carrion from other carrion insects or hosts beneficial microbes. The recent study of *Necrodes* beetles revealed that the matrix also produces heat. With this project, we will investigate **spatio-temporal patterns of thermogenesis** in the matrix, **its determinants and mechanisms** as well as the **influence of the matrix and its heat on the fitness of the beetles**.

Seven experiments are planned with thermal imaging of the matrix, analyses of fitness and behavior of the beetles, investigations of the microbiome, enzymes and by-products of meat decay in the matrix. The **first experiment** will compare heat production and beetle fitness between larval colonies of various abundance, reared on fresh and decomposed meat, in cold and optimal temperature conditions. We hypothesize that number of larvae is a key determinant of thermogenesis and that larval aggregation has large positive effects on larval fitness mostly at suboptimal conditions. In the **second experiment** we will compare heat production and beetle development between colonies reared on various quantities of meat. By manipulating the amount of food we will create conditions of a normal, low and high density of larvae and thus normal, low and high competition of larvae for food. This design will enable to test the hypothesis that competition of larvae for food is a general ecological mechanism for thermogenesis in the matrix formed by the larvae. The **third experiment** is aimed at identification of specific mechanisms of thermogenesis in the matrix. In this respect we will test the hypotheses that thermogenesis in the matrix formed by the adult or larval beetles results from microbial activity and in the case of the matrix formed by larval beetles it is enhanced through exothermal and external digestion of meat by the larvae. In parallel, this experiment will test the hypothesis that *N. littoralis* reveals indirect parental care with thermal component. We assume that presence of adult beetles on meat in the pre-larval phase improves the fitness of larvae by suppressing meat decay, promoting thermogenesis and seeding beneficial microbes. The **fourth and fifth experiments** will test how the air humidity and kind of meat affect the heat production in the matrix. The **sixth experiment** will compare thermogenesis and beetle fitness across colonies reared on meat with natural and reduced amounts of the matrix. By testing larvae under conditions of reduced matrix we want to support the hypotheses that the matrix is directly responsible for thermogenesis, and that its removal lowers fitness of larvae. The **seventh experiment** will test the hypothesis that enrichment of the adult beetle diet with blow fly larvae has positive effects on thermogenesis in the matrix and fitness of larvae that feed in such matrix.

The project will lead to a comprehensive understanding of a novel form of insect-driven thermogenesis in an important microhabitat. By providing a new perspective on the way insects produce heat, it will have an impact on **thermal ecology** and specifically the area of **thermoregulation strategies of insects**. Because the microbiome of the matrix and its enzymatic fractions will be analyzed, the project will also reveal important and stimulating links between insects, microorganisms and thermogenesis on carrion. Apart from thermal ecology, the project will result in important discoveries in **carrion ecology** and **forensic entomology**.