The ecological niche is the range of environmental conditions and resources in which an organism can thrive. However, the environment is never constant, particularly in the face of ongoing anthropogenic global change. To survive, all living creatures must respond to these changes and adapt by adjusting their ecological tolerance. Consequently, their niche breadth is never constant, but constantly evolving. It is expected that environmental stability or environmental fluctuations lead to different adaptive responses, producing either ecological specialists or generalists. However, empirical investigations still provide contrasting evidence. Although the process of niche breadth evolution is of long-standing interest to biologists, explaining the mechanisms involved and its consequences for species persistence is still one of the major challenges in evolutionary ecology and many questions yet remain unanswered.

The general aim of this project is to explain the mechanisms underlying the evolution of niche breadth. More specifically, we intend to:

1. assess whether the evolution of niche breadth in biotic dimensions is intertwined with its evolution in abiotic dimensions;
2. assess how constant versus fluctuating environmental conditions shape niche breadth;
3. track genomic changes during adaptation to constant and fluctuating abiotic conditions.

According to the widely accepted Hutchinsonian niche concept, the niche is a multidimensional ecological space that allows a population to persist. We will investigate the evolutionary interplay between two niche dimensions: (a) biotic – host plant species; (b) abiotic – temperature. We have chosen as a study system an obligate plant parasite *Aceria tosichella* (wheat curl mite), as this mite is one of the most important pests transmitting viruses of cereals worldwide. The successful spread of this mite to cereal-producing regions all over the world has been challenging researchers and cereal growers for many decades. However, efforts to understand the mechanisms responsible for increasing the environmental tolerance of mites, their niche breadth evolution, and consequently recent invasions, have not yet been undertaken.

Phytophagous arthropods are useful for studying resource specialization, as their biotic environment is composed of discrete units (host plant species). Therefore, their biotic niche breadth can be quantified as the number of plant species they explore. Both host plants and temperature are key elements defining their environment and determining their survival, development and reproduction, so it is justified to treat these niche axes as representing a vast majority of the whole niche space.

The study will be conducted on experimentally evolved populations that are adapted to either constant or fluctuating biotic conditions. They have been obtained through a rigorous, long-term, and replicated experimental evolution to either a single plant species or two alternating plant species. These populations will be used for experimental testing of their fitness in abiotic conditions and will serve as ancestral (stock) populations that will be subjected to real-time experimental evolution in different thermal regimes: constant, fluctuating predictably and fluctuating unpredictably. Subsequently, their abiotic and biotic niche breadth will be measured directly by assessing their fitness in different temperature regimes and on different host plant species. During experimental evolution in different thermal regimes, the genetic changes that may reflect adaptation to different environments will be tracked by novel and timely techniques based on sequencing whole genome sequencing.

By applying this comprehensive experimental approach we will provide important knowledge on the mechanisms that may (i) boost the ability of phytophagous mites to increase environmental tolerance across different niche dimensions and therefore to increase species ranges, and (ii) facilitate rapid adaptation to fluctuating environmental conditions, and therefore might increase the species invasiveness. As the ongoing climate change is primarily manifested by an increased environmental variance, this outcome may be of crucial scientific importance. Climate fluctuations may impact niche breadth of many plant-feeding arthropods and thus seriously affect their (both host and geographic) ranges. Understanding these mechanisms is necessary to explain successful colonization, niche and expansions, and invasiveness, especially as global change scenarios predict increased fluctuations of environmental conditions.