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Conceptual Understanding of Hypoxia Effects on Ecosystems – Example: the Black Sea's North-Western Shelf (EU-FP7 "HYPOX")

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The EU-FP7 project "HYPOX" is dedicated to monitor oxygen depletion and to evaluate existing and potential future impacts of hypoxia and anoxia in land-locked, coastal and open ocean ecosystems. An important task is to gain understanding of the physical processes behind the formation of hypoxia in parallel to the study of biological processes, nutrient cycling, and dissolved oxygen dynamics. We identified two conceptual levels of understanding: 1) the physical and biological processes of hypoxia formation, and 2) the identification of the causal chain from drivers of hypoxia formation to ecosystem response. In order to facilitate decision making in water management, HYPOX furthermore aims to improve our knowledge on the discrimination between oxygen depletion due to natural variability, and human induced drivers (climate change, eutrophication) that could potentially controlled by environmental authorities.

The north-western Black Sea represents a unique example to study the recovery of a formerly collapsed ecosystem. From the 1960ies to the mid 1990ies heavy eutrophication due to high river nutrient load combined with favorable climate conditions resulted in seasonal hypoxia and deterioration of the benthic and pelagic ecosystems of the north-western Black Sea. Following the collapse of the eastern European economies in the 1990ies, nutrient input decreased. After more than one decade, the ecosystem now shows signs of recovery. Studying the recovery dynamics provides deeper insights into the trajectories of collapse and recovery, including physical and biological regime shifts, timescales of changes in ecosystem structure and functioning, and succession dynamics in flora and fauna. Based on historical and new data, we analyze the causal chain of driver, pressure, state change, impact and ecosystem response to hypoxia in a conceptual model.