

Technologies of coastal restoration in Eastern Black Sea

Archill KIKNADZE

Coastal Protection of Georgia, TBILISI (Georgia)

The eastern part of the Black Sea coast mainly belonging to Georgia (313 km) is accumulative (62.3%) and abrasional-accumulative (37.7%). It is bordered by the pebble-sandy (80%) and sandy (20%) beaches.

Until 1982 the strategy of coast protection was the elaboration and building of new coastal protective structures. As long as this strategy deals with the results rather than with the reasons of coastal erosion it can not be considered as nature preserving. Thus total length of eroding coast in Georgia in 1961 was 155 km, in 1971-183 km and in 1981- 220 km. At the same time the total expenses of coast protection in towns (46km) and along the railways (18 km) were equal to 45 million roubles during 1961-1971 and to more than 80 millions during 1972-1981.

The Georgian Association of Seacoast Protection created in 1981 was in fact an experiment in the field of coastal management. Its activities are directed by the scientific-research institute of coastal morphodynamics. The latter integrates the scientific research, analysis, generalization of empirical data, experimenting and also plans their realization in space and time. According to its profile (study of seacoast nature) this institute developed qualitatively a new strategy of transforming seashore landscapes. The main goal of this strategy instead of protecting some sections of coast (e.g. with constructions or artificial beach nourishment) - is to achieve and retain the balanced budget of beachforming sediment in each dynamic system. In that case the whole energy of water is spent only in the transportation of sediment.

So the power of waves becomes creative instead of destructive. The weakened or intersected (by various reasons) interactions of adjacent sectors of shore are restored and the processes of self regulation of mobile beach zones along the whole morpho- and lithodynamic system are gradually reanimated. This is achieved by the different methods depending on natural conditions. At the same time constructing is considered as "surgery" and is applied only in exceptional cases -when it allows to speed up the achievement of the above mentioned goal.

As a result of realizing this strategy the length of eroding coast in 1982-1991 was cut down to 80 km., 93.2 million roubles were spent at 110 hectares of beaches restored. Natural landscapes were created in place of concrete constructions which is quite important in towns and resorts too. It is worth mentioning that in cases like the Georgian seacoast - with steep pebble beaches, large sediment flow's length (tens of kilometers with capacities more than 100 thousand m³ and velocities up to 200 cm/day etc.), numerous submarine canyons and so on even the artificial beach nourishment was considered inexpedient, nothing to say of the regulation of beachforming processes.

The new strategy is based on the results of investigation of sediment distribution during the evolution of coastal relief in the last 5-6 thousand years (i.e. in the period of slowing down and stabilization of transgression of ocean). It enabled us to work out the conception of discontinuous lithodynamic systems evolving almost autonomously and hence subject to regulation.

Impact of man on Black Sea ecosystem

Stanislas M. KONOVALOV

The Institute of Biology of the Southern Seas, SEVASTOPOL (Ukraine)

Acting as depository for anthropogenic wastes, the semi-enclosed seas of the World Ocean are subjected to man's greatest impact, particularly in highly industrialized coastal areas. Most of the pollution accumulates there, bringing about dramatical transformations in ecosystems, as evidenced by a variety of available data on ecological conditions. This paper compares the impact of man on the Black Sea ecosystem with that on the Mediterranean, Baltic and Azov Seas.

Based on the analysis of geomorphological, hydrological and hydrochemical indices of ecological capacity we conclude that the Black Sea is specifically susceptible to impacts. Very low rate of water exchange, nutrient- and H₂S-contaminated water masses amounting to 90 % of the total sea volume, huge drainage area and dominance of river run-off over precipitation account for this phenomenon.

The comparative analysis between the four seas involved nutrient loading, pollution by persistent organic substances, heavy metals and oil. Obtained results were the gravest for the Black Sea. Since available data on microbiological contamination in the coastal waters of the Black Sea are scarce, further studies should be conducted.

The most pronounced transformations were found in the Black and Azov Seas ; they have been caused by anthropogenic pollution and suddenly reduced river run-off. The transformations include replacements in dominant and subdominant species, reduced number of species in all trophic groups, reduced average life in most populations, anomalous density outbreaks in several species including invasive species .

These changes were observed in all communities. The phytoplankton and phytobenthic communities were the first to undergo transformations as a result of high nutrient loading. The zooplankton and zoobenthic communities were subjected to secondary change and decline because of the disturbed typical energy and matter fluxes at the autotrophic level. Plankton blooms have become more frequent, bringing about transient anoxic and hypoxic conditions that are fatal to most benthic communities. Transformation of nekton communities follows, caused by persistent organic substances, heavy metals, oil and other pollutants supplied to the Black Sea. The above transformations and the destroyed coastal spawning areas produce in turn a harmful reduction of fish and dolphin's numbers.

An illustrative example of outbreak of species abundance is provided by the medusa *Aurelia aurita* , which in some years yielded raw biomass of 400 - 600 000 000 t/yr. These outbreaks affect all trophic levels and, primarily, fish. Fish larvae become prey, other age-classes and adults are short of fodder zooplankton. Later, an immigrated species *Mnemiopsis leidyi* did replace *Aurelia aurita*, owing to a more rapid sexual maturation, a greater number of generations per year and to the absence of predators. At present, density of this dominant amounts to 1 - 1.5 kg/m² in the Black Sea. *M. leidyi* is extensively grazing on fodder zooplankton, larvae of molluscs and fish, which causes a substantial reduction in fish numbers, for instance in anchovy.

Thus, a substantial anthropogenic load and a lesser ecological resistance are responsible for the gravest transformations of ecosystems in the Black and Azov Seas, compared to the Baltic and Mediterranean Seas.

