

## DIVERSITY DYNAMICS AND EVOLUTIONARY ECOLOGY OF MIDDLE AND LATE TRIASSIC HALOBIID AND MONOTID BIVALVES

CHRISTOPHER A. McROBERTS

Department of Geology, State University of New York at Cortland, P.O. Box 2000, Cortland, NY 13045, USA, e-mail: mcroberts@cortland.edu

Middle and Late Triassic halobiid and monotid bivalves represent an ecologically similar group belonging to two separate clades: the Halobiidae (Order Pterioida) and the Monotidae (Order Pectinoida). A significant attribute shared between these groups is their persistent occurrence in monospecific or paucispecific shell accumulations that are frequently found in deep-water, and in many cases oxygen deficient, marine settings. Approximate age durations of species are comparable to typical ammonoids and/or conodont zones during the Triassic and in some instances have temporal resolutions demonstrably shorter, making them among the best macroinvertebrate biochronologic indexes of the Middle and Upper Triassic.

Diversity metrics including species richness, raw and per-taxon rates of origination and extinction and taxic turnover and volatility were determined for *Daonella s.l.*, *Halobia s.l.*, *Monotis s.l.* for the Middle and Late Triassic. Approximately 45 species of *Daonella* are known and have temporal durations typically confined to one or two ammonoid zones and the per-genus volatility rate is high ( $v = 0.32$ ). *Daonella* species richness is bimodal with a strongest peak (14 species) in the upper Anisian and the second and lesser peak during the middle part of the upper Ladinian (Gredleri zone). The lower Ladinian has the fewest species, when high extinction and origination result in essentially complete turnover at the Anisian/Ladinian boundary and again in the early part of the upper Ladinian. *Halobia* is species rich (slightly more than 60 valid species are known) and is less volatile ( $v = 0.17$ ) than *Daonella* and monotids. *Halobia* diversity remains relatively low during the lower Carnian (< 10 species) rising to just under 15 species by the end of the stage (Macrolobatus zone). *Halobia* diversity peaks in the lower Norian (about 17 species) and remains relatively high until the middle Norian (Columbianus I zone) with a few species co-occurring with *Eomonotis* in the upper middle Norian (Columbianus II zone). *Monotis s.l.* is highly volatile ( $v = 0.25$ ), including approximately 30 well-established species of which 12 *Eomonotis* are known from the middle Norian. A nearly complete turnover occurs between middle and upper Norian. *Monotis s.s.* achieves a diversity peak of approximately 16 species in the uppermost Norian (Cordilleranus zone) and is followed by near complete extinction at the Norian/Rhaetian boundary. At least two dwarfed *Monotis* species are known to occur in the Rhaetian (Misikella posthernsteini zone).

Halobiid and monotid species richness, extinction and origination, turnover may be related to short-term changes in the physical marine setting and in turn were driven by high within-species genetic diversity, Sea-level changes are not correlated with origination or extinction patterns, and, except for the Norian/Rhaetian boundary where high extinction rates coincide with a positive  $\delta^{13}\text{C}$  excursion, turnover peaks are not correlated with known fluctuations in the global carbon cycle. Instead, their high turnover and occurrence in dense shell beds is best explained by population instability along oxygen deficient gradients. A model involving initial colonization and substrate dominance and subsequent local disappearance. Metapopulations of sister and sibling species are replaced without competition in subsequent threshold conditions. It is hypothesized that halobiid and monotid bivalve metapopulations were controlled by rapid fluctuations in environmental conditions that would tend to favor eurytopic species with high genetic diversity and exhibit higher evolutionary turnover rates.