

付属資料

APPLICATION FORM FOR JAPAN'S DEVELOPMENT STUDIES / PROGRAM

Date of entry: month 11 year 2007

Applicant: National Institute for Marine Research and Development "Grigore Antipa" (NIMRD)
Ministry of Waters and Environmental Protection (MWEP)

1. Project digest

(1) Project Title: Assessment of Ecosystem, Coastal Erosion and Protection/Rehabilitation of the Romanian Black Sea Shore

(2) Location: Dobrogea province comprising two counties, Constanta and Tulcea (Black Sea Romanian shoreline, about 250 km in length).

City: Constanta.

From the metropolis: about 3 hours ride / 1 hour flight from Bucharest.

(3) Implementing Agency:

Name of the Agency: National Institute for Marine Research and Development "Grigore Antipa" (NIMRD), under the coordination of the Ministry of Waters and Environmental Protection (MWEP), through the Department of Oceanography, Marine and Coastal Engineering.

By the Governmental Decree (H.G). No. 686 /23.08.1999 NIMRD Constanta is defined as the national technical operator of the monitoring network (physical, chemical, biological) for the Romanian coastal waters, and for the assessment of the coastal erosion, being enabled to make proposals for legal regulations.

Number of staff of the Agency: 53 researchers, 58 auxiliary and administrative personnel.

Budget allocated to the Agency: NIMRD "Grigore Antipa" fundis, mainly from MWEP and Ministry of Education and Research, represents an average budget of 400.000 USD/yr.

The organizational chart is presented in annex I and the structure by departments work is the following (the department that is involved in the project is underlined):

- Department of Oceanography, Marine and Coastal Engineering;
- Department of Ecology and Environmental Protection;
- Department of Marine Living Resources.

(4) Justification of the Project

Present conditions of the sector

The Romanian Black Sea coast length is about 250 km that is 6% from the entire Black Sea coast length. Coastal line represents 80% beach and low altitude shores and 20% cliffs, or 84% natural shores and 16% constructed shores (hydro-technical structures, harbors, and shore protection systems).

In recent years human activities have come to play an increasingly important role in ecological changes in the Romanian Black Sea, often modifying or amplifying natural factors.

The most significant anthropogenic activities include:

- changes in the chemical composition of fresh water flowing into the sea and its loading with numerous allochthonous toxic or non-toxic substances produced by human activity;
- the increase in maritime traffic and the building of new harbors;
- the local discharge of municipal and industrial waste waters;
- coastal engineering works to consolidate and protect the shoreline (dams, barrages) and the construction of sea harbors;
- overfishing and bottom trawling.

Many of the resultant problems have had important ecological, economical and social consequences, including coastal erosion, the disturbance of ecosystem stability and water pollution. Biological diversity has declined and there have been significant changes in the structure of the biomass and primary, secondary and final production, including the upper trophic levels, which were once the object of commercial exploitation.

The main ecological result of the intensification of the eutrophication process has been a rise in plankton primary production and an increase in the frequency, magnitude and special extension of algal blooms. The most frequent species causing blooms were *Prorocentrum cordatum* up to $800 \cdot 10^6$ cells·l⁻¹ and *Skeletonema costatum* up to $90 \cdot 10^6$ cells·l⁻¹. After the period of intense phytoplankton blooms (the 1980's), during the recent period (1991-1997) their number and cell concentration decreased. A total of 20 blooms were registered, out of which only 4 had a rather high abundance (within the range 50-200 million cells·l⁻¹). Ten species (with densities exceeding 7 million cells·l⁻¹) have generated blooms, but five of them (*P. cordatum*, *Eutreptia lanowii*, *S. costatum*, *Nitzschia tenuirostris* and *Phormidium* sp.) attained maximum concentrations much lower than those in the 1980's.

The biochemical shifts in the 1980s, together with the invasion by opportunistic organisms such *Mnemiopsis leidyi* have put additional stress on the ecosystem of the Black Sea which induced drastic changes in the taxonomic composition of the zooplankton species. The species that underwent massive increases in density tended to be herbivorous and detritivorous opportunistic species, which were able to take advantage of the abundance of phytoplankton and dissolved organic matter. There were huge increases in densities of the cystoflagellate *Noctiluca scintillans*, producing real blooms during the summer months and the jellyfish *Aurelia aurita*, which took advantage of a decline in the number of planktivorous fish competing for food.

Among the species which suffered considerable decline are the copepods belonging to the family Pontellidae (*Anomalocera pattersoni*, *Pontella mediterranea*, *Labidocera brunescens*), inhabiting the superficial biotope of water - most exposed to the anthropogenic pressure, once forming large concentrations and since 1980 only isolated individuals.

A significant decline has been observed in the zooplankton beginning 1989, even during summer, all the groups with trophic value having a very dropped quantitative level (after 1989 the trophic biomasses were in summer only 1-2 mg·m⁻³). This considerable diminution of the fodder zooplanktonic biomasses was a consequence of the immigrant predator *Mnemiopsis leidyi*, added at the other anthropic influences.

In the years 1996-1997 the fodder zooplanktonic biomasses were a little higher than in previous years, even in summer months (29.57 mg·m⁻³ in July 1997 in predanubian zone and 10.07 mg·m⁻³ in Constanta area).

The quantitative and qualitative decline in the macrophyta was also observed. Several important *Cystoseira* belts have almost completely disappeared. The *Cystoseira* biomass decreased from 5400 tons fresh weight in 1971 to 755 tons in 1973 and 120 tons in 1979. The phanerogames *Zostera marina* and *Z. nana* have also undergone a considerable decline after the hydrotechnical works for harbor building, which increased turbidity in the Romanian waters.

The free substrata, which had previously been populated by *Cystoseira*, are now covered by opportunistic species with a short life cycle and a rapid growth curve. The most frequent species belong to the genera *Enteromorpha* and *Ceramium* and, to a less extent, *Ulva*, *Cladophora*, *Porphyra* and *Callithamnion*.

The most affected, especially by hypoxia conditions were the zoobenthos communities. The zoobenthos recorded in the last three decades was greatly diminished, both qualitatively and quantitatively; the number of species, particularly in biocoenosis with a lower endurance has disappeared or get rare.

The change and negative ecological processes that have occurred in recent years in the shallow bottoms had also had an impact on the *Corbula mediterranea* community. It is currently in a state of qualitative and quantitative depletion compared with 25 years ago. *Corbula* is very sensitive to ecological changes and its population has decreased considerably to be replaced by the opportunistic *Mya arenaria*.

The most striking change in the '90 years was the dramatic decline in biodiversity: of the 100 types of organisms encountered in 1965 only 12 could be found in 1982. Some groups had disappeared completely or become so rare that they did not appear in the samples.

In biocoenosis in southern zones with hard substratum a number of species and subspecies had either declined in number or disappeared completely. The main cause was the degradation of the biotope preferred by the various species, either as the results of terrigenous pollution or winter hard frost.

The biotopes preferred by these species are stones occurring in the proximity of the coast, the biotope most affected by clogging caused by hidrotechnical construction. In the course of this process, the smaller-sized species, which have reduced mobility and were sheltering in fissure in the stone, were suffocated by the stratum of mud. The species most severely affected were the *Natantia*. Of the 10 species of *Natantia* previously recorded only one, *Hippolite inermis*, was considered to be rare. Today the number has risen to five.

Crangon crangon, *Palaemon adspersus* and *P. elegans* used to be among the most numerous of the larger-sized species. But the situation of *P. adspersus*, the most appetizing shrimp in the Romanian fauna, is now critical and it appears to be on the verge of disappearing completely. *Crangon crangon* and *P. elegans* have also become rare.

Compared to the 80' when owing to repeated phytoplankton blooms the state of the benthic communities was very poor, in the years 1999-2000 a slight improvement was recorded in the qualitative composition of the benthic invertebrates' fauna, in front of the Danube Delta.

Long term investigations on the benthos in the Constanta area, when the blooms developed with a low intensity, showed also a species density rehabilitation, mainly on the density in then *Mytilus* muds - 30-50m depth.

In the last three years (1994-1997) only a slight improvement of qualitative structure of the zoobenthos was recorded. Even the tolerant species from benthic communities have also been affected by the unfavorable environmental conditions.

Hypoxia resulted in a sharp decline in the number of bottom fish inhabiting the shallow coastal waters, including: Gobiidae, Blenniidae, Labridae, Callionymidae, as well as the stingray (*Dasyatis pastinaca*), thornback ray (*Raja clavata*), turbot (*Psetta maeotica*), flounder (*Platichthys*

flessus luscus), sole (*Solea lascaris*), red mullet (*Mullus barbatus ponticus*), weever (*Trachinus draco*), stargazer (*Uranoscopus scaber*) and sturgeons (Acipenseridae).

Pelagic fish have also undergone changes in the last 20-30 years. Large predators such as bluefish, mackerel, as well as largest common tunafish and swordfish, have disappeared. After the disappearance of predatory fish, there was an increase in the number of small pelagic fish, such as anchovy, sprat and Black Sea horse mackerel.

Changes in the Black Sea ecosystems have been reflected in the taxonomic composition of commercial catches. Until the 1960s over 20 commercially valuable fish species were caught. In recent years there has been a considerable decline in total catches, from 14000 tons in 1989 to 6200 tons in 1990, 12000 tons in 1991 and 3700 tons in 1992.

Although, the last three years reflects perceptible improvement in the state of some biotic components, the whole ecosystem is still disturbed and continue to be damaged by consequences of many years of intense eutrophication.

The Romanian Black Sea coastline consists of several geomorphologic areas grouped into two large zones:

- northern, Danube Delta and Razim-Sinoe lagoon, with a length of about 170 km extending from the Ukraine border to Cape Midia, consisting mainly of terrigenous sediments with dunes, extensive lowlands, marshes and lagoons, where the altitude is generally 0.5- 0.8 m;
- southern, from Cape Midia to Vama Veche, the Bulgarian border, with an approximate length of 80 km, a relatively higher zone consisting mainly of active cliffs and pocket beaches.

In the Danube Delta, under the influence of natural factors, the shoreline is changing, advancing in one site, receding on another. Here the beach lost in the last 35 years about 2400 hectares (about 80 ha/yr.). The shoreline has retreated in some points more than 400 m, the majority having changed some 200m (Annex II). At the same time, accumulation amounted to 169 hectares, which is only 6-7 ha/yr. During storm periods, in areas where the shore is lower, the coastal barrier is often damaged or submerged by the waves allowing seawater to flow into the freshwater lakes, disturbing their ecosystem.

In the southern sector Midia - Vama Veche, where the shore is relatively higher the shoreline has a different evolution. The destructive effects are reduced, but except the beach area, the coastal processes are irreversible: gravitational breakdown or natural factors destroy cliffs.

Coastal protection structures have been built in the northern part to stabilize the coastal barrier (by closing Portita mouth, the lagoon type lake Razim was separated by the sea through a