

# Oceanographic research for a future tourist marina on the Romanian Black Sea coast

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**Abstract.** The aim of this paper is to analyze the importance of oceanographic research in the development of a future touristic marina on the Black Sea coast. Oceanographic research plays a crucial role in understanding the marine ecosystem, assessing the impact of human activities, and developing appropriate conservation and management strategies for sustainable tourism. Key areas of research include water quality assessment, biodiversity study, monitoring the impact of tourist activities on marine habitats, studying climate change, and developing adaption and mitigation strategies. By integrating oceanographic research into the planning and development process, stakeholders can ensure responsible and sustainable tourism that protects the marine environment and its biodiversity.

**Keywords:** oceanographic research, touristic marina, sustainable tourism

## 1. Introduction

The Black Sea coast holds significant potential for the development of tourism, particularly in the form of a touristic marina. The natural beauty and diverse marine ecosystem of the Black Sea make it an attractive destination for tourist seeking coastal experiences. However, the responsible and sustainable development of a touristic marina requires a comprehensive understanding of the marina environment and its vulnerabilities. This is where oceanographic research plays a crucial role [1].

Oceanographic research focuses on studying the various aspects of the marine environment, including water quality, biodiversity, ecosystem health, climate patterns, and human impacts [1]. By conducting thorough research in these areas, stakeholders can make informed decisions and implement effective strategies to ensure the long-term viability and conservation of the marine ecosystem [2].

In the context of developing a touristic marina on the Black Sea coast, oceanographic research becomes essential for several reasons [3,4]. Firstly, understanding the quality of the seawater is crucial to assess its suitability for recreational activities, such as swimming, diving and water sports. It involves monitoring the presence of pollutants, chemicals, and microplastics to minimize the potential risk to both human health and the marine ecosystem [3,4].

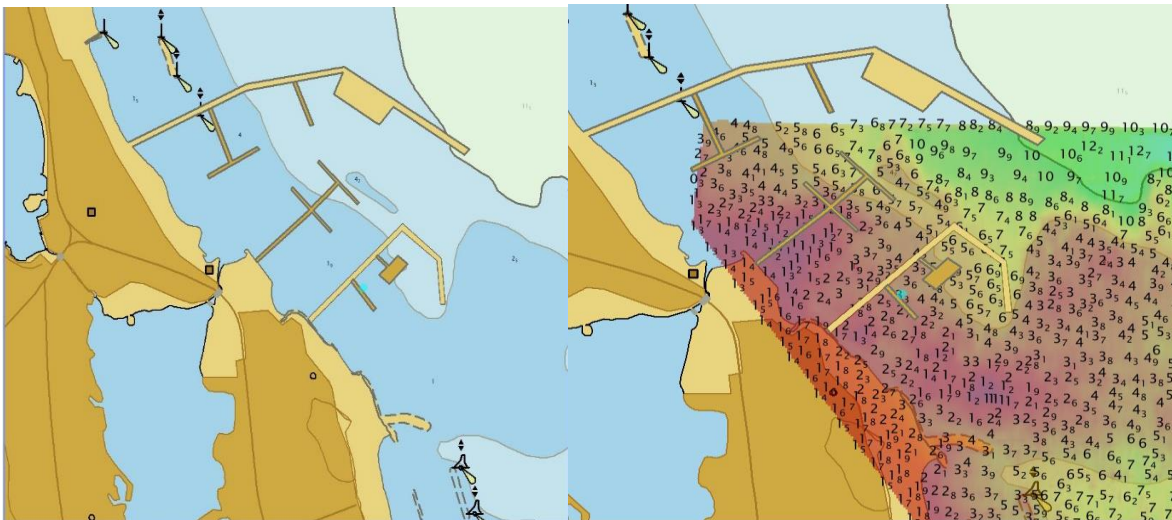
Secondly, studying the biodiversity of the Black Sea is vital for maintaining the ecological balance and protecting vulnerable species and habitats. The Black Sea is home to diverse marine life, including dolphins, whales, fish, and unique underwater flora [3,4,5]. Through in depth research, scientists can identify areas of high ecological value, sensitive habitats and migration routes of marine species.

This knowledge helps in setting conservation measures, determining appropriate zones for tourism activities, and preventing potential damage to these fragile ecosystems [6,7,8]. Furthermore, oceanographic research contributes to monitoring and managing the impact of tourist on the marine environment [8]. By evaluating the effects of various activities associated with the touristic marina, such as boating fishing, and coastal infrastructure development, researchers can identify potential threats and develop mitigation strategies [3]. This proactive approach ensures that tourism activities do not harm the marine ecosystem but rather coexist harmoniously with it [10].

## 2. Material and Methods

A case study was carried out in the Pescarie area of Constanta to explore a potential area of interest [11, 12].

The purpose of this study was to ensure that the area is optimal for the development of a modern tourist marina [10]. Much of the research in the area was carried out by the Grigore Antipa Research Institute between 2009 and 2019 regarding seawater sampling, water quality analysis, marine biodiversity monitoring, and climate change that may occur [12]. The Teledyne Caris ENC S-57 software of the Maritime Hydrographic Directorate was also used [12]. This program helps to import and process data in S-57 format according to IHO standards. Based on the use of this programme, a model tourist port was created in the area of interest (Fig.1).



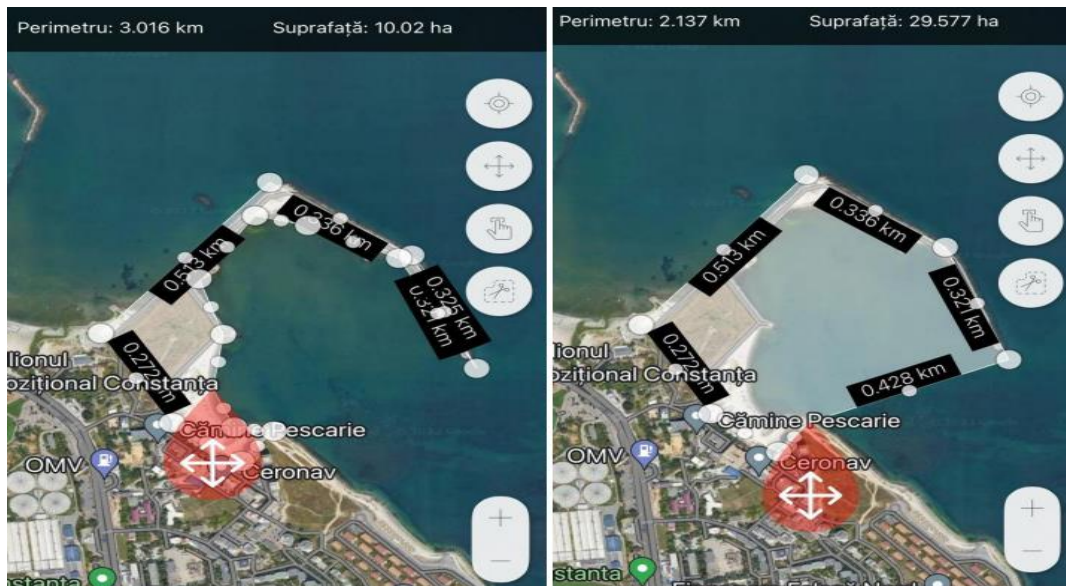
**Figure 1.** Implements a model of a turistic marina port on the Pescarie area using the Teledyne Caris ENC S-57

This project relates to the first phase of development which will cover an area of maximum 30 ha (Fig.2) and will allow the basic structure of the marina to be built from the necessary infrastructure berthing of boats, their supply and provisioning, the construction of the service area and the area for professional fishermen [133]. The area of the future tourist marina will have easy access for boats to enter the marina without problems caused by shallow water or sandbanks [14].

Following research, the proposed area has been placed in the category of low-risk areas, it does not present navigational hazards such as wrecks or areas with rocks or boulders, deep to adjacent contiguous zone boundary is a constant 10 meters and the minimum depth to shore is between 1-5 meters, so dredging can be used for certain areas [15].

A modern marina can offer a wide range of facilities to meet the needs and requirements of locals and tourists alike, but not least boat owners. Modern marinas should be equipped with moorings and pontoons [16]. Pontoons and platforms should be well equipped and designed with safety systems and boat facilities [17].

A marina must provide facilities for refueling boats, may include refueling stations for moored craft, as well as fueling systems fuel management systems to ensure an efficient and safe process [18].



**Figure 2.** Graphical representation of land area and total area in the tourist marina project of the Pescarie area Using the GPS Fields Area Measure

### 3. Results and Discussions

Concerning the presentation of the method of collecting seawater samples, in the period 2009-2019, samples were collected along the Black Sea littoral strip including the area of interest "Pescarie"[18,19].

The samples were taken following the expedition that took place every year in the warm season (from May to September-October) (Fig. 3), this period being considered ideal for the development of the phytobenthos component. Three replicates were collected from the station level on each depth gradient, generally in the range of 0-3 meters, with a metal frame of 20x20 cm, following the so-called "squares method" on hard substrate for the sampling of macroalgae and hard sand [18,19].



**Figure 3.** Map of sampling stations for macro-algae and marine phanerogams

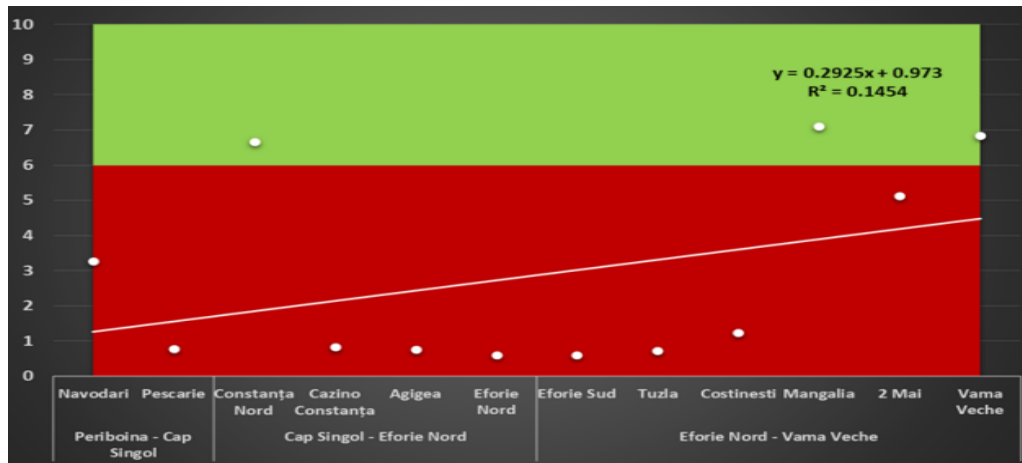
At present, phytobenthic communities are distributed on the Romanian coast between 0- and 8-meters depth, with the maximum biomass also recorded in this range of depth range. After this range, we can no longer speak of well-structured phytobenthic associations, but only patches of algae distributed in a random pattern (Fig.4.) [17,18].



**Figure 4.** Green and red algae in the Black Sea

The assessment of the ecological status of coastal water bodies and shallow water habitats on the Romanian coast was carried out using the Ecological Assessment Index (EI), based on the principle of relating the values obtained to a "threshold value", according to the principles of the Marine Strategy Framework Directive (Fig.5) [19].

Information is also presented on the qualitative and quantitative structure of the macroalgal communities formed at the base of the 11 newly constructed dykes in the coastal area (9 dikes in the Mamaia - Constanta area and 2 dikes in the Eforie Nord area), as well as information on the variability of physical and chemical parameters [19].



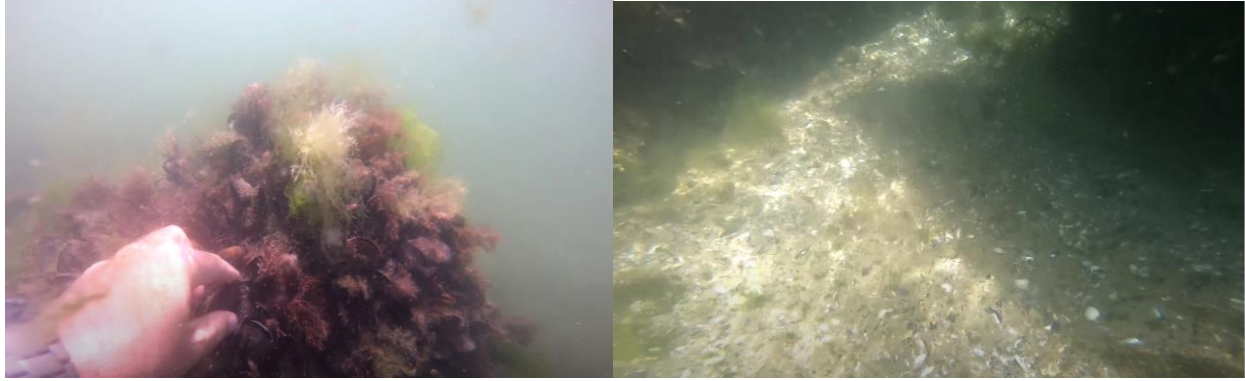
**Figure 5.** Ecological status of coastal water bodies from 2009 to 2019

In July, in the Constanta breakwater (Fig. 6) area high temperature values were reported (values between 23.2 and 24.9°C) and oxygenation conditions showed oversaturation [18,19].



**Figure 6.** Presentation of the breakwaters in the chosen area

For the infralittoral zone off the Romanian Black Sea coast, the following have been defined two major habitat types (Infralittoral Sands and Infralittoral Rock and Biogenic Reefs) and four subtypes of these habitats (*Zostera noltei* habitat, Infralittoral rock with algae photophytic algae habitat, *Coccolytus brodiaei* habitat, *Cystoseira barbata* habitat) [118]. Ecological assessment of the habitat Infralittoral rock and biogenic reefs shows non-attainment good ecological status. The Infralittoral Sands habitat was found to be in good condition during the assessment. 61% good ecological status throughout the coastal zone [19].



**Figure 7.** Representation of the infralittoral Sands and Infralittoral Rock and Biogenic Reefs

The annual habitat assessment of *Cystoseira barbata* has also shown a clear trend of improvement in the ecological status of this habitat type over the last five years (Fig. 8.) [17,18]. The water temperature in 2009 also ranged from 3.4°C to 27.6 °C, the lowest values were in February and the highest in July, the pH of coastal waters was recorded values ranging from 8.29 to 8.50 units with an average of 8.40, the monthly average values for the year 2009, indicating acidification of coastal waters [19]. The salinity of water bodies ranged from 0.21-19.11‰, the maximum value being in coastal waters [19].



**Figure 8.** Seasonal seaweed *Cystoseira barbata*

The assessment of nutrients in coastal waters carried out in the Mamaia Nord - Pescarie area in 2017 has been carried out on the basis of the samples taken, thus the data obtained were compared with the concentrations maximum allowable concentrations in national legislation for total phosphorus, nitrogen, ammonium in surface waters, the value of this period in coastal waters, which are under the direct influence of the input anthropogenic has not reached good ecological status for the indicator ammonium [18].

In the Constanta-Mamaia area, various human activities such as intense tourism, cliff consolidation, dike construction and port activities have generated significant changes in phytobenthic communities [19]. These changes have had an impact on the composition and quality of these communities of plant organisms, resulting in increased turbidity of the water and increased amounts of nutrients, but perennial marine plant species are crucial for the stabilization and rehabilitation of coastal habitats, so protecting and conserving these habitats is extremely important for maintaining biodiversity and promoting sustainable tourism in the region [19].

#### **4. Conclusions**

The study of oceanographic research for a future touristic marina on the Black Sea coast highlights the importance of basing the development of marina tourism on solid knowledge of the marine environment and the impact of human activities. By using appropriate materials and research methods, essential data is obtained for informed decision-making and the implementation of sustainable development strategies. Some key conclusions of this study include:

1. Water quality: sampling and analyzing water quality are crucial for ensuring the safety and protection of tourists and the marine ecosystem. Monitoring pollutant levels and chemical substances, as well as identifying sources of pollution, allows for the implementation of appropriate measures to conserve water quality<sup>1</sup>.
2. Marine biodiversity: Studying marine biodiversity helps identify areas of high ecological value and protect fragile habitats. Research enables the identification of vulnerable species and ecosystems, facilitating the implementation of conservation and management measures to protect the biodiversity of the Black Sea.
3. Climate change: Understanding climate change and its impact on the marine environment is crucial for planning and adaptation in the face of these changes. Climate research and forecasting contribute to the developments of adaptation and mitigation strategies to ensure the sustainability and resilience of tourism activities to climate influences.

In conclusion, the findings of this study emphasize the importance of oceanographic research in the development of sustainable and responsible touristic marina on the Black Sea coast. By integrating scientific knowledge and research findings into decision-making processes, the protection of the marine environment and the conservation of biodiversity can be ensured while providing visitors with a high-quality and sustainable tourism experience.

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