

## Research Project

### The role of sex determination in an adaptive radiation of cichlid fishes

#### Third-party funded project

**Project title** The role of sex determination in an adaptive radiation of cichlid fishes

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**Department**

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Establishing two sexes within the same species and hence from one genome, is a complex developmental process. It came therefore as a surprise that the mechanisms and genes driving this process show little conservation across taxa, sometimes being different even between sister species. In the animal kingdom, the diversity and turnover in primary sex-determining signals, including genetic and environmental factors, is particularly high in cold-blooded vertebrates, and here especially so in teleost fish. In addition, we and others could show that in teleosts also the subsequent genetic program establishing and maintaining the sexes experiences changes in gene sequence usage and expression, raising the question how these evolutionary changes in sexual development are driven and what is their cause in the largest vertebrate group.

Here, I propose to study the evolution of sex-determining systems and especially their genomic basis in a prime model system in evolutionary biology, the East African cichlid fishes. Hundreds of endemic cichlid species have evolved in Lakes Victoria, Malawi and Tanganyika, representing a unique basis for comparative studies at different time scales involving repeated patterns of diversification. My focus will be on the cichlid species flock of Lake Tanganyika, which is the ecologically, phenotypically and behaviourally most diverse cichlid assemblage.

The field of sex determination has seen some advances in the identification of new master regulator genes in fish not only including transcription factors but also other gene classes such as hormones or receptors. However, most studies either investigated single species or compared a very limited number of (closely) related species. My proposal will bridge this gap by investigating the genetic and genomic network of sexual development in the genomes of all cichlids from an entire adaptive radiation. Taxonomy and phylogeny are well established in Lake Tanganyika, an indispensable pre-requisite for this project. Moving away from laboratory model species that can only tell part of the story, I will use an integrative approach combining whole genome and transcriptome data to identify the sex-determining genes and their action reflected by their expression patterns, as well as the evolution of both, making use of a comparative approach of an unprecedented dimension.

For an even more detailed analysis, aiming to understand on a gene by gene basis how sex is determined and established, a second focus will be on a particular species, *Astatotilapia burtoni*, which belongs to the so-called haplochromine cichlids, the only lineage found in Lakes Malawi and Victoria.

I will investigate gene duplication, sex chromosome evolution and sex chromosome constitution. These data will be combined with sex-specific expression analysis and detection of genes under sex-specific selection regimes.

This project will combine recent technology, bioinformatics and molecular biology with an outstanding evolutionary model to answer the following questions i) how sex determination systems evolve in the first

place, ii) how and at which pace they change, and iii) how their turnovers impact sexual development in particular and fish evolution in general.

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