Brittny Calsbeek and Edmund Hart Receive NSF Fellowships

Brittny Calsbeek

My research deals with a major theoretical challenge in determining how selection acting within populations translates into the patterns of evolution seen at a larger scale. Specifically, we lack a general understanding of how interactions among genes change as a result of processes such as natural selection and mutation. Developing the necessary theory and statistical tools to determine how these interactions shape evolution is crucial for predicting a population's capacity to adapt to climate change, and the ability of exotic species to invade new environments. This study develops a new statistical method (the "selection skewers" analysis) that identifies changes in the relationships among genetic components of traits that would significantly alter the predicted evolution of a population. The performance of this new statistical method will be compared to previous methods. In addition, using laboratory populations of red flour beetles (Tribolium castaneum) the method will be used to empirically determine when interactions among genes are stable over time, and thus when we can accurately predict evolutionary change due to selection.

Global Climate Change

Edmund Hart

Understanding the impacts of global climate change remains one of biggest challenges ecologists face. In order to avoid local extinction, species can persist through three main strategies: 1) range shifts 2) phenotypic plasticity and 3) genetic change resulting from microevolution. Range and latitudinal shifts have been well documented. Studies have also demonstrated phenotypic changes in life history and morphological characters, but few have teased apart the difference between phenotypic plasticity and genetically base microevolution.

In order to parse out how much of an organisms response to climate change is plastic and how much is genetically based, we will study the model zooplankton Daphnia pulex. We will collect Daphnia from an existing manipulative field experiment designed to simulate climate change in vernal ponds. Vernal ponds and Daphnia are a model system to study microevolutionary responses in because vernal ponds are easy to replicate and manipulate, and Daphnia are rapidly reproducing and will have undergone many generations of selection when we begin this experiment. Because Daphnia are cyclically parthenogenic, we can use the well established quantitative genetic methods developed for clonal organisms to estimate genetic and environmental variance, heritability, and selection gradients.

We will raise Daphnia in a common garden style experiment in order to answer the following questions. (1) Is the response of Daphnia pulex to climate change manipulations plastic or a genetically based microevolutionary change? (2) What is the direction and strength of selection in Daphnia pulex in relation to climate change, and what evolutionary constraints are present?