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**Research Article**

# The Effects of Natural Life Islands Planning on Izmir Bay Ecosystem

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**Abstract**

Izmir is one of the most important trade ports of Turkey, which has hosted many important civilizations through time. Many scientific studies that have been carried out in Izmir Bay for decades point out that the Bay has become by limiting direct pollution of the Bay. However, it is a fact that the present circulation should be increased. For this reason, the Izmir Bay and Port Rehabilitation Project was revealed. The aim of this study is to choose the most suitable place for the proposed "Natural Life Islands", which are to be built from the seabed dredgings from a channel to be built to help increase the circulation in the bay. Hydroacustic and oceanographic data were collected and evaluated. After post dredging, the future flow pattern and sediment transport model should be investigated. The planned islands are expected to have an impacts on the Izmir Bay ecosystem. Therefore, it is very important to make the right decision as to the placement of the islands. As a result, the effects of the planned islands on the present ecosystem of the bay should be examined in detail.

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## INTRODUCTION

Coastal cities in Turkey have naturally developed to the industrial, commercial and tourism activities in particular, in the Mediterranean under the climatic and socio-economic conditions [1]. Izmir Inner Bay is a natural harbor where trade has been active throughout history. The ports of Izmir, Karaburun, Urla and Foça have provided fast and comfortable transportation to the Islands in the Aegean Sea and this has been the most important factor in the rapid development of the city of Izmir [2,3]. In the Ottoman period, durable roads, beautiful and artful bridges were built also increasing transportation. In 19th century, Izmir was the most important and largest city of the western Anatolia region with a population 100,000 [4,5]. Marine transportation in Izmir Bay led to the improvement of surrounding coastal cities such as Ildırı (Erythrai), Foça (Phokaia), Urla (Klozomenai), Sığacık (Theos), Ürkmez (Lebedos) and Menderes (Kolophon) (Fig.1).


**Figure 1.** The ancient Izmir and important coastal settlements [2]

In Izmir Bay, especially in the last 25 years, the port has become more active in both tourism and trade. The impacts of the Bay, the use of the port and / or the effects are kept under constant control through the Grand Canal Project that began in the 90s. In addition with the Izmir Bay and Port Rehabilitation Project, the improvement in the Bay has been increasing day by day [6]. Izmir Bay is defined as three parts as inner, middle and outer. The rivers flowing into the bay, drain lines and etc. are shown in Fig 2. However, the bathymetric map of the study area was created by adding up-to-date values to the data collected to date and adding the literature to the study.

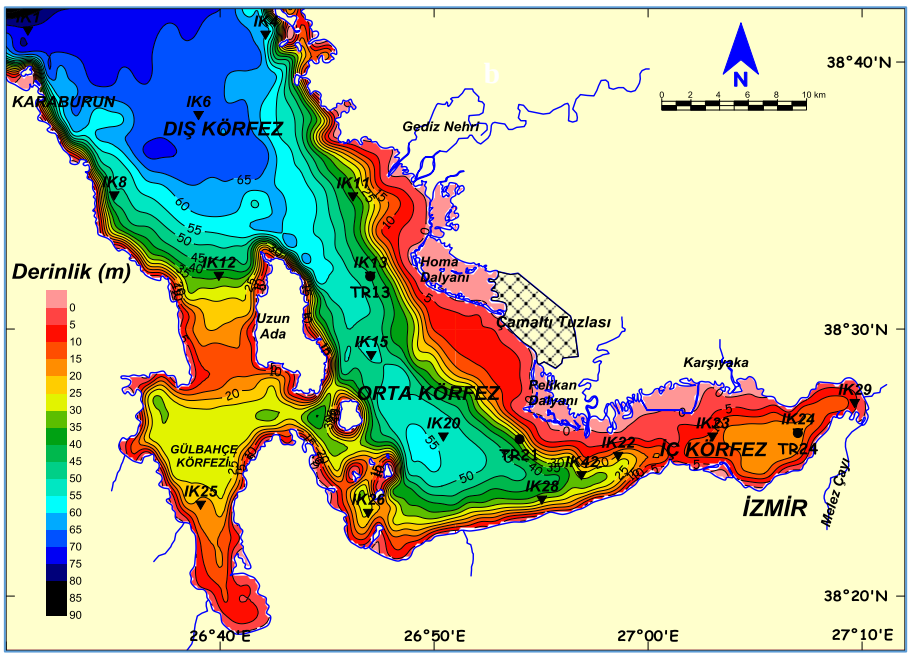


**Figure 2.** Departments, inputs and bathymetry of Izmir Bay (Atalar, 2012 [7])

The aim of this study is to estimate the effects of the material to be produced as a result of the dredging processes planned in the inner and middle sections and the effects of the planned Natural Life Islands with the use of this material (Fig.3). However, by combining shallow seismic and side scan sonar and physical oceanography data, an example has been tried to be used in such engineering studies. In order to determine the geotechnical properties of the soil forming the seabed, grab sampling stations selected in 1x1 km grid intervals within the boundaries of the study area are shown in Fig 4.

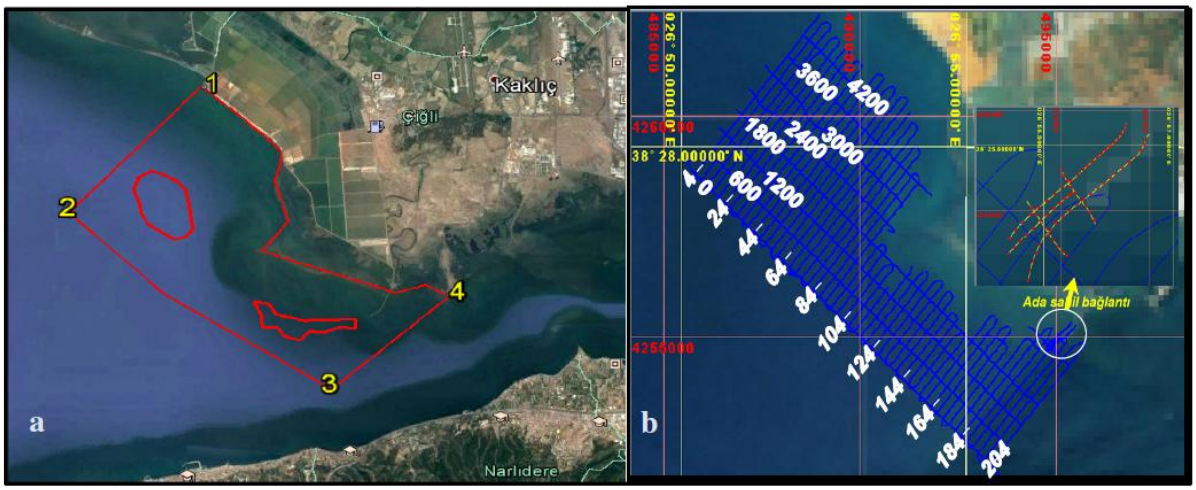


**Figure 3.** a) Study area and planned natural life islands satellite photo

b) Working lines in the study area

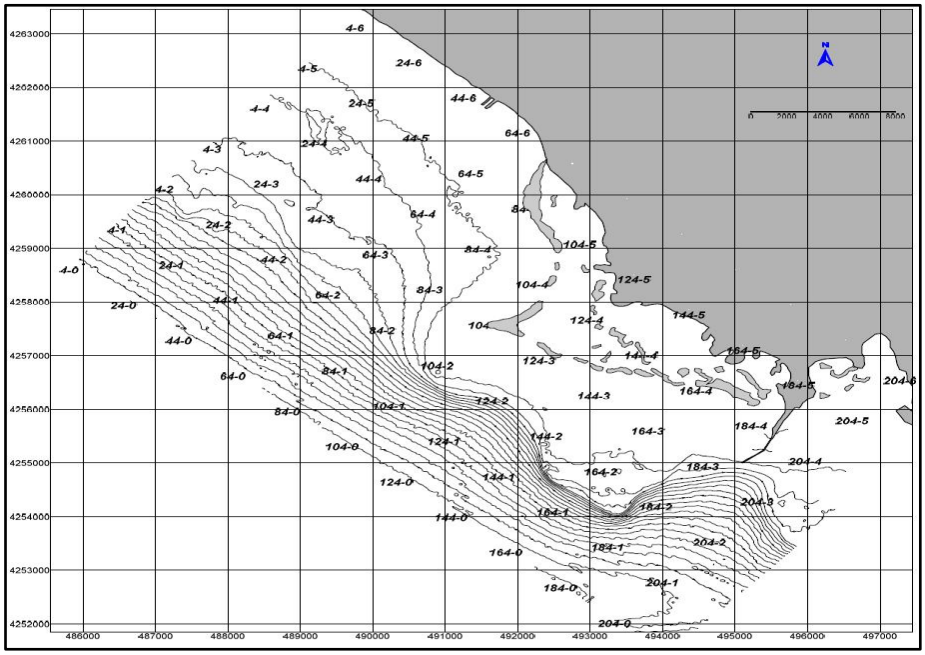

**Figure 4.** Sediment sampling stations in the study area

## MATERIAL AND METHOD

The seismic studies and side scan sonar data, which constitute the basis of this study, were collected from Research Vessel Dokuz Eylül 3 of the Institute of Marine Sciences and Technology in 2016-2017. Data were recorded and processed using Strata-Box 3510 Dual Frequency Seismic System with Cmax CM2 Side Scan Sonar. Side Scan Sonar (SSS) records, Sub-bottom Profiler (SBP) data were collected to

provide full coverage and high resolution maps with high discrimination capacity among the characteristics of the different seabed. Oceanographic data were collected continuously with Teledyne Mariner 600 kHz Acoustic Doppler Current Profile (ADCP) in each working line along the working area. Data were collected from 40 $km^2$ coastal area for Izmir Bay, up to 50 m water depth. During the study, the speed of the research vessel was chosen as 3-3,5 knots. The reason for keeping the speed within this range is the acoustic systems used to record data with maximum efficiency at these speeds. Since the recorded data can only be taken under appropriate meteorological conditions the work was interrupted due to strong winds and sea wave lengths exceeding 1.5 meters.

## RESULTS AND DISCUSSION

When all shallow seismic data are interpreted, the unit contains the A-unit (fine-grained sediments) with fine-grained sediment and the B-unit (fine and coarse-grained sediments) underneath. The upper seismological unit (A) on the acoustic foundation consists of up- to- date sediments such as clay, conglomerate-silty sand ranging in thickness from 0 to 10 m. The acoustic base (B) unit, which has thicknesses of more than 10m, consists of sedimentary layers composed of different stacks from thin to massive. Potential gas deposition sites have been observed in some areas of seismic sections (Fig.5a and 5b).

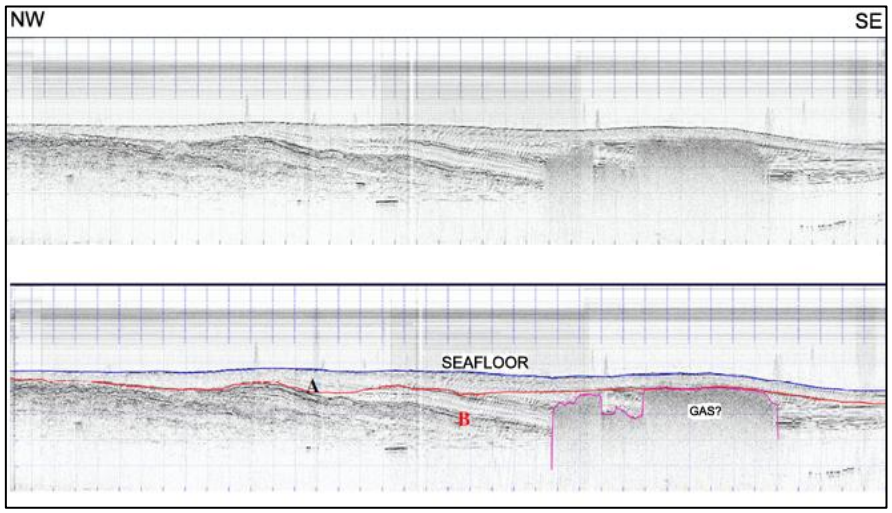


**Figure 5a.** NW-SE (NorthWest-SouthEast) seismic section from north of study area

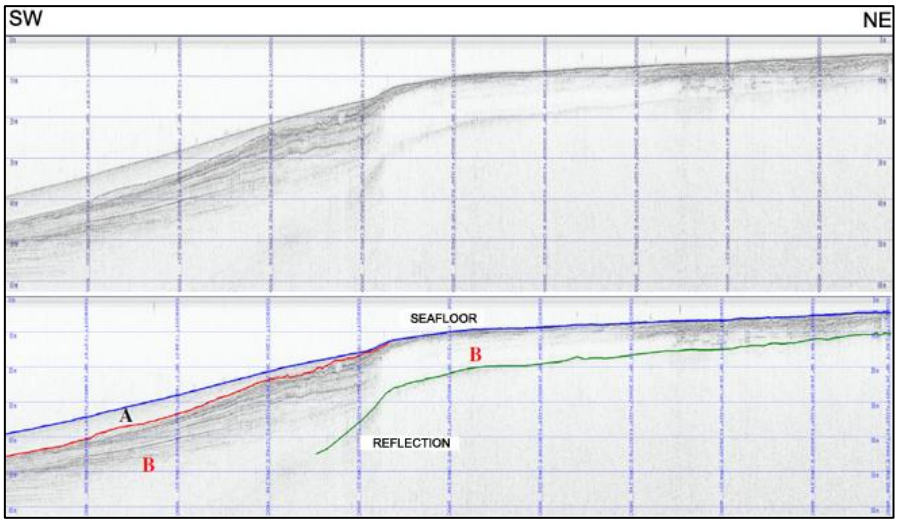


**Figure 5b.** SW-NE (SouthWest-NorthEast) seismic section from south of study area

The mosaic map in Fig.6 was drawn from the SSS data in the study area. The drawn map shows traces of possible small-scale trawl scans. In addition, cylindrical apparatuses such as closures and cages are frequently observed. The reflection records of other structures on the seafloor were observed in the sonar.

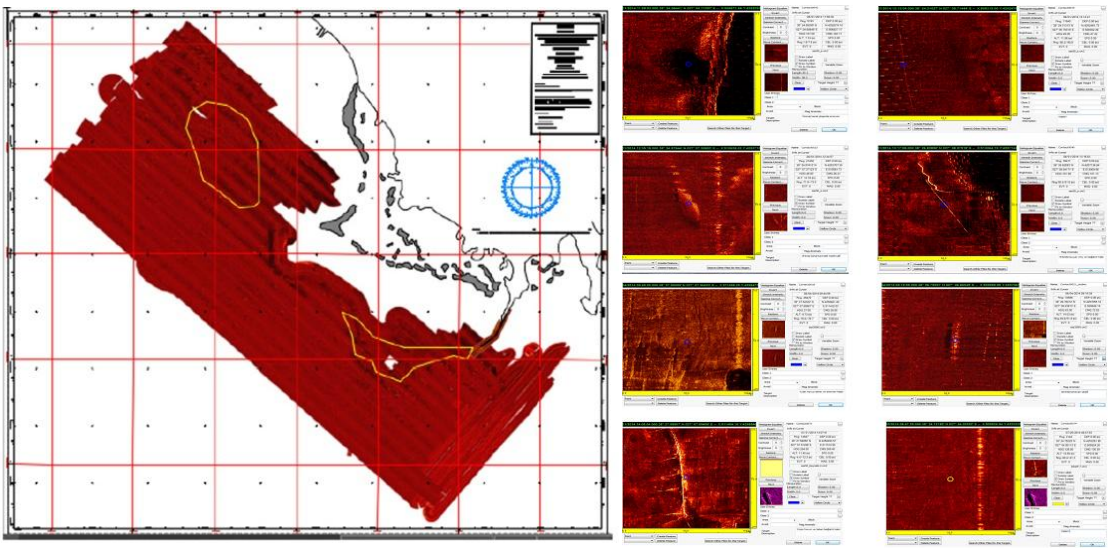

**Figure 6.** Side scan sonar mosaic map (left) and visual information about objects and structures (right) (wrecks, cable, rope and screening marks etc...)

The current directions and velocities in the study area vary depending on the seasonal conditions and the seabed morphology. The direction of current in the northern part of the region is northwest, and the common stream in the south is the south-southeast (Fig.7). The average current velocity in the north is 7 cm/s and the average current velocity in the south is 11 cm/s. Especially in coastal areas where water circulation is limited, high values (such as in station 064-6, 144-4, 184-4) were observed (Table 1). The maximum value of %18.91 organic material (station 204-6) was observed near the wastewater treatment plant. The fact that the maximum values were observed in the deep sections as storage areas and in the areas close to the wastewater treatment plant indicate the possible wastewater discharge effect.

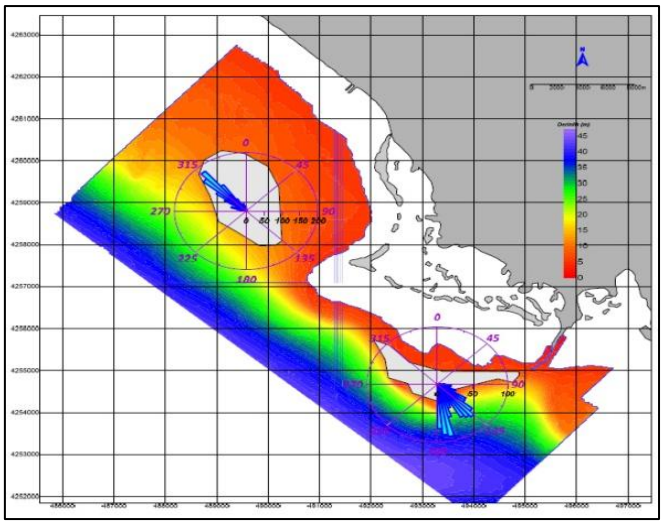

**Figure 7.** Current survey stations directions

**Table 1.** Organic materials content in some stations

| Sample ID | Dry Weight (g) | Absorption Value | Organic Material (%) | Organic Carbon (mg/gr) | Organic carbon (%) |
|---|---|---|---|---|---|
| 004-0 | 0,9541 | 0,197 | 3,08 | 15,99 | 1,60 |
| 004-3 | 1,0790 | 0,123 | 1,92 | 8,83 | 0,88 |
| 024-2 | 1,0006 | 0,153 | 2,39 | 11,84 | 1,18 |
| 024-6 | 0,9743 | 0,242 | 3,78 | 19,24 | 1,92 |
| 044-1 | 1,0201 | 0,211 | 3,30 | 16,02 | 1,60 |
| 044-4 | 1,0828 | 0,138 | 2,16 | 9,87 | 0,99 |
| 064-5 | 0,9454 | 0,133 | 2,08 | 10,90 | 1,09 |
| 064-6 | 0,9203 | 0,453 | 7,08 | 38,12 | 3,81 |
| 084-2 | 0,9648 | 0,171 | 2,67 | 13,73 | 1,37 |
| 084-3 | 1,1371 | 0,135 | 2,11 | 9,20 | 0,92 |
| 104-0 | 1,0346 | 0,217 | 3,39 | 16,24 | 1,62 |
| 104-1 | 0,9788 | 0,200 | 3,13 | 15,83 | 1,58 |
| 124-2 | 0,9829 | 0,146 | 2,28 | 11,50 | 1,15 |
| 124-3 | 1,0710 | 0,143 | 2,23 | 10,34 | 1,03 |
| 144-2 | 0,9414 | 0,162 | 2,53 | 13,33 | 1,33 |
| 144-4 | 1,0182 | 0,292 | 4,56 | 22,21 | 2,22 |
| 164-2 | 1,0193 | 0,186 | 2,91 | 14,13 | 1,41 |
| 164-3 | 1,1482 | 0,181 | 2,83 | 12,21 | 1,22 |
| 184-0 | 1,0010 | 0,268 | 4,19 | 20,74 | 2,07 |
| 184-4 | 0,9940 | 0,425 | 6,64 | 33,12 | 3,31 |
| 204-5 | 0,9393 | 0,295 | 4,61 | 24,32 | 2,43 |
| 204-6 | 0,9258 | 1,210 | 18,91 | 101,23 | 10,12 |

## CONCLUSION

The consequences of changes in the water circulation and subsequently in the ecosystem of Izmir Bay need to be thoroughly researched and evaluated. It is estimated that approximately 25 million $m^3$ of material, which is seen as mainly soft clay and sand, will be extracted from the dredging stage to be conducted in the north of the middle bay. However, the projected size of the proposed two natural life islands will require 53 million $m^3$ of dredging material. For this reason, only the planning of the circulation channel, to be built at -8 m elevation, should be examined and the bathymetric map of the bay should be reviewed at present. When we look at the bathymetric structure of the inner bay, there is a trench deeper than 20 meters in the middle bay, isolated from the outer bay. There is no study on the effect of the channel which is planned to be opened to the water movements in this trench zone. The contribution of the channel that will be opened without any modeling on all these features to the Izmir Bay should be discussed. Even though all the data obtained in this study does not indicate the possible effects to Izmir Bay, which is an important wetland habitat and port in Turkey, a more accurate inference for Izmir Bay may be reached with further studies.

**ACKNOWLEDGMENT**

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