One of the most interesting phenomena in evolutionary ecology, the domain focusing on how evolution shapes the relationships between living organisms and the environment, is temperature-size rule (TSR). It concerns the ectotherms – organisms which are not able to maintain a constant body temperature and instead are forced to adjust their physiology to environmental conditions in order to minimize the negative results of changing temperature to life processes. According to temperature-size rule, organisms experiencing higher temperature grow faster, for a shorter time and achieve smaller size than their counterparts from lower temperature. This rule was coined the biggest life-history puzzle, because it contradicts the theoretical evolutionary models at first sight.

A hypothesis, which has been proposed recently may finally solve this mystery – TSR is a response to oxygen conditions, which change with temperature changes. While the oxygen availability decreases with increasing temperature, the oxygen demands of an organism increase, especially in water conditions. Therefore, through manipulation of cells size toward being smaller, cells provide faster oxygen transport and this way they meet the oxygen demands more efficiently. The by-product of this process is a decrease in body size.

The aim of this project is to test the role of oxygen in mediating TSR on three levels: genetic, phenotypic and ecological. In the first stage, the small aquatic ectotherms, rotifers, will be exposed to experimental evolution under conditions of low oxygen availability, in order to select for smaller body size. In the next stage, the selected lines will be examined for the TSR, namely, whether their body size still responds to temperature changes. In the final stage, the ecological meaning to the tested hypothesis will be given. To achieve that, the sediment samples will be taken from small ponds to collect the deposited rotifer eggs from so-called “egg banks”. The hatched rotifers will be measured and their body size will be related to thermal and oxygen conditions of particular ponds. Using these three approaches, the hypothesis on the selection toward small size in response to environmental low oxygen conditions will be tested.

Solving the mystery of temperature-size rule will enable to better understand the mechanisms responsible for evolutionary processes. Moreover, the project results will considerably contribute to the issue of organismal response to global warming. If the results show that oxygen is the factor determining body size of ectotherms, while temperature is just a cue for body-size changes, oxygen conditions along with temperature should be included in any model considering the global consequences of climatic changes. So far, only temperature is taken into account.