The Prospects of Using an Artificial Underwater Reef in the Maritime Water Area of Georgia

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Abstract. The article discusses the importance of using underwater artificial reefs, the current situation, and prospects. The use of underwater artificial reefs has different purposes, such as strengthening fishery resources, population growth of living organisms in the sea, hydrobiological reclamation, development of diving tourism, coastal reinforcement function, etc.

The use of artificial reefs is discussed within the concept of the “Blue Economy”. Thus, the Black Sea "blue economy" goal is to preserve, protect, and reap the biodiversity of marine resources. The sea has not an unlimited resource and the anthropogenic factors can significantly reduce or increase the economic benefits of the sea. The prudent management of marine resources and the improvement of the ecological condition of the sea are extremely important for sustainable economic development.

The work discusses the importance of artificial reefs for the ecosystem, the diversity of underwater flora and fauna, and the prospect of increasing its inhabitants. The study's goal is to study the economic effects of artificial reefs, their impact on the environment, durable and easily portable design layout for the depth of the sea. And, the aim is to run the production, placement of the artificial reefs at the coastal waters of Georgia, and promote the establishment of the initiative.

Keywords: fishery, underwater artificial reefs, underwater ecosystem, blue economy.

The world climate changes have greatly affected the ecosystem, raise of a sea level and especially coral reef triangle[1] (pic. N1), which are gradually destroyed and lose their main purpose. Temperature growth to more than 2°C endangers coral reef systems. [1]

From ecological point of view importance of coral reefs is incredibly huge for the photosynthesis carried out by their algae that provides food supply in the tropical and subtropical marine food chain and contributes to nutrient processing. Apart from climate changes they undergo

[1] Coral reef triangle – that is the richest centre of the planet sea biodiversity, life and coral diversity, where more than 6000 species of fish are studied. More than 76% of the world coral species are concentration and wildlife array. It covers an area of 6 million km^2 and includes Indonesia, Malaysia, the Philippines, Papua New Guinea, Timor-Leste, and the Solomon Islands. 76% of the world coral species live in this sea "nursery" and 6 species of 7 sea turtles in the world. *https://wwf.panda.org/discover/knowledge_hub/where_we_work/coraltriangle/*

anthropological influence as well, such as degradation of underwater flora and fauna due to illegal fishing, irresponsible procuring production and pollution with various debris and wastes that is the outcome of weak management as a whole. [3]

Satisfying demand with limited resources in the economy is the subject of constant discussion and researches for economists. Humanity with their development are increasingly using natural resources so that in most cases they don't think about consequences of uncontrolled usage of them. The concept of "Blue Economy" is the defense of natural resources and proper use of them that aims to utilize existing resources to meet the economic needs but not to damage nature and ensure that there always are sufficient resources for sustainable development of economy.

Pic. N1. Coral Reef Triangle

Source: WWF (World Wide Fund for Nature) [2]

The concept of the blue economy has existed since 2012 and it aims to merge nature with business affairs. It is based on three main principles:

- ✓ Any resource can be replaced with another resource;
- ✓ Nature does not generate wastes, and thus neither business nor people must generate them;
- ✓ Waste of any production or consumption is the source of consuming new products; [4]

Health of seas and oceans is remarkably decreased due to anthropological works, accordingly changes are reflected on people's welfare. According to future forecasts world population will grow

even more that will naturally increase the demand for sea products, hence “sea health” needs significant changes such as:

- ✓ Strengthening construction/fortification works along the coastline;
- ✓ Changes in climate and quantity of population;
- ✓ Reduced fish stock due to overfishing;

Exactly an underwater artificial reef appears to be a hampering factor for overfishing, the first steps have already been taken toward usage of which. According to the Organization for Economic Co-operation and Development (OECD), the world oceans generate additional 1,5 trillion dollars in the whole economy a year. More than 10% of the world GDP and annual income approx. $ 362 billion.[5]

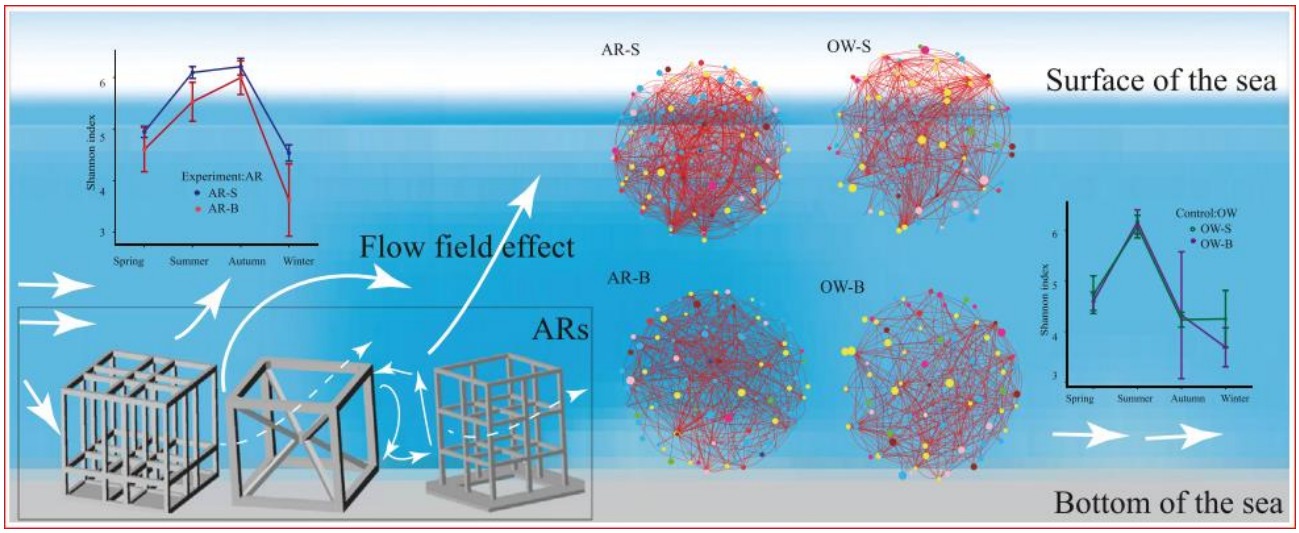
Overfishing has an adverse impact on an ecosystem and devastates natural habitats of fish. Inefficient policy may hinder sustainable development of fishery that will have negative effects on maritime countries and economic state of cities, especially in the areas where population appears to have low income.

An artificial reef is a substrate made of special materials that is placed in the areas where biodiversity is poor and a place is degraded. "It is a mass for the development of new, solid Benthic communities that obviously contributes to the growth of biodiversity and improves water quality (through water filtration). Due to the environment of the Black Sea and the species of fish, it is possible to use a material that does not contain rubber. " [6]

In 2015, in the framework of the European Union project “Research and Restoration of the Essential Filters of the Sea (REEFS)” artificial reefs were made in one of the beneficiary countries of the project in Bulgaria and were sent to Georgia. Four reefs were placed in the Black Sea in Daba Kvariati. They were placed with 25 meters distances in the depth of 12,5-14meters.[7] Similar projects are vulnerable in the Black Sea area and complete researches are not done.

According to the international practice an artificial reef (ARs) (pic. N2.) is considered to be one of the priority directions that is the subject of observation and fundamental studies for many scientists. Reef construction is studied based on researches and a natural reef is in fact an auxiliary system.

Pic. N2. Artificial Reefs (ARs) and Open Sea Water (OW)



Source: ELSEVIER June 2020. Response of protist community dynamics and co-occurrence patterns to the construction of artificial reefs: [8]

Artificial reefs are underwater artificial structures located onshore to mimic the characteristics of natural coral reefs, to attract fish and to improve and restore aquatic ecosystems.

Artificial reefs are currently used to reduce the degradation of marine fish populations and protect endangered species, as well as improving fisheries and restoring biodiversity. Various studies have shown that fish species breed abundantly around artificial reefs and a safe habitat is created for these species. As this field is new, the impact of artificial reefs on the environment is less studied and it is small in terms of evaluating the results of scientific, long-term monitoring (quantitative and qualitative). [9]

Taking into account the example of the Caribbean Sea coral reefs has been declined also degraded and destructed, in order to maintain ecosystem, it's often considered to deploy artificial reefs with structures similar to natural reefs on the seabed. Regardless of the specific purpose, it is important to note that artificial reefs do not have a negative and stressful effect on existing species. Accordingly, in order to evaluate the ecological impact of artificial reefs in the Caribbean, an analysis of 212 artificial reefs already deployed between 1960 and 2018 was conducted.

In the last century, the creation of artificial reefs was mostly spontaneous, and the expected risks and consequences were not studied. Therefore, different types of artificial reefs were used in the Caribbean:

- ✓ Ship wrecks (44%)
- ✓ Reef Balls (13%)

- ✓ Concrete structures and piles of building blocks (11%)

In addition to the main types of reefs mentioned above, plastic structures, rubber tires and hills made of oxidized metal were also used, which had a negative impact on the ecosystem as a whole. The most effective of them was the construction of reef balls (Fig. N3). The density and species richness of fish on this type of artificial reefs was higher than on natural reefs in the same depth zone. Especially many fish of the smallest species (1-5 cm) were around an artificial reef, which indicates that it was used as a nursery structure and a lot of seagrass beds were grown on them [10].

In addition to Reef Balls, various shapes and structures of artificial reefs have been designed, quite large and from 3 to 5 meters in height (Fig. N4.). Consequently, they have more massive structure and have large holes, which in turn, supports the growth of reproduction of large fish species.

Pic. N3. Reef Balls

***Source:* 1:** Tokyo Cement group. Reef Rehabilitation 2012. [11] ***Source:* 2:** Tzuen Kiat Yap, ResearchGate 2018. [12]

Pic. N4 Artificial Reef - Massive Cement Construction (3-5 m. Height)

Source: Florida Artificial Reef Program. Florida Fish and Wildlife Conservation Commission, Division of Marine Fisheries Management. [13]

Conclusion

Underwater reefs in the maritime water area of Georgia are found mainly in the coastal areas in the form of collapsed bridges and rock slopes. They are not represented in depth, because we have no islands in this water zone, and the sea inhabitants actually do not have a natural shelter. Consequently, they mainly inhabit coastal structures along the coast, coastal structure is one type of the artificial reef, although these coastal structures are ineffective for fish species living in the open waters and cannot provide them with shelter.

We believe that on the basis of the EU project in 2015 ,,Research and Restoration of the Essential Filters of the Sea (REEFS) " a research group should be set up to study ecological, biological and biodiversity condition of the artificial underwater reef deployed in 2015.

The project is very important in its essence, but it is impossible to conduct a joint research in this direction without the main stakeholders such as (public sector, international organizations, local researchers). We expect that the study will have very good results, which will give us a basis for large-scale construction in this direction, all artificial structures will be deployed at a distance of 150-200 meters from the coastline and at a depth of 15-20 meters.

Production and deployment of artificial reefs will develop the following areas:

- ✓ Richness of fish species, reproduction growth, renewal of biodiversity and development of blue economy (taking into account economic indicators, diversification of restaurant chains with local fish species and mass fishery);

- ✓ Deep coastal barrier (coastal reclamation is a constant problem in the coastal zone of Georgia. The main impacts of erosion of the coastline are underwater waves, which gradually turn into surface waves);
- ✓ Development of underwater tourism (Diving) (we had a consultation with the Department of Tourism and found out that quite a large number of visitors are interested in this kind of service, but it is impossible to offer);
- ✓ Conducting scientific research of the underwater ecosystem and providing recommendations to the state (in fact, no significant studies of the sea and its ecosystem have been carried out in Georgia)
- ✓ Make a small but significant contribution to the global campaign for conservation and restoration of coral reefs.

We believe that the research topic: " The Prospects of Using an Artificial Underwater Reef in the Maritime Water Area of Georgia" is very important and relevant. Therefore, we plan to pay great attention to work in this direction in the future and in the form of project involve organizations interested in solving this problem.

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