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Testing stratigraphic application of quantitative paleobiology: multivariate ordinations of mollusk associations from the Holocene succession of the Po Plain (Italy)

D. Scarponi (1) and M. Kowalewski (2)

(1) Dipartimento di Scienze della Terra e Geologico Ambientali (daniele.scarponi@unibo.it / Fax: +39-051-2094522 / Phone: +39-051-2094582) (2) Geosciences Department (michalk@vt.edu / Fax: +1-540-231-3386 / Phone: +1-540-231-5951)

The influence of sequence stratigraphic (base-level driven) processes on patterns derived from the fossil record has received an increasing attention. In particular, multiple recent studies, which focused on quantitative integration of paleontological and sequence stratigraphic patterns (Stratigraphic Palebiology), showed that multivariate paleoecological data, derived from rigorously collected bulk samples, can yield quantitative or semi-quantitative insights into environmental, stratigraphic, and taphonomic patterns. In this study, mollusk associations found in Holocene sequences of Po Plain (Italy) were used to test the informative power of quantitative paleoecological patterns derived from well-understood marine sedimentary successions. A densely sampled core (50 0.3dm^3 samples, including a total of 86 genera, $\sim$120 species, and more than 2000 specimens) dominated by extant mollusk species with known environmental distribution was analyzed at a genus level using multiple ordination techniques (NMDS, CA and DCA). A comparison of ordinations derived for data matrices derived using various filtering parameters – applied to remove rare taxa and/or small samples – allowed us to separate the analytically robust patterns, which persist regardless of the analytical technique and data filters applied, from the analytically volatile (and thus suspect) outcomes, which vary depending on ordination strategy used and data filters applied. The robust-performing ordination retaining the largest subset of the entire dataset has been integrated with an ecological (bathymetric) dataset compiled for extant genera from the Italian Mollusk Census Database [IMCD]. A putative bathymetric

interpretation of the first DCA axis (DC1) is suggested by a depth-related ordination of molluscs associations aligned along that axis. This is confirmed directly by a strong and statistically significant linear correlation between DC1 scores and the preferred bathymetry of extant mollusk genera recorded in IMCD ($r^2 = 72$, $p<0.001$). This result supports the hypothesis that marine benthic invertebrates may be used to calibrate quantitatively bathymetric gradients in the shallow marine sedimentary successions. The approach also offers us an independent test of sequence-stratigraphic interpretations, enhancing sedimentary basin analysis with numerical bathymetric estimates.