Universität Basel

Research Project

The genomic basis of divergence and convergence in fish species-flocks

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Project title The genomic basis of divergence and convergence in fish species-flocks
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Organisation / Research unit
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Convergent evolution — *i.e.*, the recurrent evolution of similar morphological types on different branches in the tree of life — is a pervasive phenomenon, urging generations of evolutionary biologists since Darwin to address the question, *Why and how evolution repeats itself?* Here, I propose to investigate the molecular and ecological underpinnings of the recurrent evolution of convergent species pairs of cichlid fish in the East African Great Lakes Malawi and Tanganyika, representing some of the most iconic and striking examples of this phenomenon. The observation that the convergent cichlid species pairs in sister-lakes Malawi and Tanganyika resemble each other not only in overall body shape, but in minute details of their phenotype as well as in coloration, is in the center of the debate on whether natural selection is sufficient to explain such a degree of convergence, or whether some sort of developmental or genetic constraint is influencing the way that phenotypes are generated in nature. In a first step, we will make use of hundreds of already available whole-genome DNA sequences, conduct additional DNA and transcriptome sequencing from population samples of convergent species, and use cutting-edge computational tools to establish the molecular foundation of convergent evolution in East African cichlids. This will be accompanied by an in-depth morphological and ecological examination of the convergent forms. In addition, I plan to extend the examination of the causal factors of convergent evolution towards both ends of the phylogenetic spectrum. Specifically, I propose to also study convergence *within* the cichlid species-flocks of lakes Malawi and Tanganyika including species that repeatedly diverged along a lake-stream environmental gradient, as well as convergence *between* African lake cichlids and their eco-morphologically most comparable counterpart in the marine realm, a fish community inhabiting a coral reef. Thus, we will provide what is among the first integrative, well-powered, and genome-wide analysis of convergent evolution across both cichlids and related teleosts. Our experimental design will allow us to (*i*) evaluate the relative contribution of natural selection *versus* developmental constraints to convergent evolution; (*ii*) examine whether convergent (involving distantly related taxa) and parallel evolution (involving more closely related taxa) are fundamentally distinct processes; and (*iii*) assess whether or not there are common features in organismal diversification in fish species-flocks.

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