



## **Tracing origin and collapse of Holocene benthic baseline communities in the northern Adriatic Sea**

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The shallow northern Adriatic Sea has a long history of anthropogenic impacts that reach back many centuries. While the effects of eutrophication, overfishing, pollution, and trawling over recent decades have been extensively studied, the major ecological turnovers during the entire Holocene remain poorly explored. In this study, we reconstruct ecological baselines defining benthic ecosystem composition prior to major anthropogenic changes at four stations characterized by low sedimentation and millennial-scale time averaging of molluscan assemblages. We discriminate between natural and anthropogenic drivers based on (1) stratigraphic changes in the composition of molluscan communities observed in sediment cores; and (2) changes in concentrations of heavy metals, pollutants, and organic enrichment. The four 1.5-m long sediment cores reach back to the Pleistocene-Holocene boundary, allowing for a stratigraphic distinction of the major sea-level phases of the Holocene. During the transgressive phase and maximum flooding, sea-level and establishment of the modern circulation pattern determined the development of benthic communities in shallow-water, vegetated habitats with epifaunal biostromes and, in deeper waters, with bryozoan meadows. After sea-level stabilization, the composition of these baseline communities remained relatively uniform and started to change markedly only with the intensification of human impacts in the late highstand, leading to a dominance of infauna and a decline of epifauna at all sites. This profound ecological change reduced species richness, increased the abundance of infaunal suspension feeders and led to a decline of grazers and deposit feeders. We suggest that modern soft-bottom benthic communities, in the northern Adriatic Sea, do not reflect the high compositional geographic heterogeneity of the pre-anthropogenic benthos.