Universität Basel

Research Project

Pattern and process in evolutionary radiations of fossil and living actinopterygian fishes

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Project title Pattern and process in evolutionary radiations of fossil and living actinopterygian fishes
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Palaeontologists approach evolutionary questions primarily via the study of overall patterns of diversity changes at higher taxonomic levels and along a geological time axis. Biologists, on the other hand, concentrate largely on population and species-level approaches during much shorter time spans. Yet, if a comprehensive understanding of the processes governing the generation of biological diversity is to be achieved, then an integration of the two approaches is essential. This liaison is, unfortunately, diminished by e.g. biases of preservation in the fossil record, limited communication among disciplines, and the lack of case studies with appropriate phylogenetic and ecological frameworks. In this Sinergia proposal, these difficulties are overcome with the availability of a unique collection of palaeontological population samples (in a controlled stratigraphical and palaeoecological context and consisting of hundreds of fossil specimens resembling an extinct species flock) and the access to three extant evolutionary radiations. Subject of our surveys are ray-finned fishes. As members of the largest clade of living vertebrates, they represent an appropriate model to examine the origin of biodiversity. We propose to apply a diverse set of methods to quantify – in the fossil and the living models in parallel – the interplay between morphological differentiation and taxonomic diversification in an ecological context. The fossil group to be investigated is *Saurichthys*, a Triassic genus with three fundamental features: (*i*) a worldwide distribution at a critical geological time in view of global extinction and biodiversity recovery events, and (*ii*) a fine-scaled stratigraphical record of large populations preserving individual growth data in (*iii*) contemporaneous basins, in which palaeoecology can be assessed. Here, we propose to focus on populations from different strata and in different habitats of the UNESCO site of Monte San Giorgio in Tessin, and from the Ducan-Landwasser area near Davos, Switzerland. Hundreds of specimens will be mechanically prepared to expose anatomical structures to be utilized for morphometric and anatomical comparisons. The ecological context of the *Saurichthys* radiation will be evaluated based on the analysis of stomach contents, the fossil community and habitat reconstructions using oxygen isotopes. Also, a demographic analysis will be conducted using age estimates from the growth record preserved on the operculum. These data are the starting point for comparative analyses, using the same suite of methods, in three extant species flocks: the cichlid assemblage of Lake Tanganyika in East Africa, the notothenioids of the Antarctic waters, and the sticklebacks of the temperate zone. Cladistic analysis after a revision of morphological characters of *Saurichthys* across the world, and phylogenetic analyses with molecular data in the case of extant taxa, will provide the phylogenetic framework. Palaeoecology and stable isotope analyses will provide the ecological framework. Quantification of variation and morphospace will be conducted using similar methods in key character complexes, including opercular shape, and vertebral numbers. The study of growth trajectory data in fossils and in extant taxa will provide valuable information on the developmental mechanisms behind the diversification patterns. The integration of

approaches on exceptional materials should result in the establishment of new model cases to study evolutionary diversification events in the largest clade of vertebrate animals.

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