

NEW METHODOLOGICAL APPROACH IN ESTIMATION OF THE NORTHWESTERN BLACK SEA WATER BODIES' ENVIRONMENTAL STATUS

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Abstract

The central concept of the EU Water Framework Directive - Environmental Status (ES) reflects both the degree to which people use the water environment and the peculiarities of nature conditions in different types of marine ecosystems. It has been proposed to assess ratio between nature ecosystem capacities and artificial force using Artificial Force Index (AFI). The AFI is determined from the difference between 5 WFD's classes as the result of comparison of ES assessed on morphofunctional indicators of Macroalgae and Phytoplankton with the categories of Nature Resistance Index. Negative, zero and positive AFI values have been presented for 12 water bodies of the northwestern part of the Black Sea. Reasons, under which the ES could be lower, identical or higher than the nature capacities of an ecosystem, have been discussed.

Keywords: Phytobenthos, Phytoplankton, Black Sea

Introduction

Implementation on the National level of the EU Water Framework Directive (WFD, 2000/60/EC) and the Marine Strategy Framework Directive (MSFD, 2008/56/EC) requirements and standards in all the countries of the Mediterranean-Black Seas Basin is an important condition of trans-boundary monitoring and water resources management. Ukraine has started the work to adapt the National marine ecosystems monitoring methods to the WFD key principles. It has been proposed in the paper to apply the developed in Ukraine morphofunctional indicators for macrophytes and phytoplankton, as well as Nature Resistance Index (NRI) to make expert judgement on the two constituents of Environmental Status (ES) – the nature capacity of an ecosystem and the artificial force impacting it.

Methodology

ES is the central notion on the WFD. It is used as a universal indicator to assess the «degree to which human uses of the water environment». If we use both historical and current data to assess the ES of the same ecosystem, the «altered the structure and functioning of aquatic plant and animal communities» would give us objective picture of temporal dynamics of human impact, as the nature conditions in this case will constitute relatively constant values. When we assess the ES of different types of aquatic ecosystems (coastal, shelf, estuary, bay, gulf, delta front and so on) the Biological Quality Elements (BQE) indicators contain double information: on nature capacities of the ecosystem and on the level of human impact. In this case comparison between the ES of aquatic ecosystems belonging to different types will not always unambiguously reflect human impact only. There is, for example, high probability that the state of the Black Sea Danube Delta Front will show lower ES compared to the state of the Black Sea Crimean Coast because of natural eutrophication due to river discharge and, as the result, simplification of communities and poorer biological diversity. In order to single out non-natural impact from the ES of an ecosystem we propose to use Artificial Force Index (AFI). The AFI characterizes the difference between the level of environmental processes observed in a real ecosystem including human impact and the potential level of environmental processes that could form in water bodies exceptionally under the influence of an ecosystem's natural properties. The AFI should be determined using comparative method from the difference between the WFD classes ES and NRI. For the ESC assessment we propose morphofunctional parameter as a new indicator for Macroalgae and Phytoplankton - specific surface (S/W), which is calculated according to special algorithms [1]. The S/W value is connected with the morphological structure of different aquatic vegetation life forms and reflects their environmental activity in production process. Based on the S/W, a number of new indicators are proposed to assess the ESC of benthic vegetation [2]. Use of the NRI is proposed to assess the ecosystems capacity to resist artificial force based on their natural properties. NRI is calculated as an integral value of hydrological & morphological parameters of water body bed, catchment area, geographical & climatic conditions with further reference to the WFD classification scale [3].

Result and Discussion

The first attempt of the AFI determination has been made for 12 water bodies of the northwestern part of the Black Sea. More than half of the water bodies (7) have negative AFI values, which mean that their ES is worse than nature features as the result of human pressure. The maximum negative values of the AFI (-2) were demonstrated by the Hadzhibeyskiy Liman (located within the city boundaries; sink for domestic discharges from the city with million population) and the Sukhoy Liman (with commercial port in its water area having annual cargo turnover 15 million tons). ES of the 3 water bodies correspond to the nature features of their ecosystems (AFI=0). Only 2 of the 12 Limans have demonstrated positive AFI values: the Tiligul Liman (AFI =+1) with two protected areas of regional significance along its banks and the Dofinovskiy Liman, with the lowest SC NRI category (area - 5.5 km²; average depth - 0.6 m; used to have no natural connection with the sea). At that, the highest AFI value happened to be demonstrated by the Dofinovskiy Liman (AFI = +2) as the result of successful environmental management (there is a fish farm, which has built hydro-engineering facilities and is managing water exchange with the sea). The results received entitle us to continue development of methodological approaches in assessment and comparative interpretation of ES categories of aquatic ecosystems having different natural properties. Work is executed at support Project "Towards COast to COast NETworks of marine protected areas (from the shore to the high and deep sea), coupled with sea-based wind energy potential".

References

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