

SOME REMARKS CONCERNING ACTUAL STATE OF THE DANUBE RIVER - BLACK SEA ECOLOGICAL SYSTEM

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Abstract: This paper, which is in fact a larger abstract, presents the main changes and disturbances registered in the past decades in the North-Western Black Sea ecosystems. The general state of coastal ecosystems is considered precarious, a prevalent feature being the genofund damage (extinction of some species, the threat with disappearance for other forms, impoverishment of the species populations of great commercial and ecological value).

Key words: Black Sea, coastal ecosystem

The Black Sea was known in the '60s as one of the most productive seas, having a luxuriant development of the pelagic fauna, a vast distribution of red algae belonging to the genus *Phyllophora*, a remarkable abundance of benthic filterfeeders (*Mytilus*, *Modiolus* and other species) and being an ideal feeding place for some commercial fishes migrating from the Mediterranean. The Black Sea has often been mentioned as an example of marine province where a process of naturally induced eutrophication occurs as a result of the permanent discharge of its river-borne nutrients (Băcescu, 1960; Zenkevich, 1963).

The highest biological productivity, the highest ecological diversity and the richest fisheries could be found in the north-western sector of the Black Sea, which is a semi-enclosed area of 63,900 Km² (15% of the whole sea surface and approximately 56% of its biotic bottoms, 0-200 m) with a water volume of 1,910 Km³ (0.35% of the whole volume of the Black Sea or 2.60% of the volume of the waters in the zone 0-200 m). In this sector are annually discharged 280 Km³ fresh water (85% of the whole influx in the sea) by the Danube (76%), the Dniestr (20%) and the Dniepr (4%) which drain their hydrographic basin of about 1,4 mil. Km² and fertilises a marine zone 22 times smaller than their collecting areas.

In the past two decades, in the North-Western Black Sea ecosystems, changes have been registered as a result of multiple and complex pressures which are still increasing (Gomoiu, 1981, 1982, 1987, 1992, 1995; Tolmazin, 1985 etc.). In comparison with the basic steady state level

considered in the '50s and '60s, we mentioned here the following three main changes the causes of which originating in human activities lie beyond marine environment:

1) The increasing quantities of inorganic and organic nutrients, that mean generally speaking, rapid eutrophication of the sea with all its consequences: chronic algal blooming, increasing quantities of dissolved and particulate organic matter in sea water and sediments, appearance of hypoxia and anoxia in the coastal waters below the thermocline, mass mortality of benthic organisms, the qualitative and quantitative impoverishment of populations, etc.

2) The increasing sea pollution and extension of contaminate zones from coastal waters to the offshore. Nevertheless, there are few data referring to this problem.

3) Strengthening of morphodynamic processes, erosion dominating, which have brought about profound changes at the space and at the time scale of the morphogenesis process and of the Romanian littoral morphometry.

The major causes of the three mentioned changes are closely connected with the Danubian system - the river and its whole hydrographic basin, including its delta.

It is well known that the Danubian system has a great influence upon marine ecosystems in the north-west Black Sea generally and the Romanian littoral particularly. Formerly this system was healthy and wholly beneficial fertilising the sea, favouring a high productivity at all trophic levels. The rich fisheries, the red or brown algae meadows, the mussel and other mollusc stock etc.

were nothing else but gifts of the Danube bestowed upon the sea.

Unfortunately nowadays, under the influence of numerous factors in the last two decades, the river system is completely disturbed. The direct impact upon the Danube (hydropower works - dams and embankments of the flooded zones, fluvial transport, wastewater discharge etc.) and the direct impact in the hydrographic basin (urbanisation, industry development, intensive agriculture, hydropower works on the main tributary rivers, etc.) were severe and complex and resulted in profound changes of the hydrology, hydrochemistry, the quality and trophic state of its waters and implicitly of biodiversity on one hand and the quantity and quality of biological resources on the other hand.

Loadings of inorganic nutrients in the Danube water have been increased and eutrophication processes are usually common in many sectors. Nutrients are no longer limiting factors for primary producers. In comparison to the situation of '60s, the present nutrient concentrations of the Danube, implicitly of its discharge into the Black Sea, is greater: approximately 1.7 times for nitrates and 1.5 for phosphates.

The Danube discharges annually into the sea about 1.76×10^6 t nutrients (93.65% NO_3^- , 2.7% NH_4^+ , 1.2% NO_2^- , 2.4% P-PO_4) which represents 99.525% of the total nutrient influx at the Romanian shore (0.475% is the contribution of effluents) (Chirea & Gomoiu, 1986).

In parallel with the increasing nutrient concentration, the concentration of pollutants increases as well (heavy metals, pesticides and other toxic substances). All these quantities get into the sea more quickly and in greater quantities because the zones liable to flooding, which controlled and limited the loadings carried by the Danube, were practically annihilated in consequence of the numerous embankments.

The embankments in the flood plain, especially the building of numerous dams in order to form accumulation lakes in the hydrographic basin caused the decrease of the Danube solid floor discharged into the sea and consequently brought about changes in the littoral morphogenesis processes.

Although complex, the connection between the Danube system and the marine system in the north-western Black Sea can be identified; the direct and indirect effects of human activities in the hydrographic basin of the great "diagonal" of Europe become causes of the disturbance in the marine ecosystems.

The major consequence of these disturbances is the drastic reduction of specific diversity; genofund damage (general or local extinction of some species, the threat of disappearance for other forms etc.) has been registered in all planktonic and benthic associations and in nekton structure as well. At present there are no up-to-date lists for the Black Sea fauna and flora, the genofund health is not known and the ecological implications of the species disappearance or population impoverishment are also unknown.

The general actual state of the Black Sea coastal ecosystems (mainly the north-western ones which have been strongly affected in a regressive, negative direction in comparison to the situation that existed 20 years ago) can be considered precarious if we just refer to the disappearance of some species or the impoverishment of species populations of great commercial and ecological value (Gomoiu, 1992). The main features of the coastal ecosystem as a whole can be thus summarised:

1. Species diversity, both as variety and equitability component, is low; only the most tolerant forms have remained out of the old associations; few species from the community nucleus, only 1-2 representatives are dominant in number or weight.
2. Stratification and spatial heterogeneity, as a pattern of diversity, are quite simple, poorly organised.
3. There is a lack of balance between the pelagial ("algal blooming") and benthic (obliteration) on the one hand, then between autotrophic organisms and heterotrophic ones or between macro forms and micro ones on the other hand.
4. The role of primary producers and of the decomposers has increased dominating the metabolic processes of the ecosystem (intensification of microbiological processes follows phytoplankton bloomings).
5. Extrabiotic inorganic nutrients enter the system in great quantities and are no longer limiting factors for the phytoplankton.
6. The quotient between production and biomass (P/B) is usually high, the primary trophic base being in excess.
7. Trophic chains are simple, linear (feeding on phyto- and bacterioplankton prevails).
8. The ecosystem has a weak resistance to exterior disturbances, being characterised by a permanent instability and great fluctuations of the populations, by discontinuous and irregular processes and phenomena.

In the present simplified structure of the Black Sea, the new mechanisms of biological production,

less understood nowadays, provide fish catches which quantitatively exceed sometimes the former ones, but they have a low commercial value (sprat, Mediterranean horse mackerel and anchovy instead of sturgeons, turbot, mackerel, Atlantic bonito etc.). The new ecological balance remains delicate, fragile, unforeseeable, dominated by the Danube influence, by an eutrophication syndrome; consequently urgent measures are necessary for ecological restoration, both in the Danube and NW Black Sea ecosystems. That means mainly interdisciplinary programmes of research and integrated monitoring, of pollution control, of building artificial reefs; such measures will be economically and ecologically efficient only on

condition that they are included in a unique action-plan carried out through international collaboration.

Considering the eutrophication of the Black Sea with all its negative implications is caused by the increasing quantities of nutrients discharged into the sea in the latest decades, the major solution for re-establishing the balance of coastal ecosystems is the limiting of the influx of nutrients and other pollutants. The limiting of the chemical constituents must be first achieved in the drainage basin of the Danube - the greatest eutrophication and pollution source in the West of the Black Sea (other tributary rivers are equally considered - the Dniepr and the Dniestr).

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