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Temporal changes in body size of Corbula gibba bivalve captured in sediment cores from the Gulf of Trieste

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Many marine ecosystems worldwide are affected by eutrophication and hypoxia. A major increase in the frequency of hypoxia, mucilages, bottom trawling, and sediment pollution occurred in the 20th century in the Gulf of Trieste (northern Adriatic Sea). To assess the effects of these anthropogenic impacts on body size of bivalves, we evaluate temporal changes in size structure of the bivalve Corbula gibba, a first-order opportunistic species tolerating hypoxia, pollution and sediment disturbance and presently inhabiting the Eastern Atlantic and Mediterranean. Our analyses are based on the basis of 7,656 shells from four 1.5 m long sediment cores. These cores cover the past ∼500 years in the northern part and ∼10,000 years in the southern part of the Gulf of Trieste. The northern location (Panzano) exposes late highstand muds with a decadal to centennial-scale resolution. The southern location (Piran) exposes a transition from transgressive sandy muds to highstand skeletal sands and a shell bed with millennial-scale resolution. The chronology of the cores is based on radiocarbon-calibrated amino acid racemization of shells of C. gibba. We find that, first, assemblages at both locations exhibit a stable size structure during the highstand phase. In the core, median size fluctuates between 2-3.5 mm in all increments, but show a significant increase in the 95th percentile size during the 20th century. At the northern stations, right-skewed distributions (with a dominance of juveniles) shift to bimodal distributions and the 95th percentile size increases from 8.6 to 11.5 mm at the transition to the 20th century. At the southern stations, the 95th percentile size increases from 6.6 to 8.8 mm. Second, in the pre-20th century sediments, the 95th percentile size is significantly larger at northern (8.6 mm) than at southern stations (6.6 mm), indicating that the northward increase in primary productivity contributes to geographic trends in size. However, the 20th century size increase in maximum size by 2-3 mm affecting both locations (1) is larger than the geographic size increase (1-2 mm) associated with the northward transition from mesotrophic to eutrophic habitats and (2) is due to an unprecedented shift in the shape of size distributions. Shell drilling and fragmentation frequencies remain rather constant up-core at all stations. The increase in size of C. gibba in the 20th century rather coincides with increasing concentrations of total organic carbon and total nitrogen, and can be related to enhanced food supply driven by nutrient enrichment. This species benefits from organic enrichment, either driven directly from enlarged planktonic or benthic algal production and indirectly from released competitive pressure under intermediate hypoxia not only in terms of abundance but also in terms of body size.