



Europe's Neogene and Quaternary lake gastropod diversity - a statistical approach

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During the Neogene Europe's geodynamic history gave rise to several long-lived lakes with conspicuous endemic radiations. However, such lacustrine systems are rare today as well as in the past compared to the enormous numbers of "normal" lakes. Most extant European lakes are mainly results of the Ice Ages and are due to their (geologically) temporary nature largely confined to the Pleistocene-Holocene. As glacial lakes are also geographically restricted to glacial regions (and their catchment areas) their preservation potential is fairly low. Also deposits of streams, springs, and groundwater, which today are inhabited by species-rich gastropod assemblages, are rarely preserved. Thus, the pre-Quaternary lacustrine record is biased towards long-lived systems, such as the Late Miocene Lake Pannon, the Early to Middle Miocene Dinaride Lake System, the Middle Miocene Lake Steinheim and several others. All these systems have been studied for more than 150 years concerning their mollusk inventories and the taxonomic literature is formidable. However, apart from few general overviews precise studies on the γ -diversities of the post-Oligocene European lake systems and the shifting biodiversity in European freshwater systems through space and time are entirely missing. Even for the modern faunas, literature on large-scale freshwater gastropod diversity in extant lakes is scarce and lacks a statistical approach.

Our preliminary data suggest fundamental differences between modern and pre-Pleistocene freshwater biogeography in central Europe. A rather homogenous central European Pleistocene and Holocene lake fauna is contrasted by considerable provincialism during the early Middle Miocene. Aside from the ancient Dessaretes lakes of the Balkan Peninsula, Holocene lake faunas are dominated by planorbids and lymnaeids in species numbers. This composition differs considerably from many Miocene and Pliocene lake faunas, which comprise pyrgulid-, hydrobiid-, viviparid-, melanopsid- and planorbid-dominated lakes. Nevertheless, several pre-Holocene lakes, such as the early Middle Miocene Lake Rein (Styrian Basin, Austria), several Middle Miocene lakes in Hungary and some Pliocene ones in France, are strikingly "modern" in their generic inventory and genus/species relations. This suggests that the modern composition is not necessarily a young pattern, explained only by the glacial bottleneck. Nevertheless, an overall turnover from melanopsid-pyrgulid-dominated faunas towards planorbid-viviparid-dominated lake faunas from Miocene to Pliocene seems to be reflected in the data on central Europe. This rule of thumb, however, is contradicted by melanopsid-dominated faunas on the Aegean islands during the Pliocene.

The FreshGEN project (Freshwater Gastropods of the European Neogene) is currently collecting data for providing the first detailed assessment of the composition of the European freshwater gastropod fauna during the Neogene and Quaternary at species level, with emphasis on lake faunas. This includes revealing shifts in the overall γ -biodiversity, changing evolutionary hotspots, faunal gradients, and the evolution of endemic radiations. The results will be discussed in terms of regional and global patterns and will be related to regional and large-scale climatic changes during the Neogene.