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Macroevolutionary dynamics within Neogene lacustrine ecosystems of Central and Southeastern Europe

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The Miocene mollusks from Central and Southeastern Europen lacustrine environments represent an outstanding example for endemic evolution. Therein two seemingly independent biogeographic flocks developed.

The older one flourished in the Miocene Dinaride Lake System (DLS) comprising geographically parts of Croatia, Bosnia and Herzegovina, and Serbia and Montenegro. It was formed during the late Oligocene and Miocene in today NW-SE trending intramountain basins parallel to the slowly rising Dinaride mountain chains. Therein the extensional tectonics activated enhanced subsidence of elongated depressions during the early to late Miocene. The comparatively low terrigenous input supported the diversification of lacustrine environments including deep water settings as well as shallow water habitats. This diversification of habitats was the kick-off for the spectacular radiation of the benthos fauna, an evolutionary impulse initiated more than 10 my prior to the much better known Lake Pannon radiation. The fauna of the DLS, thus, formed a biogeographic barrier between the Tethyan realm in the south and the Paratethyan assemblages in the north. Some mollusk genera, such as the decoiled elongated planorbid *Orygoceras* display their first appearance in the early Miocene of the Dinarid lakes and persisted into the late Miocene to show up again in the Lake Pannon. Within the dreissenids, however, no such lineages can be documented convincingly. Instead, parallel evolution caused morphologies which are highly reminiscent of the much younger Lake Pannon faunas. The same phenomenon is expressed within the gastropod genus *Melanopsis* showing iterative morphology developments.

The second biogeographic flock coexisted during the lower and middle Miocene in

the adjacent Miocene Paratethys Sea before experiencing an evolutionary burst during the late Miocene. The faunistic relation between those biogeographic entities is still unsolved. Hence although paleogeographic overlaps are suggested by the occurrence of the DSL dreissenid *Mytilopsis kucici* (BRUSINA) in the Karpatian of the Austrian Fohnsdorf and Vienna Basins such common elements are unknown during the late Miocene. Both biogeographic entities gave rise to phases of very high morphologic disparity, developing independent macroevolutionary systems. Thus the low diverse early to middle Miocene circum-Paratethyan dreissenid fauna is contrasted by very species-rich late Miocene Lake Pannon assemblages. Two peaks with about 34 taxa during the middle Pannonian and even 61 taxa in the late Pannonian to Pontian are documented. *Dreissena* appears during the early late Miocene; soon it occupies the morphospace which was claimed by *Mytilopsis* during the early and middle Miocene. Already the latest Miocene and especially the Pliocene bring about a distinct decline in generic diversity coinciding with a reduced morphologic disparity. The loss of *Congeria* and of the Dreissenomyinae with the beginning respectively during the Dacian results also in the limitation to the ancestral nearshore epifaunal filterfeeding strategy, characterizing extant dreissenids. The ecological niches settled and life-strategies developed by dreissenid bivalves during that time is outstanding and unique for this group of now-a-days usually byssate filter feeding epibionts. Like their modern relatives the Miocene dreissenids conquered freshwater habitats as well as brackish water but always avoided normal marine environments. Aside from a large number of “ordinary” byssate epibionts, the Miocene and Pliocene dreissenids developed lineages adapted to soft-bottom habitats. One group within *Mytilopsis* developed sediment-reclining strategies whilst the dreissenomyid flock even managed to penetrate the sediment by active burrowing. Whilst filter feeding is suggested to have been the prevailing feeding strategy for *Mytilopsis*, *Dreissena* and the dreissenomyids throughout the considered interval, *Congeria* was discussed to have utilized chemosymbiosis as additional energy resource. On the generic level, the maximum diversity was achieved during the late Pannonian when the dreissenid family was represented by at least 5 genera, including the 3 endemic genera *Congeria*, *Dreisenomya* and *Sinucongeria*. *Congeria* is considered as late Miocene offshoot of *Mytilopsis*. At the same time the range of ecological strategies reached a peak comprising epifaunal (*Mytilopsis*, *Dreissena*) and infaunal (dreissenomyids) filter feeding and maybe even chemosymbiosis (*Congeria*?).

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