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Causes and consequences of hypoxia on the Western Black Sea Shelf

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The Black Sea, containing the world's largest natural anoxic basin since ca 7500 years (Jones & Gagnon 1994), suffers from combined effects of anthropogenic eutrophication, overfishing and climate variability (Oguz & Gilbert 2007). We discuss causes for hypoxia in western shelf waters. Freshwater runoff by the large rivers Danube, Dniester and Dnieper results in strong thermohaline stratification that limits bottom water ventilation on the north-western shelf during warm seasons. This makes the western shelf generally prone to oxygen deficiency. During autumn and winter, the thermohaline stratification is eroded by frequent storms and the water column is re-oxygenated. The causal chain of anthropogenic eutrophication since the 1970s led to seasonal hypoxia on the western shelf for more than 20 years causing the catastrophic decline of key shelf habitats (Mee et al. 2005). More frequent and intense algal blooms, red tides (i.e. Noctiluca, Prorocentrum cordatum) and changes in species composition in phytoplankton resulted in deposition of surplus organic matter on the seafloor increasing the oxygen demand, with serious consequences for pelagic and benthic ecosystem structure and functioning.

During hypoxia, release of reduced substances like ammonia and phosphate from the sediment to the water fuelled eutrophication internally (Friedrich et al. 2002). The combination of existing data with those gained during EU FP7 HYPOX on the Romanian shelf enables to assess the development of bottom water hypoxia and changes in benthic community and hence, the current state and trends in recovery of the Romanian Black Sea shelf ecosystem. Mud worms are the winners of eutrophication and hypoxia, whereas filter feeders like Mytilus galloprovincialis and Acanthocardia paucicostata are the losers. The western shelf benthic ecosystem showed a significant reduction in species diversity, a reduction of biofilter strength due to the loss of filter-feeder populations and flourishing of opportunistic species such as worms. Following the economic collapse of eastern European countries during the 1990s, riverine nutrient loads decreased and the ecosystem is showing signs of slow recovery, such as a decrease in the frequency and duration of hypoxic events. However, nutrient fluxes from the sediments did not decrease significantly (Friedrich et al. 2010). We observe slight recovery of the macrobenthic community structure in terms of species numbers in the Romanian pre-Danubian sector. Opportunistic species, e.g., ascidians, worms and fast growing filamentous algae are currently filling ecologic niches left by the past ecosystem collapse.

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