

Evolutionary patterns and processes in mollusks of temperate ancient lakes

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Ancient lakes have long been recognized as evolutionary theatres and hot spots of endemism and the evolution of their morphologically often highly diverse species flocks has received much attention. However, as each ancient lake has its own geological and evolutionary history, modes of speciation may differ from system to system. Ancient lakes can act as evolutionary reservoirs that assure the survival of relict species, but at the same time, extant species may evolve through intra-lacustrine speciation. Phylogenetic relationships of many ancient lake taxa are still unresolved. Also, the lack of robust morphological, anatomical, and phylogeographical data has largely prevented a rigorous testing of evolutionary hypotheses (particularly in invertebrate groups).

Three major lines of evolutionary researches have been recently followed in different temperate ancient lakes of which selected cases studies are presented.

Patterns of speciation have been tested in a presumed species flock of the gastropod genus *Valvata* of Lake Ohrid. The study revealed that the endemic *Valvata* spp. do not represent an ancient lake species flock but rather an ancient lake species scatter. Also, in contrast to many other gastropod groups in Lake Ohrid, no radiation occurred in Lake Ohrid valvatids and it is suggested that Lake Ohrid served as a reservoir for relictary valvatid species. This study outlines that previous interpretations of speciation patterns can be misleading in the absence of a robust phylogenetic framework.

Biogeographical origin and scales of endemism have been tested for a Lake Ohrid endemic bivalve species, *Dreissena stankovici*. This study showed that *D. stankovici* is not restricted to Lake Ohrid but is indeed the most widespread and dominant species in the west-central Balkans. This example demonstrates the need for an enhanced and spatially adequate sampling in any study related to ancient lake endemic species.

The invasion of exotic species into ancient lake environments is often cryptic and sometimes unrecognized or neglected. If not already the case, the impact of such species invasions will in future undoubtedly become one of the most severe threats to the vulnerable biodiversity of ancient lakes. The establishment of a globally invasive gastropod, *Physa acuta*, has been documented recently for the

Andean ancient Lake Titicaca. Its potential impact is discussed in the light of gastropod invasions in ancient lakes.

Lake Baikal mollusks are prime models to address a wide range of research questions in evolutionary biology. Freshwater limpets of the family Acroloxidae are a taxonomically small group involving complex evolutionary patterns with ancient lake radiations, relictary populations and widespread taxa. A spectacular radiation of Acroloxidae occurs in Lake Baikal. Phylogenetic origin in space and time, character evolution and modes of speciation as well as adaptive components of the radiation are discussed. The case study of Acroloxidae is used to outline the potential of Lake Baikal mollusks for advanced studies on organismal evolution in general and climate change as driving force in speciation in particular. Lake Baikal provides an ideal model lake to study those processes on a wide range of taxa and temporal and spatial scales using a comparative approach.