10. Rapid Evolutionary Adaptation: Potential and Constraints

**Organizers:**Carolin Wendling, Jürgen Gadau

The vast diversity of life on earth is the result of evolutionary processes that have been acting for billions of years. Consequently, it is often assumed that evolution requires long periods of time. Evolutionary adaptation to new environments as driven by natural selection can, however, occur very rapidly within tens of generations. This raises two questions:(1) What are the mechanisms of rapid adaptation? Is rapid adaptation predominately dependent on the selective fixation of new mutations or changes in allele frequencies of standing genetic variation? (2) Which additional factors enhance or constrain rapid adaptation? Is the speed of adaptation influenced by phenotypic plasticity, demographic changes, genetic and genomic architecture, or environmental heterogeneity? This symposium addresses these questions by combining new developments in evolutionary theory with empirical investigations of rapidly adapting and experimentally tractable systems of animals, plants, and microorganisms. We will bring together researchers with a strong background in population genetics, ecological theory or evolutionary biology investigating the relationship of phenotypic and genetic adaptation. By combining theoretical analyses with empirical studies, we take advantage of the current genome sequencing technology and will foster discussions beyond the descriptive analysis of genomic variation towards a detailed understanding of the underlying evolutionary processes.

* 3. Exploring the role of nongenetic inheritance in evolution

**Organizers:**Pim Edelaar, Russell Bonduriansky, Troy Day

Most biologists now agree that nongenetic inheritance occurs, and much current research focuses on identifying novel examples and exploring the proximate mechanisms enabling it. However, it is not yet clear whether it is an important factor in evolution, and this question has been the subject of considerable controversy. Moreover, while recent theoretical work shows how nongenetic inheritance could play a role in evolution, compelling empirical examples are still lacking, at least outside the context of human gene-culture coevolution. These considerations make nongenetic inheritance a relevant and timely symposium topic.

With this symposium we aim to provide a podium for theoretical and empirical developments in this area, and attempt to make concrete progress by showcasing and discussing:

* the diversity of mechanisms mediating nongenetic inheritance,
* explicit data/experiments that bear on the question of how nongenetic inheritance can influence the dynamics and outcomes of adaptive evolution,
* the interaction between genetically and nongenetically inherited traits,
* the issue of time-scale (stability) of nongenetically inherited traits.

We hope that presenters also discuss the research they think still needs to be done to understand the role of nongenetic inheritance in evolution.

**Plasticity in evolutionary potential under environmental variation in a population of pied flycatchers, *Ficedula hypoleuca***

***Justine Le Vaillant, Carlos Camacho, David Canal, Jaime Potti and Jesús Martinez-Padilla***

One major objective in evolutionary biology is to understand how the interplay between natural selection and genetic variation results in local adaptation. However, genetic changes in life-history traits produced after the consistent action of agents of selection are not widespread, particularly in breeding timing in birds. An alternative mechanism that allows local adaptation without genetic change is phenotypic plasticity. From an evolutionary perspective, phenotypic plasticity can be an evolutionary mechanism if there is additive genetic variation underlying trait plasticity. Here, we explored the role of microevolution and phenotypic plasticity as mechanisms of adaptive evolution in response to multiple climatic factors. We took advantage of “animal models” to explore the genetic basis of phenotypic plasticity and microevolution of laying date using a long-term study (1987-2016) of pied flycatchers (*Ficedula hypoleuca*) monitored at the individual level. Our results show: 1) a lack of temporal trend, due to large yearly variation in all climatic variables considered; 2) an increase in population density; 3) a lack of temporal trend in the genetic basis (breeding value) of breeding date; 4) statistical support for a genotype-by-environment interaction when considering the two most important climatic factors explaining selection on breeding date in the population: variation in spring temperature and mean North Atlantic Oscillation in winter. Given the presence of a genotype-by-environment interaction and the observed increase in population density, our results suggest that evolution may favor more plastic genotypes able to adapt to stochastic environments.