Can parasite evolution reinforce the effects of climate warming?

Objectives of the project

The predicted global warming will cause unprecedented changes impacting humanity and whole Earth. Future climate changes will not only have direct adverse effects on ecosystem functioning but may also influence biological interactions such as those between a host and a parasite. In consequence global warming may increase the risk of parasite infections. It is commonly believed that global warming will result in a "sicker world", with infectious diseases increasing in prevalence and virulence. However, these predictions are based on short-term experiments that have not recognized evolution that could lead to thermal adaptation, despite the fact that microparasites are predisposed to evolve rapidly. This project aims at filling these gaps in our knowledge by testing whether **parasites' prevalence and virulence is altered under elevated temperatures and if previous long-term exposure to warming amplifies this effect. Moreover, it will be tested whether long-term exposure to warming is reflected in genetic changes, prevalence and overall parasite taxonomic and genetic diversity in natural systems.**

Research to be carried out

A planktonic crustacean Daphnia and a parasite *Caullerya mesnili* were chosen as a host-parasite model system. Daphnia are an essential link between producers and higher levels of the trophic pyramid. A gut parasite Ichthyosporean *Caullerya* will be used as a parasite model.

This project will employ a unique **combination of experimental and natural evolution**, allowing exploring different levels of controllability and biological relevance. The parasite evolution towards warming will be studied under natural conditions using a system of ten lakes. Five of these are warmed, five are not. This unique set of replicated warm and control lakes provides an outstanding "natural experiment" for testing parasite evolutionary adaptations to elevated temperatures. All these lakes are located near Konin, Poland. The lakes with elevated temperatures have been artificially heated for ca. 60 years, since their inclusion in a cooling system of power plants. Additionally, thermal adaptations will be induced using experimental evolution. The *Caullerya* isolates from the control lake will undergo 1-yr evolution in the laboratory (under elevated vs. under control temperatures). Evolutionary adaptations to elevated temperatures will be quantified at the trait- and genome-level.

Reasons for choosing the research topic

The project will provide broad insights into the role of parasite adaptation in climate-driven disease emergence. Understanding the extent to which parasites adapt is important for predicting disease spread in a warmer world. This proposal gives the chance for the first integration of parasites and their evolutionary adaptations into research on global warming in aquatic ecosystems. It also focuses on infections of ecologically relevant host – *Daphnia.* Infection of this most abundant lake zooplankton group can affect entire ecosystems via cascading effects. The project allows taking a unique possibility to observe which similarities and differences emerge between parasite evolution in the lab and in nature. The warm lakes offer globally unique opportunity for observing adaptations to warmer world. Our understanding of rapid evolutionary adaptations of host-parasite systems to global warming is crucial for a proper evaluation of long-term trends and forecasting ecosystem functions and services under present and future warming.