



Influence of municipal wastewater discharge on soft bottom macrofaunal communities nearby the underwater sewage duct of Trieste (northern Adriatic Sea)

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Human activities have the potential to alter the diversity and composition of biological communities in natural environments, which can cause changes in ecosystem functioning. This has led to the development of environmental assessment techniques that take into account species identity, as organisms can contribute differently to various ecosystem processes; these approaches are integrative to the structural community analysis. Biological Traits Analysis (BTA) is used to compare the abundances of specific biological traits in samples to produce information about how ecosystem functioning may change across a specific marine system. Structural and functional (BTA) analyses were used to assess the influence of municipal wastewater discharge on soft bottom macrofaunal communities nearby the sewage outfall of the Gulf of Trieste. Sediments were sampled at 18 stations positioned along an increasing distance from the end of the pipe and its diffusion area, the source of organic matter. Precisely, three stations were located very close to the duct (<5 m) (stations OD, OM and OP), 7 stations were positioned 100 m far from the duct (stations T1, 1D, -1D, 1M, -1M, 1P, -1P,), 7 stations 200 m far from the duct (T2, 2D, -2D, 2M, -2M, 2P, -2P). The reference station was positioned 2 km away from the duct (RS). Sediment characteristics, i.e. grain-size, sediment redox potential (Eh), Total Organic Carbon (TOC) and Total Nitrogen (TN), were assessed at each station. The whole area was characterized by muddy sediments with TOC values ranging from 11.5 (-1M) to 17.4 (T1) mg C g⁻¹. The total macrozoobenthic abundance varied between 260.0 and 2473.3 ind. m⁻² at RS and OD, respectively. The latter station was characterized by the lowest value of biodiversity ($H' = 1.19$) compared to the highest one at RS ($H' = 5.38$). This was due to the dominance of the polychaete *Capitella capitata*. This species is well known to be dominant in areas characterized by organic enrichment. The BTA analysis was performed on 187 taxa collected from the whole area. High expressions were shown for traits as adult longevity, reproductive frequency, mobility and feeding habits. Short life span, semelparous, sessile and surface deposit feeder invertebrates were dominant at stations subjected to continuous sewage discharge. Overall, the functional and structural analyses of macrozoobenthic communities in the area surrounding the sewage outfall of Trieste suggest that these soft-bottoms are affected by a moderate organic stress. Further, integrative approaches that consider a set of environmental features in relation to structural and functional macrofaunal patterns provide a useful tool for understanding, monitoring and assessing ecosystem functioning in an impacted area.