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RESEARCH ARTICLE

A study on some physico-chemical properties of Marmaris Bay (Southern Aegean, Turkey)

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Abstract

Marmaris Bay is in the area where the southwest corner of Turkey meets the Mediterranean Sea and Aegean Sea. It is a semi-enclosed bay and one of the popular tourism destinations of Turkey. To understand the spatial and temporal variation of water quality in the bay, this study was carried out between May 2011 and April 2012. Seven points were strategically selected and selected physico-chemical parameters in water samples were measured monthly. The ranges of these parameters found as (BDL: below detection limit); temperature: 14.31 to 27.16°C, pH: 7.40-8.93, dissolved oxygen: 4.20-8.50 mgL^{-1}, electrical conductivity: 52.160-59.540 μScm^{-1}, salinity: 34.34-39.84‰, nitrite nitrogen: BDL-0.50 mgL^{-1}, nitrate nitrogen: BDL-30.00 mgL^{-1}, ammonium nitrogen: BDL-2.50 mgL^{-1}, phosphate ion: BDL-4.00 mgL^{-1}, and chlorophyll-a: 0.03-2.44 mgL^{-1}. The results revealed that deterioration in water quality and pollution occurred mostly during the peak period of tourism in summer.

Keywords: Marmaris Bay, water quality, physico-chemical parameters, environment factor, tourism activities

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Introduction

Marmaris Bay is located in the region where two different water masses meet from the Mediterranean and Aegean Seas (Eryılmaz and Eryılmaz Yücesoy 2008). The Bay has seawater features such as physical parameters (salinity, dissolved oxygen etc.) typical of the Mediterranean (Anonymous 2013).

The city of Marmaris is a natural port city with four marinas as the bay provides a natural shelter for yachts and other recreational vessels. Marine organisms are contaminated by pollutants owing to the increase in population density and sea traffic during summer months (UNEP/MAP 2012). This is resulted from the release of bilge waters and solid wastes by marine vehicles as well as petroleum products used in marinas (Anonymous 2013). The other negative factors which

impact on the Bay are the filling and eradication of open spaces for the creation of tourism centers, as well as industrial, agricultural, administrative and military waste of various types of institutions (Çoker 2017).

The adequacy of water quality data collected in the current monitoring systems is now being queried in Turkey (Gündoğdu and Özkan 2006). Factors such as turbidity, algae, nutrients, and temperature are mainly affecting the water quality. Monitoring of these parameters is crucial for understanding the current status of marine resources, seasonal to inter-annual cycles of oceanographic phenomena, and how they relate to marine species life cycles (Ritchie *et al.* 2003).

The aim of this study is to determine the seawater quality of Marmaris Bay because there is lack of comprehensive scientific studies on sea water quality in the Bay. Monthly measurements were made and based on these measurements, the physico-chemical status of Marmaris Bay was presented according to water pollution control regulation of Turkish Seawater Quality Criteria (Official Gazette of the Turkish Government 2004). Besides its purpose of protecting the historical and natural beauty of Marmaris Bay for future generations, the study is important in terms of establishment and sustainability of a tourism center, understanding the temporal and spatial fluctuation of pollutants in the Bay.

Materials and Methods

Marmaris Bay is a popular tourist destination and has many coves, cruising facilities and modern yacht marinas. The sampling was carried out between May 2011 and April 2012. The physical and chemical data were collected by an equipped vessel at seven stations in the following localities in the marinas of Icmeler, Yalancı Straith and Marmaris (Figure 1, Table 1).

The samplings in the studied stations were carried out on a monthly basis. The main physical parameters (salinity, water temperature, pH, conductivity, dissolved oxygen) were measured *in situ* by YSI 556 MPS (Multi Probe System).At each sampling station, a water sample was collected from the surface, put into a 500 ml container and stored in a cold storage until the analyses. The water samples were analysed at the Freshwater and Marine Biology Laboratory, Fisheries and Aquaculture Faculty, Muğla Sıtkı Koçman University, for the main chemical parameters such as nitrite, nitrate, ammonium, phosphate, and chlorophyll-a.

For the determination of nitrite in seawater, 1 ml of x-naphthylamine hydrochloride solution was added to 50 ml of water sample and mixed. The samples were then measured at 543 nm using PG T80 UV-VIS spectrophotometer. The limit of the analysis range was 0.01-1.00 mgL -1 (Egemen and Sunlu 1996).

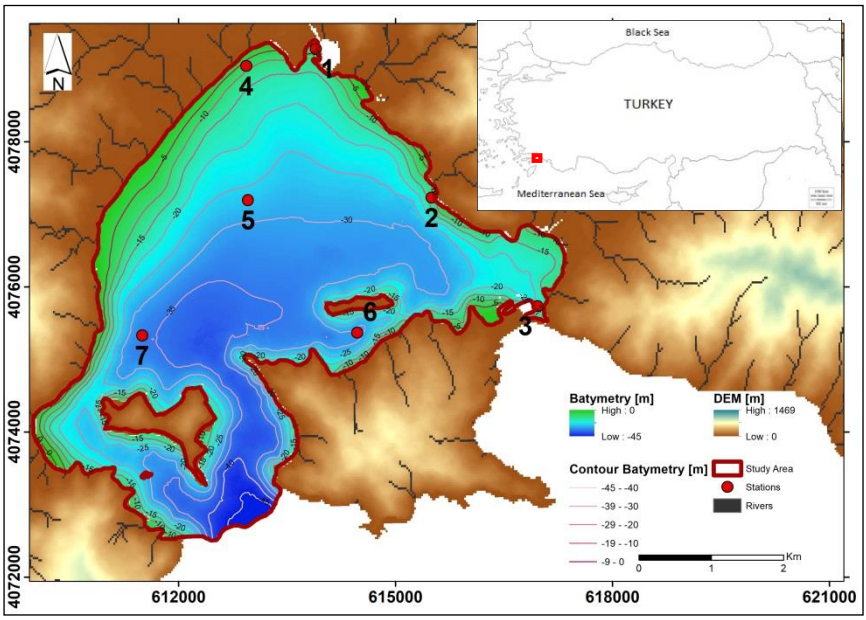

Figure 1. Sampling stations in Marmaris Bay

Table 1. Coordinates and depth of sampling stations

Stations	Coordinates	Max. Depth (m)
1	N36°51.12′ E28°16.65′	15
2	N36°50.00′ E28°17.71′	17
3	N36°49.18′ E28°18.68′	18
4	N36°50.00′ E28°16.00′	12
5	N36°50.00′ E28°17.35′	29
6	N36°49.00′ E28°17.00′	32
7	N36°49.00′ E28°15.00′	37

For nitrate determination, phenol-sodium phenate buffer, 1 ml of hydrazine-copper reduction reactivity was added to 41 ml of seawater sample and mixed. The containers were covered with paraffin and stored in the dark for 24 hours. After 24 hours, 2 ml of acetone, 2 ml of sulfanilic acid, 1 ml of x-naphthylamine hydrochloride and 1 ml of sodium acetate solution were added to the mixture and were mixed thoroughly. Then, measurement at 543 nm by the spectrophotometer (PG T80 UV-VIS Spectrophotometer) were made. The limit of the analysis range was 0.01-3.00 mgL^{-1} (Egemen and Sunlu 1996; APHA 2005).

The phenate method was used for the determination of ammonium (APHA 2005). To 50 ml of seawater sample, 2 ml of phenol solution, 2 ml of sodium nitroprusside solution and 5 ml of oxidation solution were added. The sample

containers were covered with paraffin and stored in the dark at room temperature (22-27°C) for colour formation, subsequently, measured at 640 nm with a spectrophotometer (PG T80 UV-VIS Spectrophotometer). The limit range was between 0.02 and 2.00 mgL^{-1}.

The ascorbic acid method was used for phosphate determination (APHA 2005). To 50 ml of seawater sample, 8 ml of the mixture solution (15 ml of ammonium molybdate solution, 50 ml of sulphuric acid solution, 30 ml of ascorbic acid solution, and 5 ml of potassium antimony tartrate were added. After 10-25 minutes, the samples were measured at 880 nm using PG T80 UV-VIS spectrophotometer. The limit range was between 0.15 and 1.30 mgL^{-1}.

The chlorophyll-a was determined following Parsons *et al.* (1984). Water samples were filtered through GF6 Schleicher and Schuell 47mm glass fiber filter paper. The filtrates were stored frozen at -18°C until the analysis. The sample filters were placed in tubes, to which 10ml of 90% acetone was added and then stored frozen for 24 hours in the dark. After 24 hours, the samples were centrifuged at 3000 rpm, the sample extract (liquid part) was taken by a pipette and put in a spectrophotometer cuvette in order to measure the absorbance of the sample at 750, 664, 647 and 630 nm. The chlorophyll-a concentration was calculated using the following formulas by Parsons *et al.* (1984):

$$\text{Chlorophyll a (Chl} - \text{a)} = 11.85 \text{ x } 664\text{E} - 1.54 \text{ x } 647\text{E} - 0.08 \text{ x } 630\text{E}$$
$$\text{Chlorophyll a (mg/L)} = \text{C x v / V}$$

where:
C: Calculated chl-a value in the first equation,
E: Absorbance value each wavelength,
v: Volume of acetone used for extraction (ml),
V: Volume of water filtered (L).

Results and Discussions

The annual measurements of each parameter at seven stations in Marmaris Bay are presented in Table 2. Water temperature were recorded as 14.31-27.16°C, pH 7.40-8.93, dissolved oxygen 4.20-8.50 mgL^{-1}, Electrical conductivity (E.C.) 52.160-59.540µScm^{-1}, salinity 34.34-39.84 ‰, nitrite nitrogen Below Detection Limit - 0.50 mgL-1, nitrate nitrogen BDL-30.00 mgL-1, ammonium nitrogen BDL-2.50mgL^{-1}, phosphate ion BDL-4.00mgL^{-1}, chlorophyll-a 0.03-2.44mgL^{-1}. In Marmaris Bay, various components such as tourism activities, precipitation, wastes from the streams and port activities affect the physico-chemical composition of seawater.

In this study, the pollutant load coming by different sources into Marmaris Bay and the results of the physico-chemical parameters of the bay and the stations with heavy pollution loads were examined.

The water temperature ranged between 14.31 and 27.16 °C. The lowest value was measured at station 5 in January and February and the highest value was at station 1 in September. Eryılmaz and Eryılmaz Yücesoy (2008) recorded the lowest surface temperature as 15.37°C and the highest as 24.32°C. According to this study, the minimum temperature was found lower and the maximum temperature was found higher than the previous study in 2008.

The pH of the marine environment depends on temperature and the biochemical processes. The pH values showed seasonal or even daily changes but the pH mean value was 7.80 in the marine as reported by Ivanoff (1972) and Ross (1979). Oxidation of the organic matter and respiration consume the dissolved oxygen, then release carbon dioxide into the water, decreasing the pH value (Demirak 2003). The pH value is higher in winter than in summer in this study. The pH values were measured between 7.43 and 8.93 in this study. The lowest value was measured as 7.43 at station 5 in December. Anthropogenic incidents, such as sewage overflows or runoff, can cause decrease in pH (EPA 2006). The highest value was measured as 8.93 in station 6 in May. In Çandarlı Bay, Büyük Menderes Delta and Güllük Bay, the pH values are 8.50-8.70; 7.90-8.50 and 8.12-8.56 (Anonymous, 1995; Demirak, 2003). The pH value was below the limit value reported for Turkish Seawater Quality Criteria in the Official Gazette (2004), which reported values between 6.00 and 9.00. This is consistent with 7.43-8.93 in this study. Samsunlu *et al.* (1995) determined pH values between 8.12 and 8.35 in Marmaris Bay. It is in harmony with the pH values found in Marmaris Bay.

Conductivity is one of the most useful and widely measured water quality parameters in marine environment (Miller et al. 1988). In addition to being the basis for the calculations of salinity and total dissolved solid matters, conductivity is the primary indicator of change in an aquatic system. Most water bodies provide a fairly constant conductivity that can be used as a baseline of comparison to future measurements (EPA 2012). An important change, whether it is due to natural flooding, evaporation or anthropogenic pollution, can negatively affect water quality. A sudden increase or decrease in conductivity may indicate pollution. Agricultural flow or a sewage leak will increase conductivity due to the additional chloride, phosphate and nitrate ions (EPA 2012). An oil spill or addition of other organic compounds will reduce conductivity as these elements are not separated into ions (USGS 2013). In either case, additional dissolved solid matters will have a negative effect on water quality.

Table 2. Measurements (range and mean) of physico-chemical parameters in Marmaris Bay

Stations / Parameters	1 (Min-Max) Mean	2 (Min-Max) Mean	3 (Min-Max) Mean	4 (Min-Max) Mean	5 (Min-Max) Mean	6 (Min-Max) Mean	7 (Min-Max) Mean
Water Temperature (°C)	14.32-27.16 18.70	14.36-26.76 18.51	14.40-26.54 18.48	14.53-26.63 18.61	14.31-27.00 18.29	14.5-26.82 18.87	14.5-26.6 18.25
pH	7.76-8.20 7.90	7.40-8.45 7.84	7.70-8.60 7.87	7.75-8.37 8.02	7.43-8.41 8.00	7.92-8.93 8.04	7.8-8.60 8.02
Dissolved oxygen (mgL^{-1})	4.20-8.12 6.84	4.68-8.25 7.01	4.90-8.10 8.98	5.92-8.34 7.74	6.28-8.50 7.57	4.83-8.26 6.65	5.04-8.43 7.55
Electrical Conductivity (μScm^{-1})	52.160-59.460 57.340	55.215-59.460 58.320	55.613-59.460 58.340	55.721-59.492 58.500	55.600-59.540 58.430	55.587-59.510 58.370	55.591-59.529 58.530
Salinity (‰)	34.34-39.81 38.25	35.85-39.80 38.83	36.95-39.82 39.04	37.04-39.80 38.75	36.95-39.84 38.99	36.96-39.82 39.06	35.61-39.13 38.51
Nitrite nitrogen (mgL^{-1})	0.04- 0.50 0.33	*BDL-0.40 0.18	BDL-0.44 0.07	BDL-0.50 0.12	BDL-0.28 0.03	BDL-0.23 0.01	BDL-0.10 0.01
Nitrate nitrogen (mgL^{-1})	3.02-30.00 4.84	BDL-28.92 4.67	BDL-21.03 2.47	BDL-30.00 7.05	BDL-24.01 4.94	BDL-13.04 1.05	BDL-9.98 1.09
Ammonium Nitrogen (mgL^{-1})	0.01-2.31 0.68	BDL-2.48 0.74	BDL-1.92 0.27	BDL-2.50 0.86	BDL-1.89 0.23	BDL-1.64 0.16	BDL-1.01 0.08
Phosphate ion (mgL^{-1})	0.04-3.95 0.93	BDL-3.93 1.10	BDL-3.00 0.66	BDL-4.00 1.71	BDL-1.85 0.57	BDL-1.25 0.60	BDL-2.87 0.83
Chlorophyll-a (mgL^{-1})	0.03-1.34 1.22	0.07-2.09 1.12	0.08-2.04 1.33	0.06-2.23 1.45	0.06-2.14 1.53	0.07-2.36 1.79	0.17-2.44 1.90

*BDL: Below Detection Limit

Samsunlu *et al.* (1995) determined the electrical conductivity values as averaging 41.86 μmhol/cm in the winter season, 60.84 μmhol/cm in the spring season, and 53.26 μmhol/cm in the summer season. The electrical conductivity in this study were recorded between 55.600 and 59.540 μScm^{-1}, the lowest value was measured as 55.600 μScm^{-1} at station 1 in March and the highest value was measured as 59.540 μScm^{-1} at station 5 in July. It was observed that the changes in electrical conductivity measurements depend on high water temperature and evaporation of the water surface. The electrical conductivity values were low in winter season. This can be related to the input of precipitation and sediments coming from the rivers entering into the bay (Anonymous 2013).

The salinity is affected by various factors such as rocks in the aquatic environment, precipitation, and evaporation in the aquatic environment. Salinity is below 5 ‰ in fresh waters. Distribution of living organisms in the salty waters or fresh water depend on the osmoregulation (Cirik and Cirik 2005). The lowest value of salinity was found as 38.66 ‰ in the winter season, the highest value was found as 39.02 in the spring season by Eryılmaz and Eryılmaz Yücesoy (2008). The measured salinity was 35.61-39.84 ‰. The lowest value was found at station 7 in May and the highest value was found at station 5 in July. The salinity values were high in the summer season and low in the winter season.

The measured nitrite nitrogen (NO_2-N) values varied from below the detection limit (BDL) to 0.50 mgL^{-1} during the study period. The highest value (0.50 mgL^{-1}) was measured at station 1 and station 4 in June, July, August, and September. The lowest values (BDL) were detected in the winter season in all stations. The monthly fluctuations of nitrite nitrogen observed throughout the year in all stations are due to the fact that nitrite is present in the intermediate oxidation stage in both oxidation of ammonia nitrogen to nitrate and reduction of nitrate (Samsunlu 2005).

The reason for the high nitrite nitrogen value depends on the amount of environmental waste coming from the rivers entering Marmaris Bay, seasonal marina activities, daily boat trips discharging waste water into the sea, boat traffic, a dolphinarium (at station 4) and intensive use of beaches by tourists.

Nitrate nitrogen (NO_3-N) values ranged between BDL-30.00 mgL^{-1}. The lowest values were detected at station 2, 3, 4, 5, 6 and 7, whereas, the highest values were detected at station 1 and 4 in June, July, August, and October according to the analysis limit range (1.00-30.00 mgL^{-1}).

Ammonium nitrogen (NH_4-N) values were found between BDL and 2.50 mgL^{-1}. The lowest values (BDL) were recorded in winter season and the highest value was recorded in September. The ammonium in the water is a mid-product of the decomposition of generally nitrogen-containing organic substances and can be of an anthropogenic or animal origin. Ammonium concentration changes for

various reasons such as pH, temperature, algal bloom and decomposition (Demirak 2003). Ammonium value in the Turkish sea water general quality criteria is 0.02 mgL^{-1} in the official gazette (2004), which is lower from the values in this study. This is a sign that tourism activities negatively affect Marmaris Bay.

Nitrite, nitrate, and ammonium nitrogen values were high during the summer period. This is related to high temperature and excessive use of the coastal area. Marmaris Bay is a semi-enclosed bay and a highly popular destination for vacationers especially in the summer season. Therefore, nitrite, nitrate, and ammonium nitrogen values were observed as critical parameters for Marmaris Bay requiring continuous monitoring.

In this study, the values of nutrients were higher than the reported values in different bays in Turkey and a previous study in Marmaris Bay. For example, the Bank of Provinces Project (1979) reported a range of ammonium between 0.165-0.247 mg/L in Marmaris. These values were higher than the limit and in line with those reported in the present study. Samsunlu *et al.* (1995) reported nitrate values as 0.67 μmol/L in the winter season, 0.36 μmol/L in the spring season, and 0.48 μmol/L in the summer season in Marmaris Bay. These values were lower than the limit and those reported in the present study.

Phosphorus is present as phosphate ions in natural water and waste water, derived by decomposition of dead marine organisms. In addition to the natural sources, phosphorus compounds are transported into the marine environment from domestic and industrial wastes and especially in detergents. For this reason, the concentration of phosphorus depends on the human population of the region (Davis and Cornwell 1991; Krom *et al.* 1991; Karpuzcu 1984; Uslu and Terkman 1987; Pahlow and Reibesell 2000). Samsunlu *et al.* (1995) reported phosphorus values with a maximum level of 0.14 μmol/L in the winter season, 0.81 μmol/L in the spring season, and 0.84 μmol/L in the summer season in Marmaris Bay. Koçak and Küçüksezgin (2000) also studied and reported high values of nitrate-nitrite-ammonia and phosphate in winter and spring season in Marmaris Bay. The maximum level of phosphorus in seawater in summer starts to decrease in autumn reaching a minimum level in winter (Shaffer, 1986). Phosphate ion measurements ranged between BDL and 4.00 mgL^{-1} in this study. The lowest values were BDL (except station 1) in winter season. The highest value was found in August and September. The Bank of Provinces Project (1979) reported the measurement of phosphate value between 0.028 and 0.137 mg/L in Marmaris Bay. Samsunlu *et al.* (1995) determined the phosphate values as 0.23 μmol/L in the winter season, 0.26 μmol/L in the spring season, and 0.21 μmol/L in the summer season. These values were lower than the critical level and lower than those reported in the present study. The permanent presence of phosphate can be related to water pollution and the continuous precipitation

input from the rivers entering Marmaris Bay (Samsunlu *et al*. 1995; Samsunlu and Akça 1999).

Chlorophyll-a is one of the ecological indicators for the eutrophic level of the marine environment. The index is used to describe the biomass in the marine environment (Han and Jordan 2005). The chlorophyll-a values were measured between 0.03 and 2.44 mgm^{-3} in this study. The lowest value was measured at station 1 in July. For Marmaris Bay, a previous study reported average values of chlorophyll-a as 0.06 mg/m^3 (winter), 0.41 mg/m^3 (spring), and 0.34 mg/m^3 (summer) (Samsunlu *et al.* 1995). These values were lower than the limit and not in line with those reported in the present study. The highest value (2.44 mgm^{-3}) was identified at station 7 in April 2012 (and throughout the summer) as a result of the continuous input of nutrients to the marine environment and based on heavy sediments from the rivers throughout the Bay (Samsunlu *et al*. 1995). In Marmaris Bay, excessive production of phytoplankton can be the result of input of additional nutrients due to the touristic activities concentrated in the region and the increasing number of daily boat trips, according to the Chamber of Shipping (2012). There are 131 cruising/sailing boats and 54 daily trip boats registered at the Marmaris harbour. Also according to the Marmaris Municipality, the total number of recreational boats and yachts was 1333 in 2011 and 1469 in 2012.

During the spring season, chlorophyll-a values were high. This situation can be interpreted as a consequence of the presence of nutrients accumulated at the proper temperature and then used by primary producers, as well as the heavy sediment input into the Bay by streams during winter. In this study, the values of chlorophyll-a were higher than the reported values in different seas and bays in Turkey. For example, Grasshoff *et al.* (1983) reported Black Sea values of chlorophyll-a as 1.10-1.60 mg/m^3. In the Marmara Sea, chlorophyll-a values have been identified as 1.30-1.70 mg/m^3 (Tuğrul *et al.* 1986). Küçüksezgin *et al.* (1995) reported a chlorophyll-a range 0.03-0.70 mg/m^3 in the Aegean Sea, for Gökova Bay (Muğla), chlorophyll-a value was recorded as 0.02 mg/m^3 (Büyükışık *et al.* 2001). For Marmaris Bay, chlorophyll-a values were reported as 0.06 mg/m^3 (winter), 0.41 mg/m^3 (spring), and 0.34 mg/m^3 (summer) in a previous study (Samsunlu *et al.* 1995). The chlorophyll-a value was found higher in this study than in those different seas and bays in Turkey previously reported. This can be explained by the continuous entrance of nutrient elements into the marine environment.

Moreover, between May 2011 and April 2012, Ercan *et al.* (2013) reported the level of an indicator bacterium *Vibrio cholerae* in water samples of 18 station in Marmaris Bay. *V. cholerae* suspected colonies, growth on TCBS, was identified non *V. cholerae* by biochemically tests. In the summer, total and fecal coliform levels were high in the beach and marinas. Together with the result of the

present study it is concluded that in the tourism seasons the Bay is under the anthropogenic impacts of biological pollution.

Table 3. Amount of bilge and wastewater taken from yachts in 2011-2012 (Anonymous 2011, 2012)

Months	Number of boats 2011	Bilge water (Lt) 2011	Wastewater (Lt) 2011	Number of boats 2012	Bilge water (Lt) 2012	Waste Water (Lt) 2012
January	6	-	800	7	-	8300
February	6	1000	3700	4	-	3900
March	3	390	300	9	200	14 500
April	4	100	13 150	28	-	68 200
May	97	1500	109 785	143	-	527 450
June	184	2750	665 950	409	550	1 616 110
July	173	-	676 150	408	-	1 599 390
August	415	7800	1 449 335	528	-	1 897 180
September	342	5820	1 273 850	455	-	1 818 850
October	110	200	443 950	183	-	716 050
November	-	-	-	11	-	33 750
December	-	-	-	5	-	4 600
TOTAL	1340	19560	4 636 970	2190	750	8 308 280

The results of this study enabled us to make the following recommendations to protect the water quality of Marmaris Bay:

- Monitor water quality of Marmaris Bay and streams that enter into the bay (including the winter rivers),
- Provide sustainability to develop projects for Marmaris Bay with the related institutions and NGOs located in Marmaris in cooperation with universities is essential.
- Manage the excessive use of the Bay by setting a limit to the number of daily tour boats during the peak tourism season,
- Enforce the discharge of bilge water to the bilge collecting tank which is available at the end of the daily tour and the use of the Blue Card application by the relevant institutions and organizations. The Blue Card system was created for digital tracking of waste collection from vessels, fishing ports, marinas and other similar coastal resort by waste type and quantity to prevent illegal discharging into the sea. The application has started to control the data input in an electronic format (Ministry of Environment and Urbanization 2013; 2016). In accordance with the Ship Waste Tracking Systems Application Circular, 200 Blue Cards were purchased from the Ministry of Environment and Urbanization of Mugla and distributed to boats and sea vehicles in 2011 (Anonymous, 2011) (Table 3). The Blue Card System for the Circular, 25 wastewater discharge points in Marmaris region were established by the Chamber of Shipping in 2013 (Chamber of Shipping, 2017).

In Marmaris Bay, there are several components that affect the physico-chemical composition of seawater such as tourism activities (daily tour boats, over-use of the coasts, bilge waters etc.), rainfall, waste water and solid wastes from streams and port activities. As a result of this study, it was determined that sea water quality and environmental pollution are deteriorated, especially in summer months due to heavy tourism, in some stations. The water quality in Marmaris Bay is generally normal during the winter months, but it is disrupted due to the increased population during the tourism season in summer. This study was the first monitoring study on a monthly basiscarried out within a bay in southern Turkey. It provides the baseline data for future studies in pursuit of sustainable use and better management of Marmaris Bay.

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Marmaris Körfezi'nin bazı fiziko-kimyasal özellikleri üzerine bir çalışma

Öz

Araştırma alanı olarak belirlenen Marmaris Körfezi, Türkiye'nin güneybatısında Ege Denizi ile Akdeniz'in birleştiği bir bölgededir. Muğla iline bağlı sahil yerleşim yeri olan Marmaris ilçesinin ana karakterini belirleyen önemli unsurlardan biri de Marmaris Körfezi'nin yarı kapalı bir koya benzemesi ve turizm yönünden Türkiye'nin önemli yerlerinden biri olmasıdır. Marmaris Körfezi'nin seçilmiş noktalarında, Mayıs 2011-Nisan 2012 tarihleri arasında su kalitesi yönünden gerçekleştirilmiş bu çalışmada, araştırma sahasının tanıtılmasının yanı sıra, stratejik noktalardan seçilmiş 7 istasyondan alınan su numunelerinde bazı fiziko-kimyasal parametreler araştırılmıştır. Seçilmiş istasyonlardan alınan su numuneleri Muğla Sıtkı Koçman Üniversitesi Su Ürünleri Fakültesi Temel Bilimler Laboratuarı'nda analizleri yapılarak deniz suyu kalitesi yönünden değerlendirilmiştir. Analiz sonuçları, su sıcaklığı: 14.31 to 27.16°C, pH 7.40-8.93, çözünmüş oksijen 4.20-8.50 mgL^{-1}, elektriksel iletkenlik 52.160-59.540 μScm^{-1}, tuzluluk ‰ 34.34-39.84, nitrit ALA-0.50 mgL^{-1}, nitrat ALA-30.00 mgL^{-1}, amonyum ALA-2.50 mgL^{-1}, fosfat iyon ALA-4.00 mgL^{-1}, klorofil-a 0.03-2.44 mgL^{-1} olarak bulunmuştur. Yapılan bir yıllık bu çalışma sonucunda, özellikle yaz aylarında turizm sezonuna bağlı olarak bazı istasyonlarda su kalitesi ve çevresel anlamda kirlenmeler olduğu tespit edilmiştir.

Anahtar Kelimeler: Marmaris Körfezi, su kalitesi, fiziko-kimyasal parametreler, çevresel faktörler, turizm faaliyetleri

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