

Research and Restoration of the Essential Filters of the Sea

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Abstract

The Black Sea is very fragile ecosystem and has its own ecological problems related to human activities. It is one of the most isolated sea which has connection to the Mediterranean with narrow and shallow Turkish Straits system. These problems are more acute than those in open marginal seas having a free water exchange with the oceans:

- massive pre-fertilization of Black Sea with nitrogen and phosphorus compounds known as “anthropogenic eutrophication”,
- disposal of insufficient purified waste waters,
- degradation of bottom algal communities,
- oxygen deficiency in near-bottom water layers
- unmanaged fisheries, overfishing and lack of sufficient control mechanisms,
- invasive species,
- lack of information and economic difficulties,
- human made construction on the coasts (such as roads, ports, landfills)

Due to support ecosystem artificial reefs may play an important role in the Black Sea. This is the basic reason for the creation of the project “Research and Restoration of the Essential Filters of the Sea (REEFS)” project supported by EU under The Black Sea Joint Operational Program.

Keywords: REEFS Project, The Black Sea, artificial reefs, biodiversity, indicators.

Özet

Karadeniz çok hassas bir ekosisteme sahiptir. İnsan faaliyetlerinin sonucu olarak kendine özgü bazı ekolojik sorunları bulunmaktadır. İzole bir deniz konumunda olup Akdeniz ile teması dar ve sığ Türk Boğazlar Sistemi üzerinden sağlanmaktadır. Yaşanan sorunlar açık deniz irtibatı olan diğer denizlere göre daha ani etkilere sahiptir. Bunlar:

- Yoğun azot ve fosfor birikiminin neden olduğu “antropojenik kirlilik”,
- Dip alg topluluklarının çürümesi ve birikimi,
- Zemine yakın kısımlarda oksijen yetersizliği,
- Balıkçılık faaliyetlerinin iyi yönetilemeyişi, aşırı avcılık ve yetersiz control mekanizmaları,
- İşgalci türler,
- Karadeniz ekosistemi ile ilgili bilgi eksikliği ve ekonomik zorluklar,
- Kıyılarda yapıları (yollar, limanlar, deniz dolguları vb)

Karadeniz'de ekosistemi desteklemek için yapay resifler önemli bir rol oynayabilirler. Bu temel ihtiyaç nedeniyle AB Karadeniz Ortak Faaliyet Programı tarafından desteklenen “Denizin Zorunlu Filtrelerinin Araştırılması ve Restorasyonu (REEFS)” projesi yürürlüğe konmuştur.

Anahtar Kelimeler: REEFS Projesi, Karadeniz, yapay resifler, biyoçeşitlilik, indikatörler.

Introduction

Artificial reefs are often defined as any human-made structure or equipment deliberately placed in marine environment where that structure does not exist under natural circumstances. The purposes for constructing and placement of these structures under water are:

- enhancing the fishery resources and increasing populations of all sorts of plants and animal marine life,
- hydro biological amelioration,
- tourists entertainment.

Research and Restoration of the Essential Filters of the Sea (REEFS, 2014) project is a joint cross-border initiative of five partners from the riparian countries - Bulgaria, Ukraine, Romania, Georgia and Turkey. REEFS is a project focused on the scientific research of environmental impact of the artificial reefs in the area of Black sea countries.

The main objectives of this project can be summarized as:

- Strengthening the joint knowledge and information base needed for application of artificial reefs to address the organic pollution in the maritime ecosystem of the Black Sea Basin,
- Supporting policy makers in defining contemporary strategies, action plans and internal measures for recovering of marine resources, allowing sustained Black Sea fishing in the future,
- Significantly boosting progress towards improving the marine environment of the Black Sea.

The overall objectives of REEFS Project is to establish long-term partnership platform for scientific, technical, administrative and awareness raising activities in favor of artificial reefs practice as a way of active support of the self-restoration of the Black Sea ecosystem.

There is no legal framework among the riparian countries for the establishment of the artificial reefs in the basin. The laws of the Black Sea countries differ both by the content of specific rules and by the name of individual acts, by the authorities, which appear competent on artificial reefs subject and by the way of implementation of these standards.

Depending on its hierarchy and its level of abstractness, the legal applicability of national laws of each country pays insufficient attention to the issues related to the artificial reefs. In some cases, these issues are regulated only indirectly by existent legislation and often there is a gap in the law.

Except partially for Bulgaria and Turkey, in the other countries there is no specific legislation, which explicitly provides for regulation of activities, associated with artificial reefs.

There are 5 partners from Bulgaria, Georgia, Romania, Turkey and Ukraine. Partner institutions are:

Bulgarian Biodiversity Foundation (BBF) (Consortium leader)

Bulgarian Biodiversity Foundation (BBF) was established in 1997 with the support of the Bulgarian-Swiss Biodiversity Conservation Programme (BSBCP).

Since its creation BBF has supported efforts of the Bulgarian Government and the Swiss Agency for Development and Cooperation in implementing sustainable management practices in 7 key regions of Bulgaria-Central Balkan, Dobrudja, Bourgas Wetlands, Ropotamo, Strandja, Eastern Rhodopes and Pirin.

The BBF team has carried out numerous direct nature conservation activities such as Action Plans for endangered species, Management Plans for protected areas and preparing

and submitting documentation for declaring and announcement a new protected areas-nature parks and Ramsar Sites.

Main interes areas of BBF are:

- Enhancement of the protected areas network,
- Supporting biodiversity community,
- Creating models for education in conservation biology,
- Increasing the public awareness.

Ilia State University (ISU) (Georgia)

It was founded in 2006. University supports and develops research on fundamental problems of sciences. Based on the research conducted within the scopes of fundamental sciences, Ilia State University directs the study of Georgia in all related directions. This way, the University emerges as an initiator of international studies and is an active participant of international programs in this domain. Institute of Zoology and Institute of Ecology at the Ilia State University has got the possible capacity and experts to actively participate and support the REEFS project. The University owns Grigoleti Black Sea Research Center close to Poti Port that will be at disposal for research within the REEFS project as well.

Mare Nostrum (Romania)

Mare Nostrum is a nongovernmental organization comprised of citizens concerned about the severe degradation of the Romanian Coastal Environment, whose mission is to promote the transformation from the current unsustainable practices and attitudes towards more sustainable and environmentally conscious methods regarding the utilization of Romanian Coastal Zone. Being part of this project is a new challenge for Mare Nostrum NGO to give them the possibility to develop and promote ensuring the sustainable development of the coastal zone by increasing the

number of artificial reefs and provide more information about the installation and methodology on artificial reefs, as well as establishment of new institutional and legislative framework.

Faculty of Marine Sciences of Karadeniz Technical University (Turkey)

Faculty with the Department of Fisheries has widely focused on marine ecology, fisheries management, fish processing and aquaculture. Besides education and training, Department has carried out number of projects on fisheries and fisheries management, fishing gear and selectivity, marine protected areas, aquaculture, fish nutrition, water circulation systems, seafood processing, conservation and hygiene, physical and chemical oceanography, molecular biology and fish genetics and marine ecology funded by either nationally and internationally. Department has aimed to be more active to solve problems related with the Black Sea, try to increase the research area within the EEZ of Turkey, increase cooperation with the research institutions in the Black Sea countries as well as the European institutions.

Odessa Branch Institute of Biology of the Southern Seas, National Academy of Sciences of Ukraine (OBIBSS)

The Institute was established in 1964 by the special resolution of the Presidium of Academy of Sciences of the USSR. The main scientific direction of OBIBSS is the research of the structure, space-time variability and sea ecosystems functioning in connection with the habitat conditions. Scientific trends are being worked out and orientated towards the solution of theoretical and applied issues of constructive aquatic ecology including faunistics and floristics of the areas under study, systematic of separate groups of hydrobionts, inventory of

the flora and fauna, the evaluation and working out of standards for anthropogenic loads on water ecosystems, pollution and self-purification of aquatic biocoenoses, ecology of water body subjects to the influence of large port-industrial complexes and communal agglomerations, hydrobiological amelioration and restoration of damaged ecosystems, mathematical modeling of aquatic ecosystems for the purpose of obtaining unbiased diagnosis and prognosis of their state, the creation of computer bases of ecological data on the north-western Black Sea shelf, coastal areas and limans of the Danube-Dniester interfluvium. Under REEF project their specific aim is to ensure the smooth project implementation in Ukraine, to coordinate the research activities of the REEFS project and participate in the methodology and training packages development together with the other partners.

Methodology and Structure

Some of the main activities and objectives of the REEFS project are related to the analysis of the relevant legal and institutional framework in riparian countries and to respective particular proposals and recommendations for improvement of the legislation on biodiversity conservation in the Black Sea Basin. In order to reach these goals the evaluation of the existing legal and institutional framework of Bulgaria, Georgia, Romania, Turkey and Ukraine, relevant to the subject and purpose of the REEFS project, a list of analyze regulations, conclusions, recommendations for improving the relevant provisions of national legislation on the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural environment in the Black Sea as well as on easing administrative procedures in connection with the placement of artificial reefs, proposed by experts and stakeholders in

those countries.

Research and analyses are performed by a working group of legal advisors, country assistants and scientist.

In order to carry out scientific studies a list of indicators have been concluded to measure the effectiveness of artificial reefs to improve of water quality and increase biodiversity (Table 1).

All forms of nutrients are needed because the decreasing concentration of nutrients along the gradient of current gave us possibility to calculate intensity of self-purification of the water by seaweeds that covered the artificial reef. Besides the number of nutrients that excreted by mussels is very important.

Biochemical oxygen demand, total number of bacteria in the water and the total number of coliform bacteria are the standards of water quality in recreation zone of the sea.

The direction of current varies each hour, but it is known the direction of the water transportation, the identification of the sampling points can be determined easily. The initial samples may give information about water quality before the reef and final samples will give information about water quality after the reef. The comparison of these groups of the samples shows the effectiveness of fouling community in purification process.

Type of Reefs and Site Selection in Trabzon

Preliminary "Akordeon type" REEF modules had been decided in the project. After the warning of the experts it had been changed to "Piza type" considering the rough sea conditions. Preliminary tests had shown that "Piza type" had also the risk of destruction and swept away with the bottom currents. So the final decision had been made on the use of "Serpentine type" of reef modules in the project (Fig. 1).

Table 1. Indicators in the reef project

Indicators of water quality	Indicators of biological diversity
<ul style="list-style-type: none"> ● Nutrients (NO₂⁻, NO₃⁻, NH₄⁺, N_{org}, N_{min}, PO₄⁻) ● Concentration of particle organic matter (POM) ● Biochemical oxygen demand (BOD5) ● Total number of bacterioplankton. ● Total number of coli form's bacteria. ● Total number and biomass of phytoplankton 	<ul style="list-style-type: none"> ● Macrophytes (species composition, number, biomass, projective cover of hard substrates) ● Macrozoobenthos (species composition, number and biomass on the soft bottom and hard substrates-AR; size-age composition of mussels, that will be necessary for calculation of their filtering effect). ● Fish (species composition, average catch of fish per day)
<p>Before water sampling it is necessary to measure the direction and rate of the current on the same depth were will be install the artificial reefs. Water samples in triplicate should be picked up according to the direction of the current before and after the reefs. So total number of water samples during one observation is 6 as minimum. It is desirable to pick up the samples three times (one month, four months and a year after installation of the reefs).</p>	<p>Before installation of artificial reefs it will be necessary to investigate bottom community in research area (macrophytes, zoobenthos and fish). Samples of artificial reefs fouling in triplicate should be picked up after installation of the reefs (one month, four months and one year).</p>

After receiving the legal permissions from the Ministry of Food, Agriculture and Livestock (MFAL), research and installation area was selected in Sürmene (Civra) within the coordinates of 40.135910E-40.913183N, 40.135910E - 40.922235N, 40.174787E - 40.913909N, 40.174787E-40.922870N (Fig. 2).

The height and diameter of the shallow water type serpentine reef modules is 8.2m and 2.8m, respectively. Six modules will be installed in the area. In order to fix each module, 2.7 tons of concrete blocks will be used.

Reef modules will be imported from Bulgaria and tender process is ongoing.

Artificial Reefs in Turkey

There are several attempts on artificial reefs since 1989. The first applications were done in the Aegean Sea and followed by Mediterranean (Table 2). Finally it became very attractive to all the local governments located on the coast line of the other Seas. Trams, ships, planes and concrete blocks were used in these applications.

In Turkish coasts, licensed artificial reefs which are trams, ships, planes and concrete blocks, were settled at 62 locations. Most of them are located mainly in the Mediterranean and the Aegean Sea coasts. Only 3 of them are located in the Black Sea coasts.

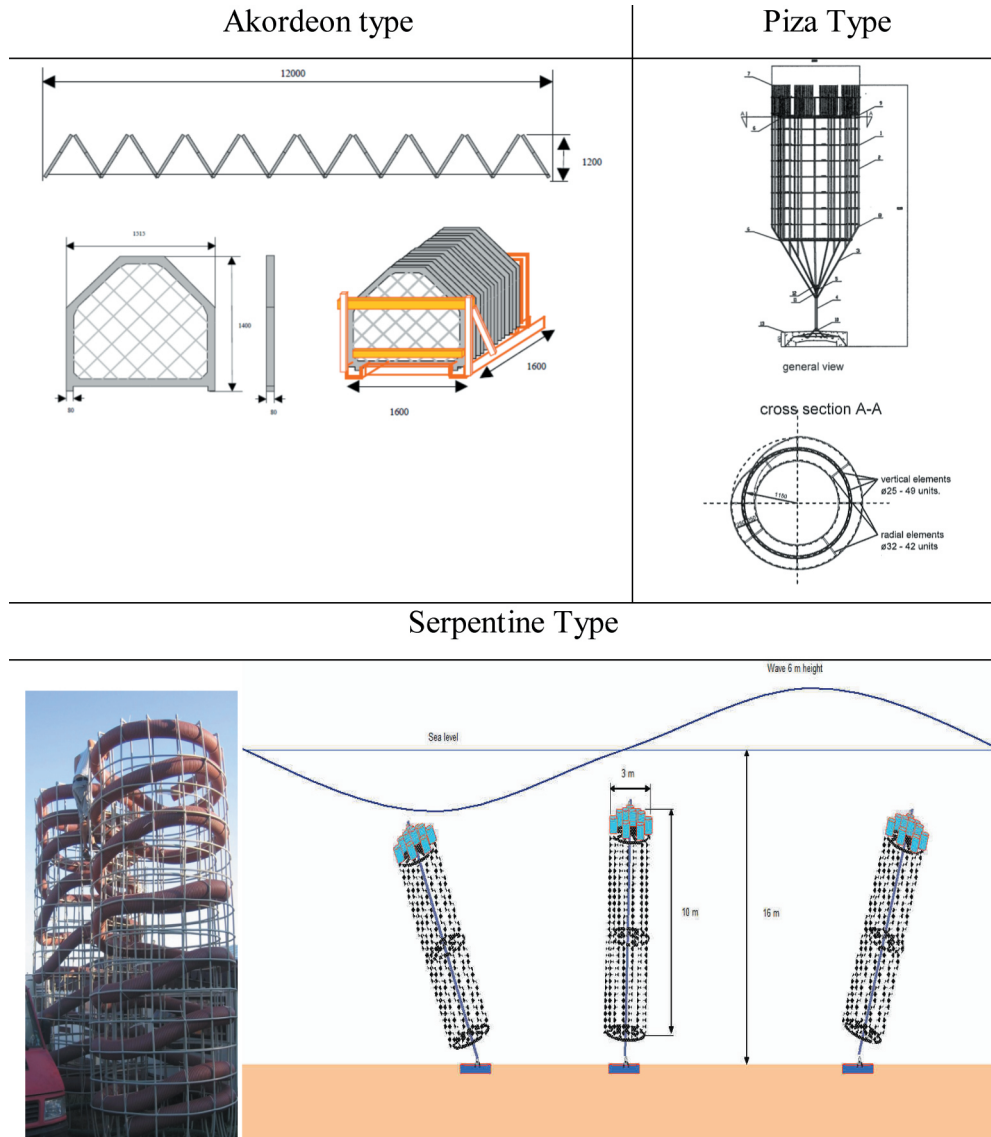


Figure 1. Artificial reef types in the REEF project.

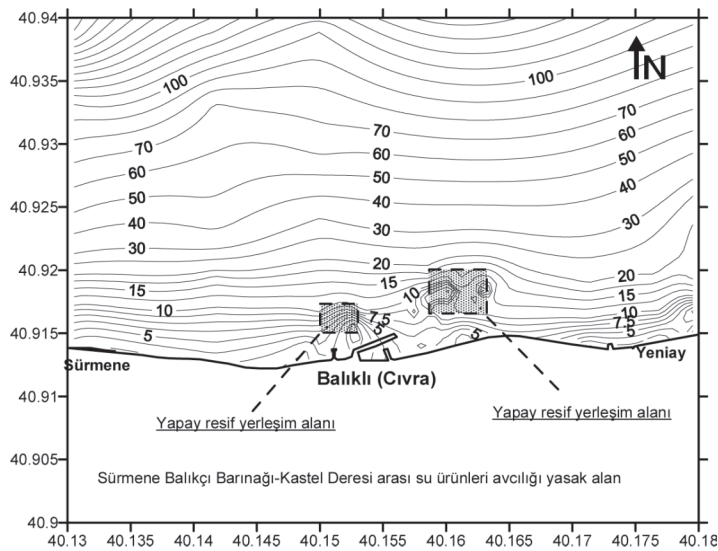


Figure 2. Reef installation area.

Table 2. Artificial reefs in Turkey

Year	Province	Location	Type	
1989-2014	İzmir	Urla, Urkmez, Foça, inner bay, Çeşme, Gumuldur, Hekim island	Concrete blocks, trams	9
2011	Aydın	Didim	Ship	1
2001-2012	Muğla	Marmaris, Bodrum, Fethiye	Ship, plane, concrete blocks	5
2006-2011	Antalya	Alanya, Centrum, Three islands, Kas	Ship, plane, concrete blocks	7
2006-2011	Balıkesir	Ayvalik, Erdek Mudanya	Ship, concrete blocks	3
2009	Mersin	Erdemli	Ship	1
2009-2012	Adana	Yumurtalık	Concrete blocks	2
2010	Edirne	Saros körfezi	Plane, ship and other materials	1
2011	Yalova	Centrum	Concrete blocks	
2011-2012	Rize	Centrum	Concrete blocks, Coast guard boat	2
2011	Trabzon	Surmene	Concrete plates	1
2005-2010	Düzce	Akçakoca	Plane, concrete blocks	2
2012	Kocaeli	Karamürsel	Concrete blocks+ship	1
2012	Ordu	Ünye, Fatsa	Concrete blocks	2
2012	Samsun	Centrum	Coast guard boat	1
2000	Zonguldak	Centrum	Concrete blocks	1

After 2000, in order to create a legal base to cover increasing demands MFAL has started legislative procedures for the future. The first legal document was prepared in 2000 for the implementation artificial reefs as preliminary guideline. According to the site selection:

- There would be no conflicting interests with existent legal activities (military, navigation, tourism, fishing, aquaculture, coastal zone management),
- Height of reefs not over 1/3 of water depth and limited under 40 m length for each reef module groups.
- Muddy bottoms are not good for the reefs,
- Ground slope should not be over 30⁰,
- Site needed to be safe from strong currents,
- High sediment transportation areas (under the effect of river discharge

areas) is not suitable,

- Constructions on Posidonia and other flora are not permitted.
- Data on currents, light penetration, temperature, oxygen, salinity, pollutants etc. are needed to confirm suitability.
- Reef modules should be implemented in line with the master plan prepared according to the geographic and topographic characteristics of the region.
- Reef installed areas should be lightened and put on navigational charts where necessary.
- Awareness meetings (at least one) are essential with all local stakeholders with the representatives of the Ministry before the installation process.

Materials used to construct modules should be high quality concrete blocks

reinforced with iron frames with no environmental impact. Waste materials as old tires, ash, and contraction wastes should not be used.

Design of the reef modules must permit water circulation, easy surface attachment, have longer life and resistance, and can be easily repaired and good for serial production.

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