Hypoxic bottom water and meiofauna in the Gulf of Trieste

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The Gulf of Trieste (Northern Adriatic), a semienclosed system, is characterized by a thermohaline stratification throughout much of the year (April - October). Morphologically, the Gulf is a flat submarine plain about 20 - 26 m deep in its central part sloping more steeply to shallower depths in the NW part. Surveys over 20 year period indicated that the central part of the Gulf is frequently distressed by oxygen depletions in the bottom layer. A comparison of the bottom layer dissolved oxygen concentrations gave significantly (t-test, $p < 0.05$) higher values closer to the coast at depths 20 m. Seasonal hypoxia of the bottom layer may exacerbate to anoxia, verified in late August-September of 1974, 1980, 1983, 1987 and 1990, leading to macrobenthic mortalities.

A meiofaunal survey of the southern part of the Gulf during August 1985 (VRISER, 1991) releaved higher abundances along the coasts spreading into inner parts of muddy bays (1500-2400 ind./10 cm2), and decreasing towards open north Adriatic waters and the central part of the Gulf of Trieste. Reduced abundances were most marked (464 ind./10 cm2) at the station in the centre of the Gulf.

Analysis of the meiofaunal material collected during 1985 showed 71 species of harpacticoid copepods which ranked the second most abundant after nematods. Horizontal distribution of harpacticoid abundances roughly followed that of total meiofauna, though with less marked increase towards the coasts and muddy bays. In contrast, towards the central part of the Gulf, the reduction was even more obvious than for total meiofauna. The result of the diversity (Harpacticoida) analysis was much the same: the majority of stations showed Shannon-Weaner indices between 2.4 and 2.6, which were reduced to 2.26 in the central Gulf of Trieste. A similar horizontal distribution was found for macrobenthic biomass in 1974 (FEDRA *et al.*, 1976) which showed a drastic decrease of wet weight from 300 g/m2 to 10 g/m.

The severe hypoxia registered in September 1990 greatly influenced the macrobenthic community, especially Echinodermata, Ascidiacea, Spongiaria. A survey in the area where oxygen saturation dropped below 10 % showed nearly halved meiofaunal abundances. A year later (September 1991) the meiofaunal abundances returned to values registered in 1985.

These results lead us to the conclusion that there exists in the deeper, central part of the Gulf an "anoxic depression", affected by recurring oxygen depletions and characterized by reduced macrobenthic and meiobenthic abundances, as well as lower diversities. On the other hand, our data indicate that meiofauna may survive short periods of severe hypoxia, which has catastrophic consequences for macrobenthos. Moreover, even when meiofauna suffered mortality, it returned to nearly normal abundances in about one year, though some structural changes may appear.

It seems that reduced vertical mixing and specific hydrodynamic conditions in the deeper parts of the Gulf of Trieste set the stage for severe hypoxias. From several hundreds of separate measurements (STRAVISI, 1987), it was shown that the circulation in the Gulf is mainly wind driven, with a vertically averaged velocity of ~ 10 cm/s. Generally, with easterly winds ("bora" ENE) the whole water column is moving counterclockwise. The layer below 10 m is moving almost permanently counterclockwise, with typical transport velocities of 2-3 cm/s. Tidal currents (mean velocities 3-10 cm/s) are most significant in calm weather, but they just move virtually the same water mass forward and backward along the axis of the Gulf. The circulation of the bottom layer in the middle of the Gulf, where depths are 22 m, were not measured so far. But, we can reasonably conclude that the circulation of this layer is even weaker than that in the bottom layers surrounding the central part, especially during the summer when westerly winds are more frequent. In this case, momentum of the upper layer drifted by westerly winds can be balanced by motion in opposite direction in the intermediate layer, leaving the bottom layer almost uncoupled from the motions above and alongside.

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