

Macrobenthos recovering from eutrophication at the scale of the northwestern continental shelf of the Black Sea

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Black Sea NW shelf: An ecosystem under stress

The northwestern continental shelf of the Black Sea has been affected by severe eutrophication and bottom hypoxia since the seventies due to an increase of anthropogenic activities.

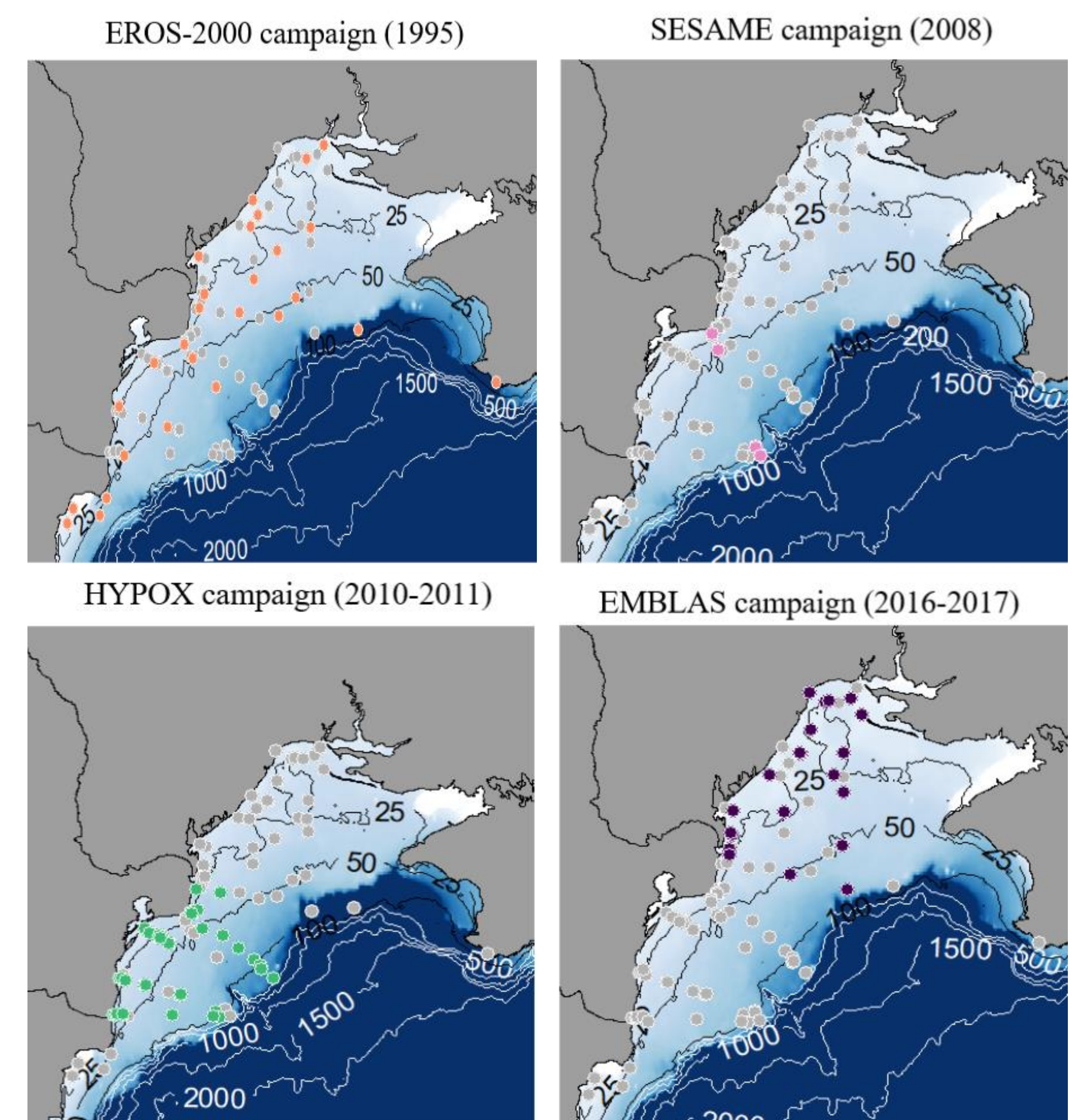
As a direct consequence, macrozoobenthos has suffered well-established decline in terms of biomass and diversity with modification in the benthic communities assemblage.

From 1990, some signs of recovery in the pelagic system have been observed as a result of a decline in nutrient load. Recovery of the benthic communities is less rapid and still fragile.

Black Sea NW shelf: Datasets from 1995 to 2017

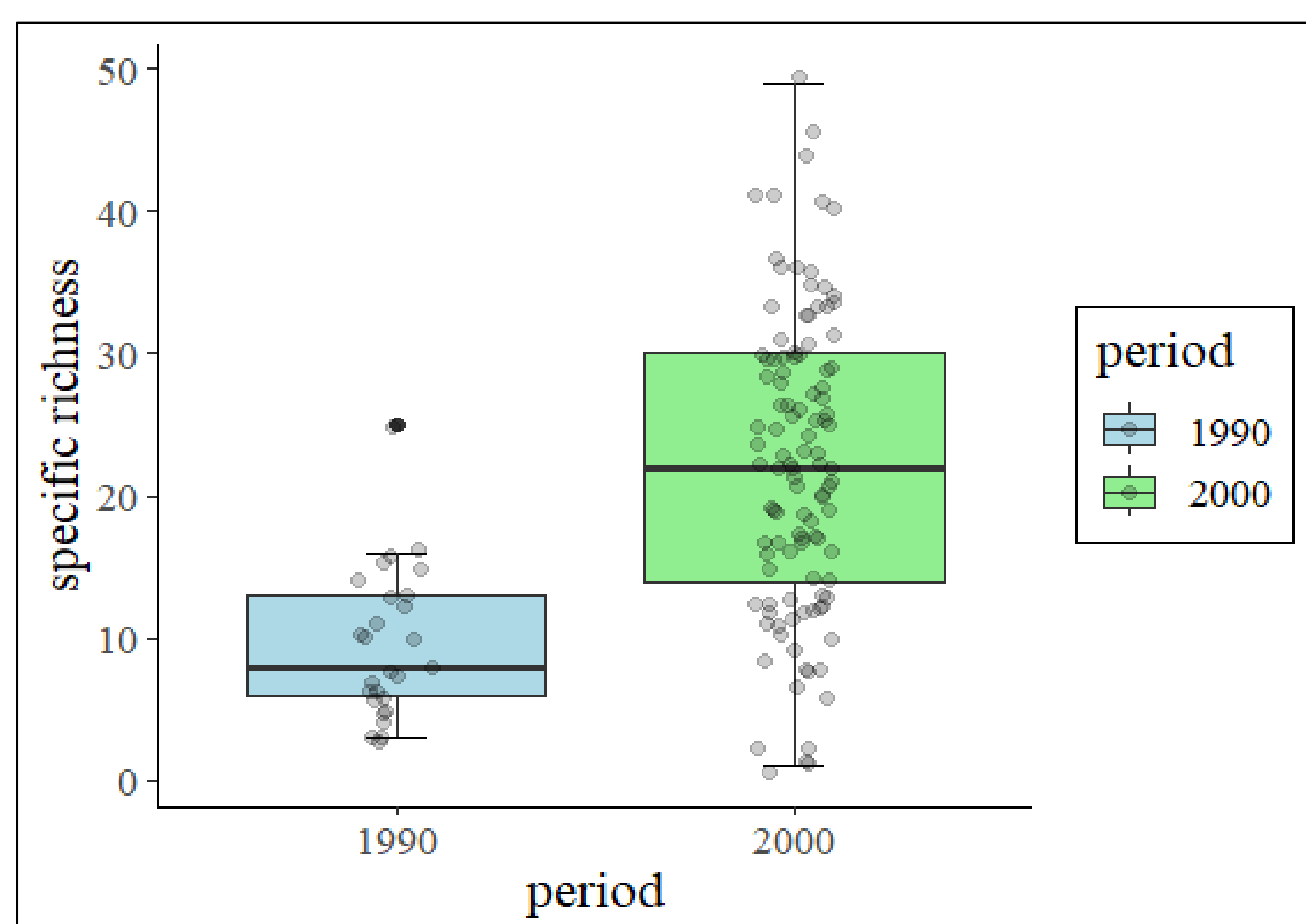
In this study, we compiled macrozoobenthos data for 138 stations over the shelf from 1995 to 2017 within the framework of the EROS-2000 (1995), SESAME (2008), HYPOX (2010-2011) and EMBLAS (2016-2017) projects. A total of 191 taxa are recorded. Environmental data are also computed from a coupled physical-biogeochemical model and hypoxic sites are mapped (i.e. < 63 $\mu\text{mol O}_2/\text{liter}$).

A comparison is made between the 1990s and 2000s period to evidence a potential recovery of the benthic communities in terms of species assemblage and extension in the hypoxic area.

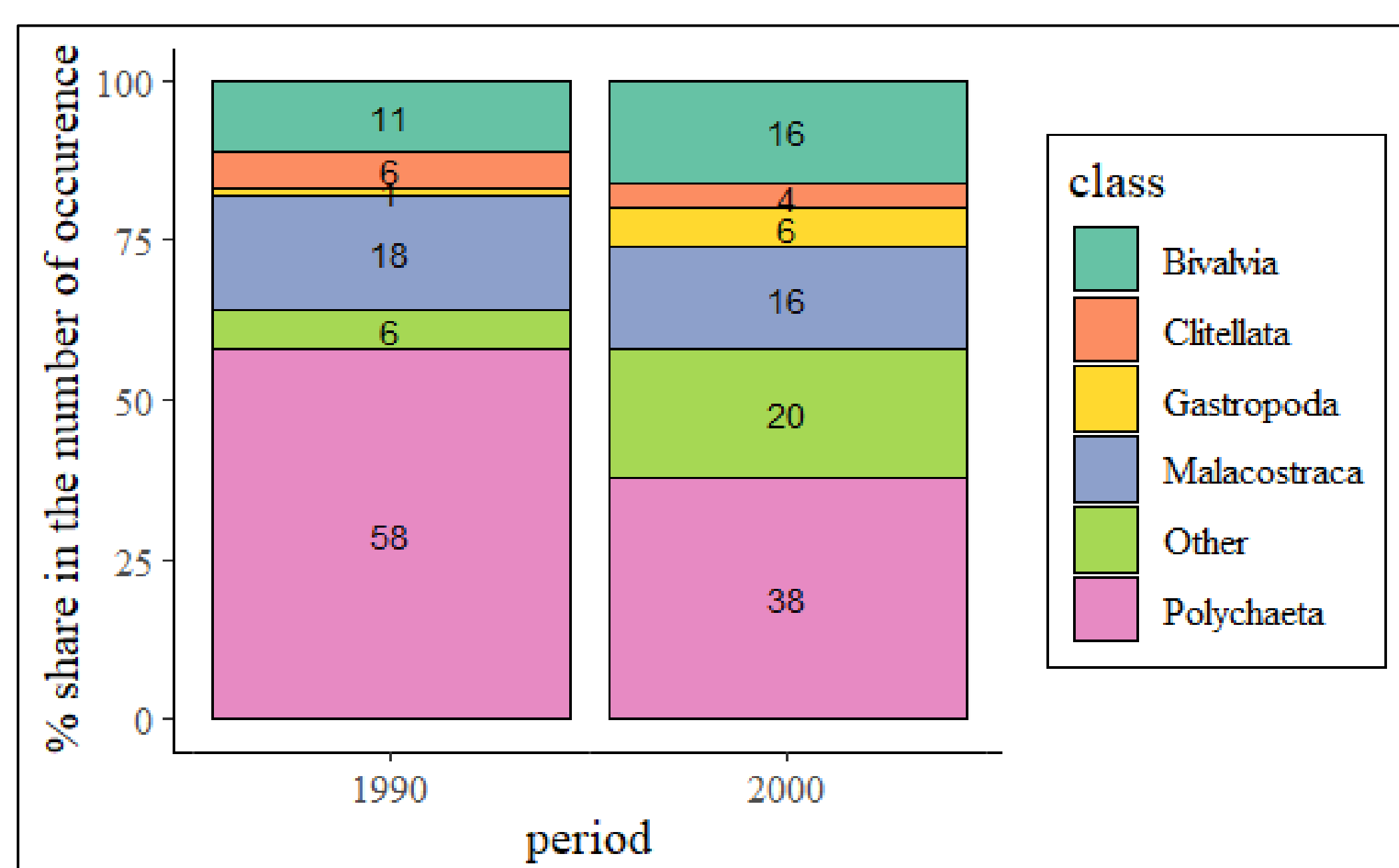


Signs of macrozoobenthos recovery ?

- Higher specific richness (i.e. number of taxa per site) for the 2000s period.

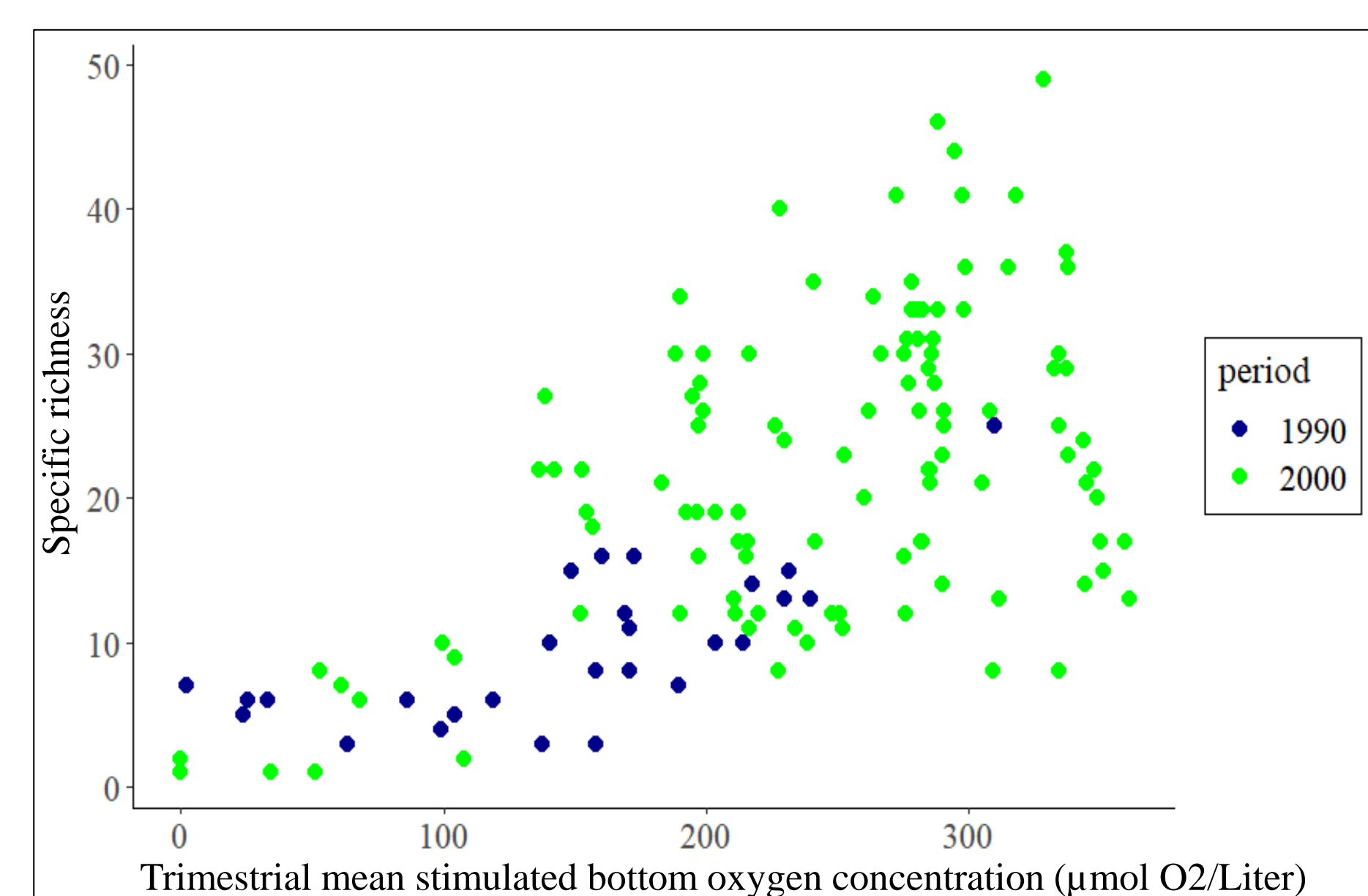


- Taxa with different threshold tolerance to hypoxia: decrease in the total share of *Polychaeta* and increase of *Mollusca*.

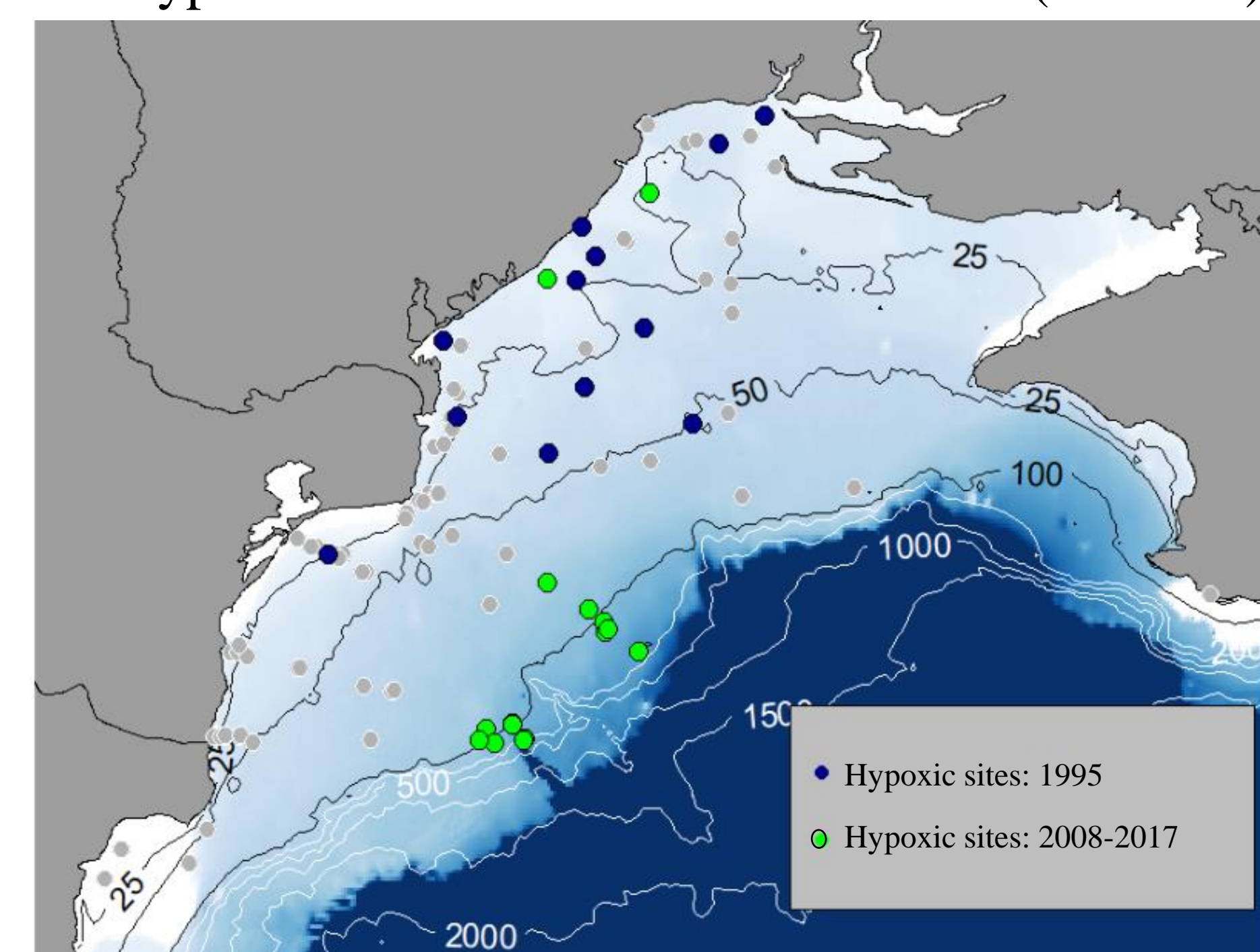


Signs of hypoxia recovery ?

- Specific richness and bottom oxygen are positively correlated.



- Hypoxic sites at the edge of the shelf due to the upwellings of anoxic waters from the deep basin (permanent).
- Hypoxic sites in the north-east part of the shelf due to eutrophication: decrease in hypoxia zone from 1995 to 2008-2017 (seasonal).



Take-home message

- On the path to recovery, decrease of the class *Polychaeta* can be explained by a reduction in anthropogenic stress on the Black Sea ecosystem leading to a reduction of opportunistic deposit-feeder (oligochaetes and some species of polychaetes) simultaneously with the increase of epibenthic species (crustaceans, mollusc) and specific richness.
- However, development of invasive species and persistence of opportunistic species tend to mitigate the recovery tendency.
- Reduction in bottom hypoxia caused by eutrophication due to the discharge of rivers (e.g. Danube) from 1995 to 2008-2017.
- Higher bottom oxygen concentration is directly associated with higher specific richness.