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AND URBANISATION

MARINE QUALITY BULLETIN

Aegean Sea

DIRECTORATE GENERAL OF ENVIRONMENTAL IMPACT ASSESSMENT,
PERMIT AND INSPECTION

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

Ministry of Environment and Urbanization has been conducting pollution and quality monitoring studies in all seas of Turkey -the Black Sea, the Marmara Sea and Straits, the Mediterranean Sea and the Aegean Sea- since the 2000s under the Regional Sea Conventions signed by Turkey (Barcelona and Bucharest Conventions) and national and international legislation. Since 2011, the marine monitoring studies have been carried out on the basis of ecosystem-based management approach under the "Integrated Marine Pollution Monitoring Program". Through the monitoring program, it is aimed to establish a scientific background for the determination of national marine and coastal management policies and strategies for the Turkish seas; where comprehensive assessment reports are prepared about the findings based on the historical and up-to-date data.

The "Integrated Marine Pollution Monitoring Program" conducted by the Ministry has been operated in 3-year periods since 2014 under the coordination of TÜBİTAK-Marmara Research Center with the cooperation and contributions of many acknowledged specialists and scientists from the universities and research institutions.

In the framework of the monitoring program; the physicochemical properties of the water column, ecological status indicators, state of pollution, radioactivity levels, marine litter accumulated at the coasts and the seas, the seafloor and water column biodiversity/habitats, contaminant levels in the target species of economic value are monitored. With these results, quality classifications have been made for assessing the status of coastal water bodies and marine areas. Also, multi-variable data sets have been created to determine and follow up the definitions and targets of "good environmental status" for our seas. The monitoring activities in all Turkish seas -Black Sea, Marmara Sea and the Straits, the Mediterranean Sea and the Aegean Sea- consist of the following components.

- Monitoring of biodiversity and ecological quality (including alien species),
- Monitoring of eutrophication,
- Monitoring of pollutant levels and their trends as well as in terms of human consumption,
- Monitoring of marine litter in sediments, water and at the coasts.

The Aegean Sea - Marine Quality Bulletin-2017 contains the eutrophication component assessments for the 2014-2017 period and ecological quality status assessment for the year 2016.

2 DEFINITIONS

CTD: Conductivity and **T**emperature measurements of sea water relative to **D**epth (In situ measurements).

Ecological Status: The structural and functional quality of aquatic ecosystems. According to the Water Framework Directive, coastal waters are assessed with 3 biological quality elements (phytoplankton, zoobenthos and macro algae) and in 5 quality classes (high/good/moderate/poor/bad).

Monitoring of Eutrophication: Relevant indicators like nutrient levels and their temporal changes, dissolved oxygen levels at the bottom and/or intermediate layer depths and their temporal changes, chlorophyll-a levels in euphotic water column, light penetration, prevalence and distribution of opportunistic macroalgae are monitored at the seafloor and in the water column. The assessments are made with integrated data on pressures and impacts.

Secchi Disk Depth (SDD): It is an indicator of light transmittance in the marine environment which is commonly used in eutrophication assessments owing to both the ease of measurement and the possibility of comparison with historical data. The Secchi disk depth decreases when the particulate matter in water column increases, however, it increases when the light transmittance increases.

Water Management Unit (Coastal Water Body, CWB): Identifies a surface water part characterized by significant physical, hydro-morphological, ecological properties and by pressure analyses. It is the smallest coastal water management unit handled by the Water Framework Directive (2000/60/EC).

Marine Assessment Unit (MAU): Marine areas defined for monitoring as specified in the Marine Strategy Framework Directive (2008/56/EC); and initially was set with DeKoS Project which are still subject to official confirmation.

TRIX Index: Trophic Index (TRIX) is a scale for the trophic status (eutrophication) classification of coastal surface waters. It is a logarithmic calculation method including such parameters as the Total Phosphorus (TP) and Dissolved Inorganic Nitrogen (DIN) which are among nutrients; Chlorophyll-a (Chl-a) which is a quantitative indicator of planktonic biomass; and aDO% (oxygen saturation deviation from 100%DO) which is an indicator of photosynthesis intensity.
TRIX index (Vollenweider *et al*. 1998; Bendoricchio *et al*. 2005) is calculated with the following formula;

$$TRIX = (Log_{10}[Chl\text{-}a \times aDO\% \times TIN \times TP] + k) / m$$

Chl-a: Chlorophyll-a concentration (µg/L),
aDO%: Absolute deviation from the oxygen saturation value: I 100-DO% I
DIN: Dissolved inorganic nitrogen: $(NO_3+NO_2+NH_4)$-N (µg/L)

TP: Total phosphorus (µg/L)

k: Equation constant; 1.5

m: Equation constant; 1.2

Classification ranges according to this index are given in the Table below.

Table 2.1 TRIX Values and Class Definitions

TRIX Value	Class Definition
< 4	No Risk of Eutrophication (High quality)
4 - 5	Less risk of eutrophication (Good quality)
5 – 6	High Risk of eutrophication (Moderate quality)
>6	Eutrophic (Bad quality)

Supplementary information about the sampling, measurement and analysis methods can be found in the Appendices.

3 GENERAL INFORMATION

This section includes general information about the monitoring stations and campaigns in the Aegean Sea. The monitoring activities from 2014 to 2017 were carried out by the TÜBİTAK Marmara Research Vessel which is a fully equipped oceanographic research ship with a hull length of 41.2 meters. The information about the monitoring stations in the 2014-2017 period is given in Table 3.1. Also, the detailed information about the stations monitored in 2017 is available in Appendix-1.

Table 3.1 Information about the Monitoring Stations in the Aegean Sea

Monitoring Components	2014	2015		2016		2017
	Summer	Winter	Summer	Winter	Summer	Summer
Water Column	65	64	68	75	80	80

3.1 The Aegean Sea Coastal Water Body (Water Management Unit)

There are 16 Coastal Water Bodies (CWBs) in the Aegean Sea, listed in Table 3.2 and shown in Figure 3.1.

Table 3.2 The Aegean Sea Coastal Water Bodies (Water Management Units)

Coastal Water Bodies (Water Management Units)
EGE01: Bozburun
EGE02: Datça
EGE03: Inner Gulf of Gökova
EGE04: Outer Gulf of Gökova
EGE05: Gulf of Güllük
EGE06: B. Menderes-Didim- Söke
EGE07 Gulf of Kuşadası - Çeşme
EGE08: Gulf of Gerence-Ildır
EGE09: Outer Gulf of İzmir
EGE10: (Inner) Gulf of İzmir
EGE11: Foça SPA
EGE12: Gulf of Çandarlı-Aliağa
EGE13: Gulf of Dikili – Edremit Gulf
EGE14: Ayvacık – Mahmudiye
EGE15: North Aegean-Çanakkale Strait
EGE16: Meriç-Saros

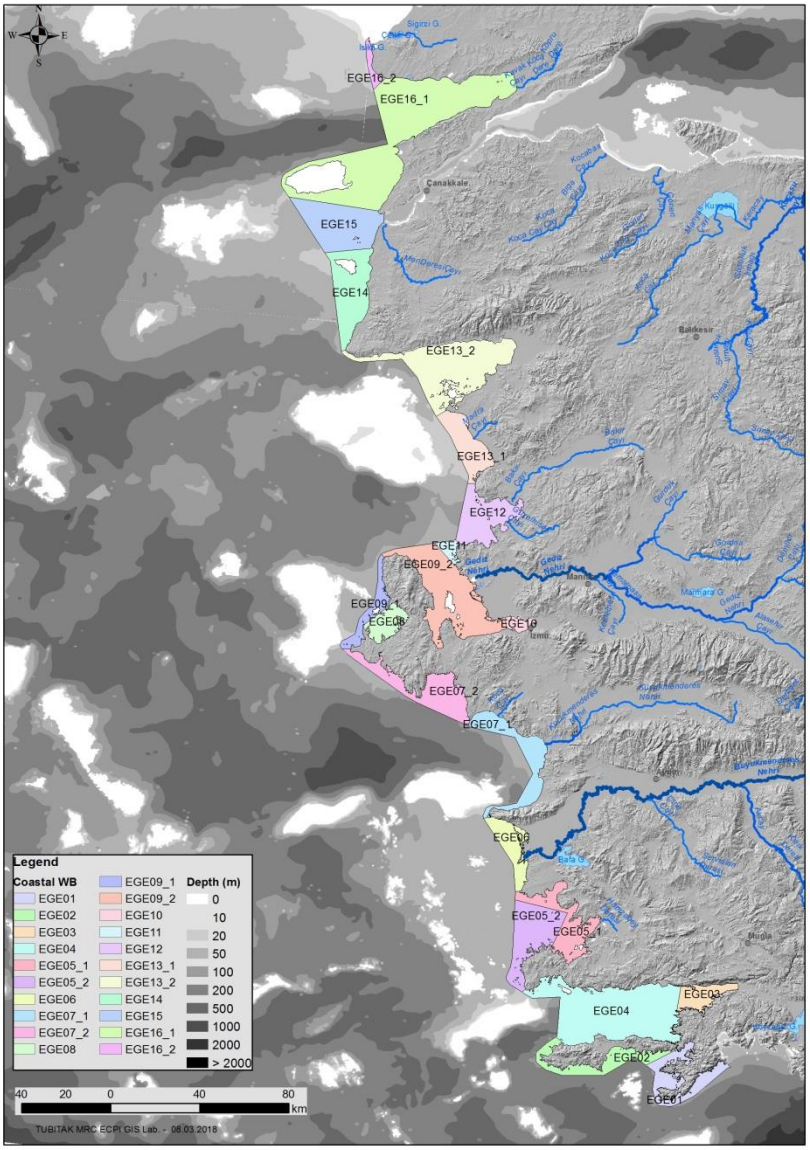

Figure 3.1 The Aegean Sea Coastal Water Bodies (Water Management Units) (DeKoS, 2014)

3.2 Information on the monitoring stations and campaigns in the Aegean Sea

Information about the monitoring stations (codes/location, coordinates, depths, etc.) studied in the Aegean Sea in the summer of 2017 is given in Appendix-1. Under the “Integrated Marine Pollution Monitoring Program”, the summer term sampling activities in the Aegean Sea were performed in August 2017 via *in situ* measurements and samplings at 80 stations (Figure 3.2). In the summer period, seawater physicochemical variables (CTD including in-situ fluorescence and radiation, dissolved oxygen, pH, nutrients, Secchi depths) and chlorophyll-a were measured at both coastal (16 CWBs) and marine waters (MAUs).

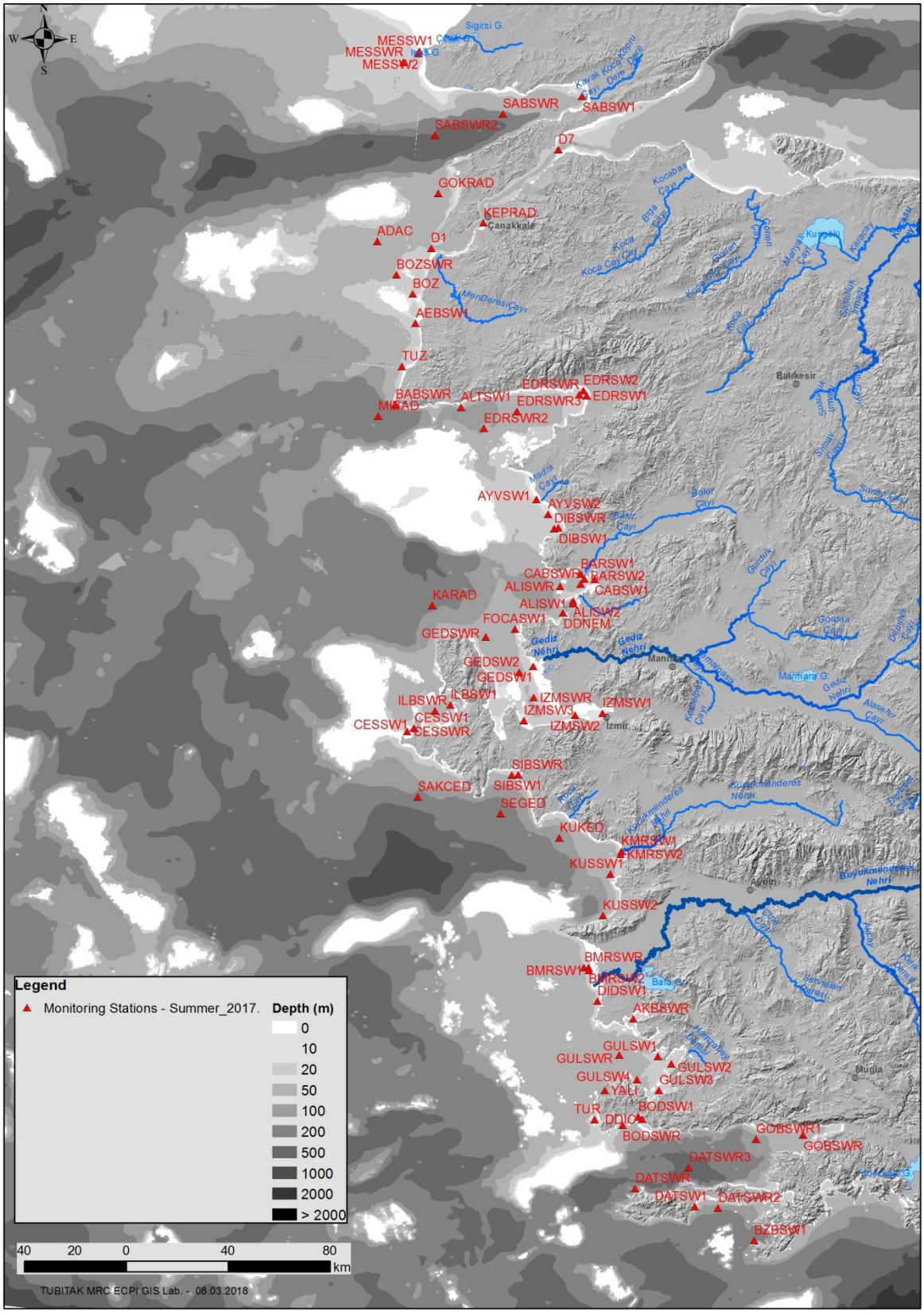

Figure 3.2 Map of the monitoring stations in the Aegean Sea in the summer of 2017

4 EUTROPHICATION STATUS of THE AEGEAN SEA

As part of the eutrophication assessment of the Aegean Sea, the following variables were also assessed together with Physical Variables (salinity, temperature, pH, density changes, etc.).

- Nutrient levels
- Chlorophyll-a levels
- Dissolved Oxygen levels
- Secchi Disc Depths

This section includes the assessment results of the above mentioned variables in the Aegean Sea coastal water bodies.

4.1 Variability of Nutrients

For surface distributions of nutrients; the surface dissolved inorganic nitrogen (DIN), silicate (Si), nitrite-nitrate nitrogen (Nox) and total phosphorus (TP) concentrations were assessed. 2014-2017 data from the Aegean Sea CWBs on the surface layer (0-10m average) nutrients (NO_3+ NO_2 –N, NH_4, PO_4^{-3}, TP and Si), their ratios (N:P, Si:N) and comparisons of salinity-temperature properties are given in Figure 4.1 and Figure 4.2.

When the nutrient concentrations are assessed seasonally, it is observed that there was no significant difference between the summer and the winter values; however, the measurements of 2017 revealed lower values at all the CWBs. Nox values were observed to be generally lower than 0.5 µM in both seasons; however the concentrations were found to be higher by 2 to 4 times (0.5-2 µM) especially at EGE06 (Büyük Menderes River Mouth) and EGE10 (Inner Gulf of İzmir); which could be attributed to the fact that the both CWBs are under river/fresh water input influence. In addition, the Inner Gulf of İzmir is thought to be under the influence of urban discharges. The high concentrations were also detected at EGE15 (exit of the Çanakkale Strait) and EGE16 (Meriç River mouth) in the winter of 2015. In the sampling period, the Meriç river mouth (EGE16) was under the influence of a large river input; while the Dardanelles is thought to be under the influence of the nutrient-rich surface waters coming from the Marmara Sea. Including the 2017 summer samplings, all the samplings revealed that the CWB EGE10 had significantly larger nutrient concentrations than all the other CWBs. N:P ratios were observed to be generally below 16 (Redfield ratio); reaching some higher ratios only at some CWBs in the 2015 winter period. Si:N ratios were generally below 20; whereas some higher values were detected in 2017 at EGE03 (Gulf of Gökova) and EGE10 (Inner Gulf of İzmir).

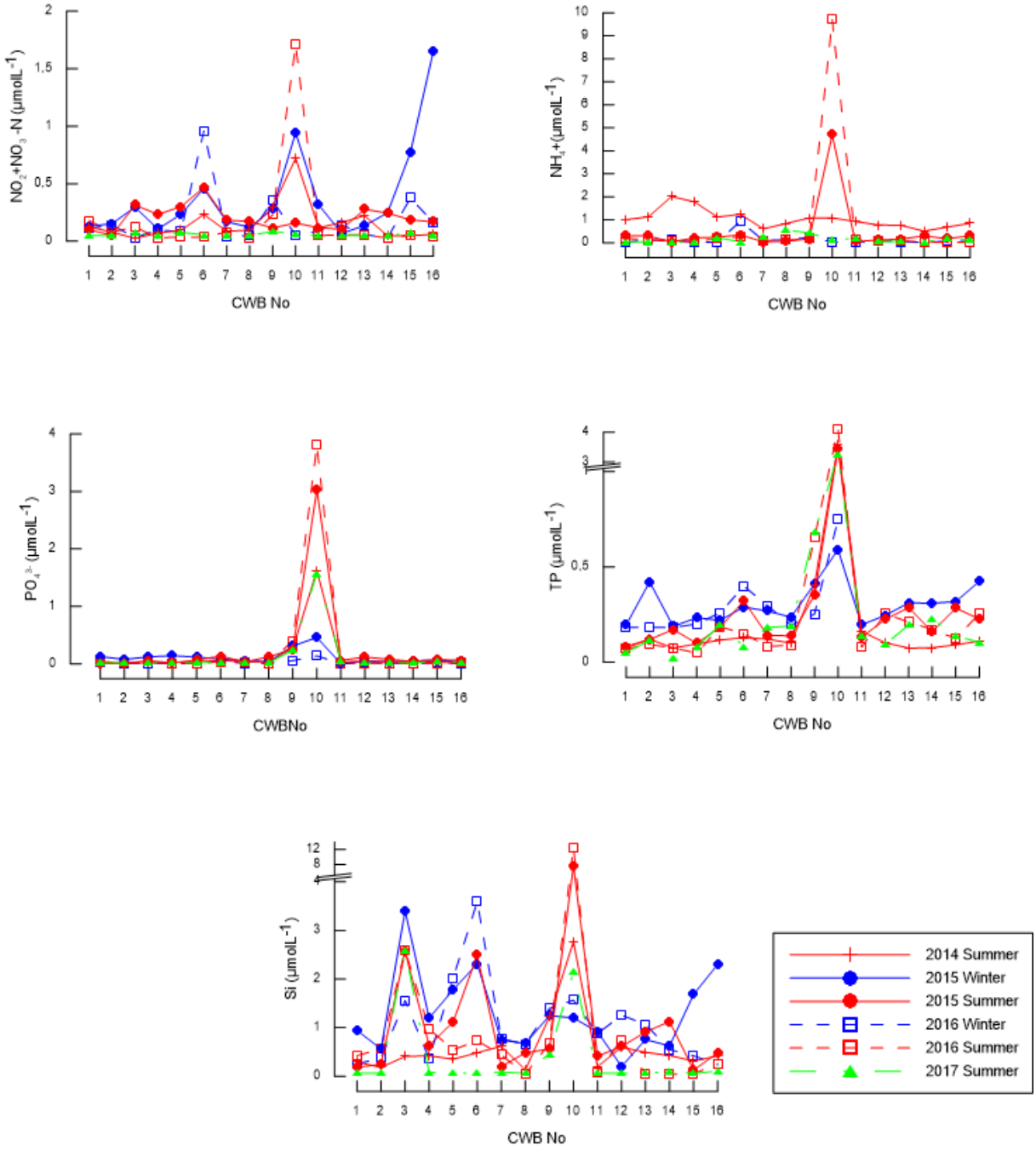

Figure 4.1 Comparison of the 2014-2017 nutrients data of the surface layer (0-10m average) of the Aegean Sea CWBs

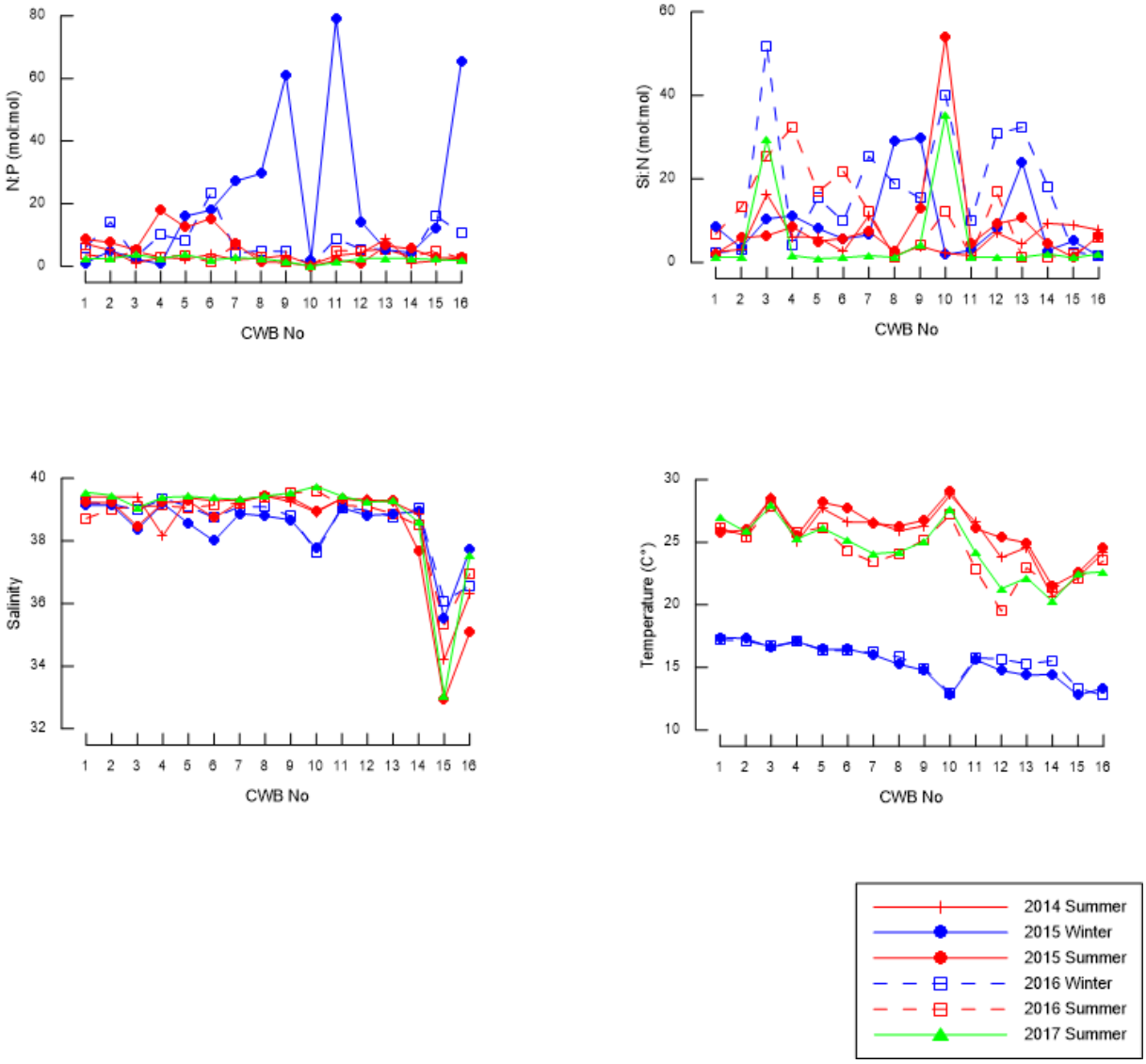

Figure 4.2 Comparison of the 2014-2017 physical properties and the nutrient ratios of the surface layer (0-10m average) of the Aegean Sea CWBs

4.2 Chlorophyll-a levels

Figure 4.3 shows the comparison of the 2014-2017 surface layer (0-10m average) chlorophyll-a concentrations at the Aegean Sea CWBs.. The 2017 summer period surface distributions of chlorophyll-a, which is an indicator of phytoplankton biomass, revealed that the concentration across the Aegean Sea was <0.5 µg/L. Although the waters coming from the Dardanelles are relatively rich in nutrients, the Northern Aegean surface waters were not distinctively affected. The highest concentrations were observed in the Gulf of Izmir. In particular, the chlorophyll-a concentration was detected to reach up to 20 µg/L at the station IZMSW1 (Inner Gulf of Izmir). Relatively high concentrations (>0.5 µg/L) were also measured in the Gulf of Güllük, the Akbük Bay and the Büyük Menderes river mouth.

The comparison of the 2014-2017 surface layer chlorophyll-a concentrations at CWBs revealed no significant variation between the summer and winter periods; while relatively high values were observed in the Inner and Central Gulf of İzmir and in the Gulf of Güllük. The relatively high values in the Northern Aegean Sea in winter months might be the result of the Marmara Sea inputs and winter mixing causing nutrient enrichment of the surface waters.

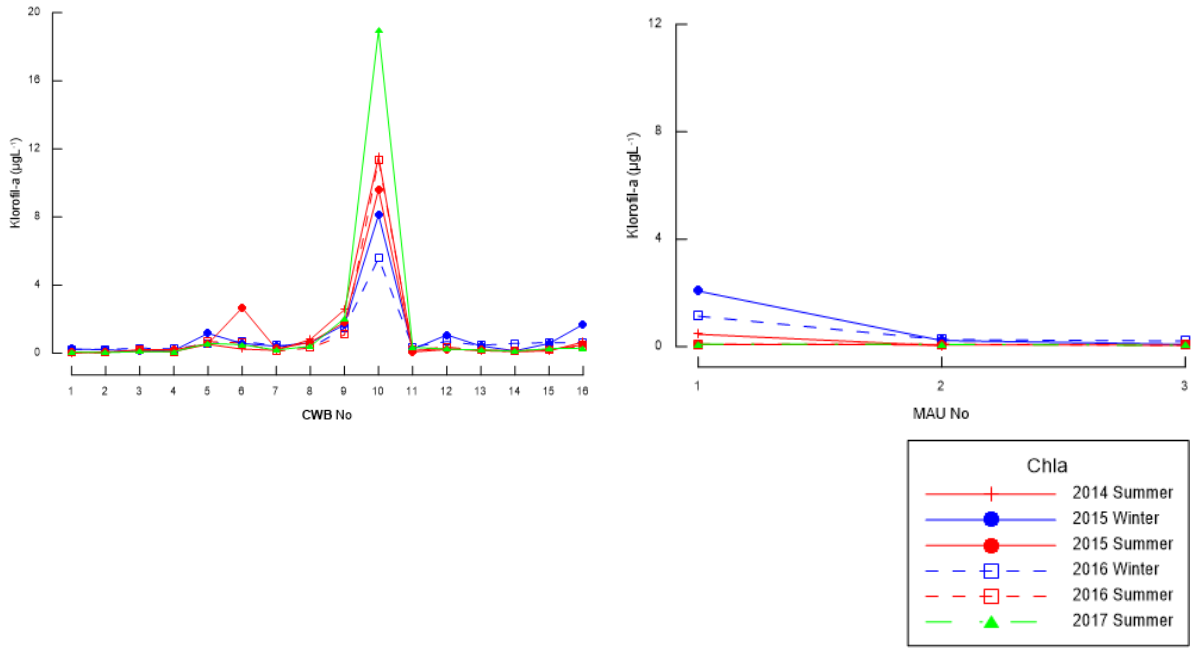

Figure 4.3 Comparison of the 2014-2017 surface layer (0-10m average) chlorophyll-a concentrations. of the Aegean Sea CWBs

4.3 Dissolved Oxygen Levels

Dissolved oxygen profiles of the Aegean Sea in the summer of 2017 showing all the stations together are presented in Figure 4.4. The DO values throughout the Aegean Sea ranged from 4.4 (bottom value at St. GULSW2 in Güllük Gulf) to 8.5 mg/L; yielding an average of 7.1 mg/L.

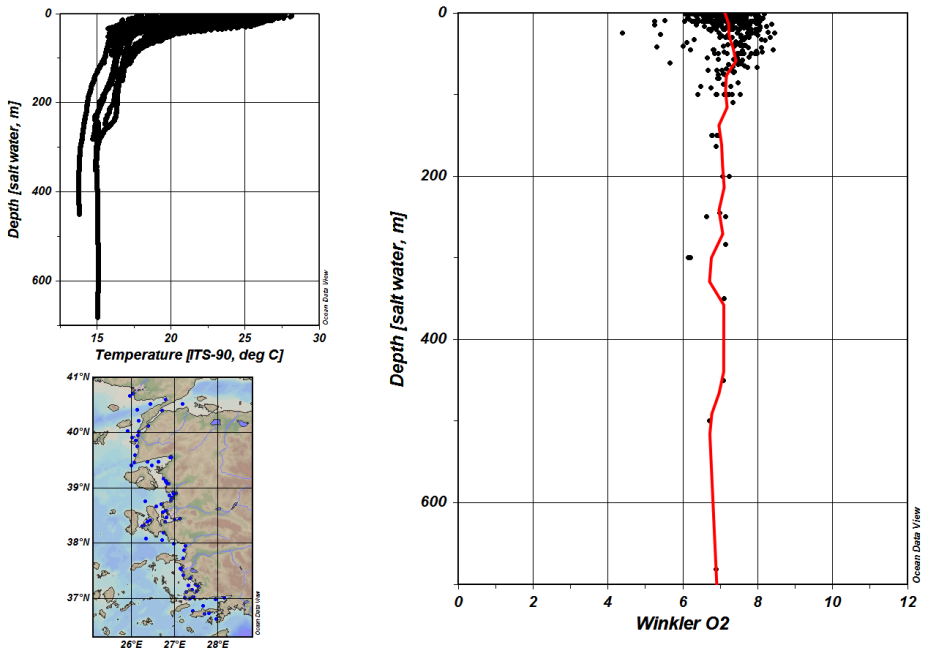

Figure 4.4 Dissolved oxygen profiles in the 2017 summer samplings of all the stations in the Aegean Sea

4.4 Secchi Disk Depth

Secchi Disc Depth was found to change between 1 and 26 m in the 2017 summer period in the Aegean Sea. The lowest depths (<5m) were observed in inner parts of the bays and gulfs. Especially the Inner Gulf of Izmir is the worst exhibiting 1m SDD value. It is possible to assert that SDD values are higher in the summer months generally; which could be attributed to decrease of river transports due to the decrease in precipitation in summer months as well as the increase in light intensity and the penetration of it.

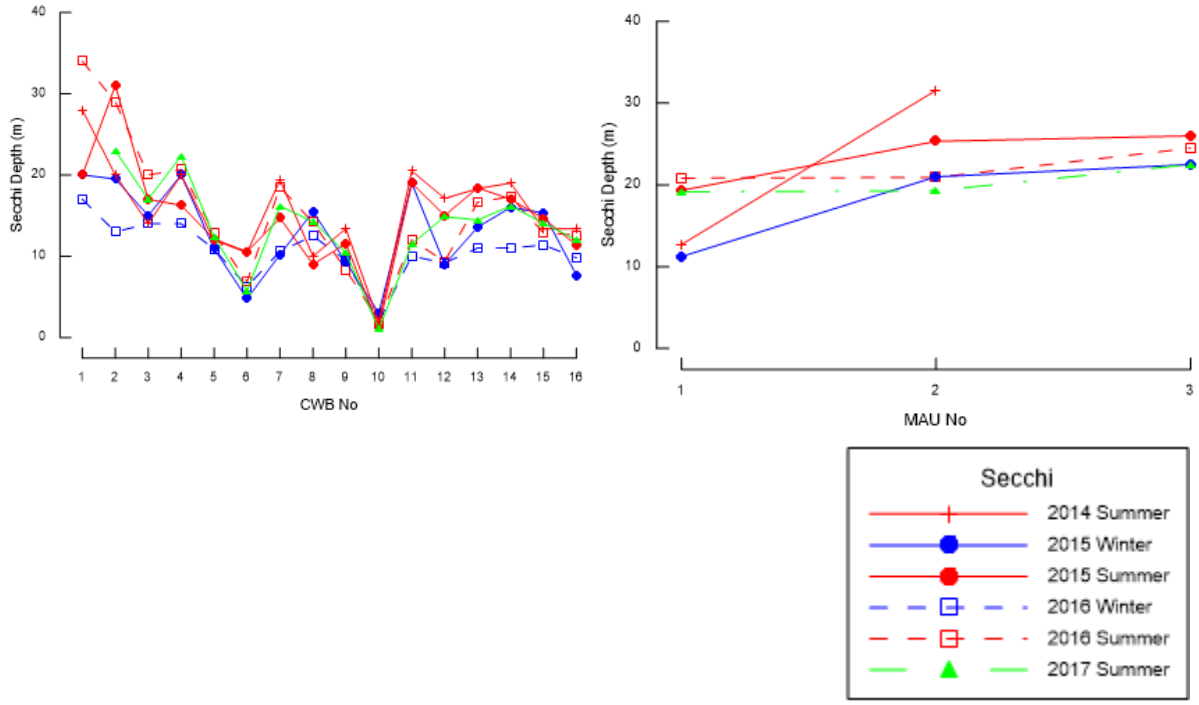

Figure 4.5 Comparison of the 2014-2017 Secchi disk data obtained in the Aegean Sea CWBs

5 TRIX INDEX ASSESSMENT

According to the TRIX Index values calculated with the trophic status indicator parameters (nutrients, chlorophyll-a and oxygen saturation percentage), the TRIX values were generally calculated to be <4 (No risk of eutrophication) in the 2017 summer sampling period, except for 2 stations. The stations in the Inner and Central Gulf of İzmir revealed TRIX values ranging from 4 to 6 (usually being >5 and having high risk of eutrophication).

When the 2017 summer period is compared with the 2014-2016 period in general terms, the 2017 summer period is found to have lower TRIX values.

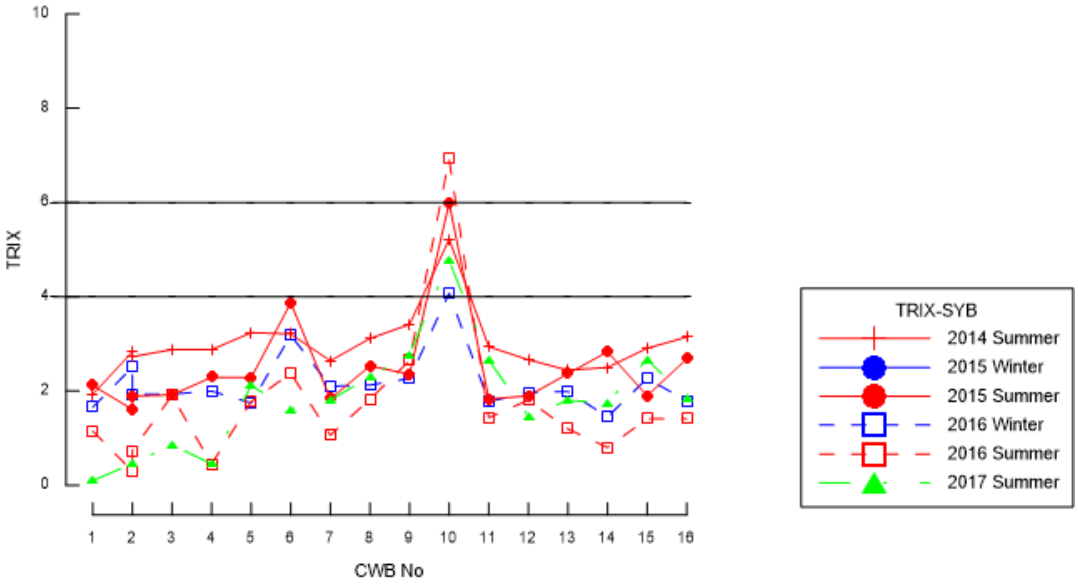

Figure 5.1 2014-2017 TRIX values of the CWBs in the Aegean Sea

6 GENERAL ASSESSMENT

Ecological Quality Status of Coastal Water Bodies

This section includes ecological quality status assessments for the 2014-2016 period on the basis of the findings of CWBs according to Water Framework Directive by biological parameters (phytoplankton, macro algae and benthic invertebrates) as well as supporting parameters (TP, Nox, SDD). Figure 6.1 shows the ecological quality status assessments of the Aegean Sea by WFD's 5-class characterization codes.

Meriç River Mouth (a part of CWB16), central and outer part of Gulf of İzmir (a part of CWB 9), coastal areas under the pressure of rivers (CWB 6 and 7) as well Gulf of Güllük have shown "moderate" quality in 2016. The quality of these water bodies might have changed between moderate/good at different

monitoring periods which needs special care and should be treated with appropriate actions to grantee the “good” status. Inner part of İzmir Bay is the worst, showing “bad” quality as in the previous years. Rest of the water bodies are in god/high status almost in all sampling periods.

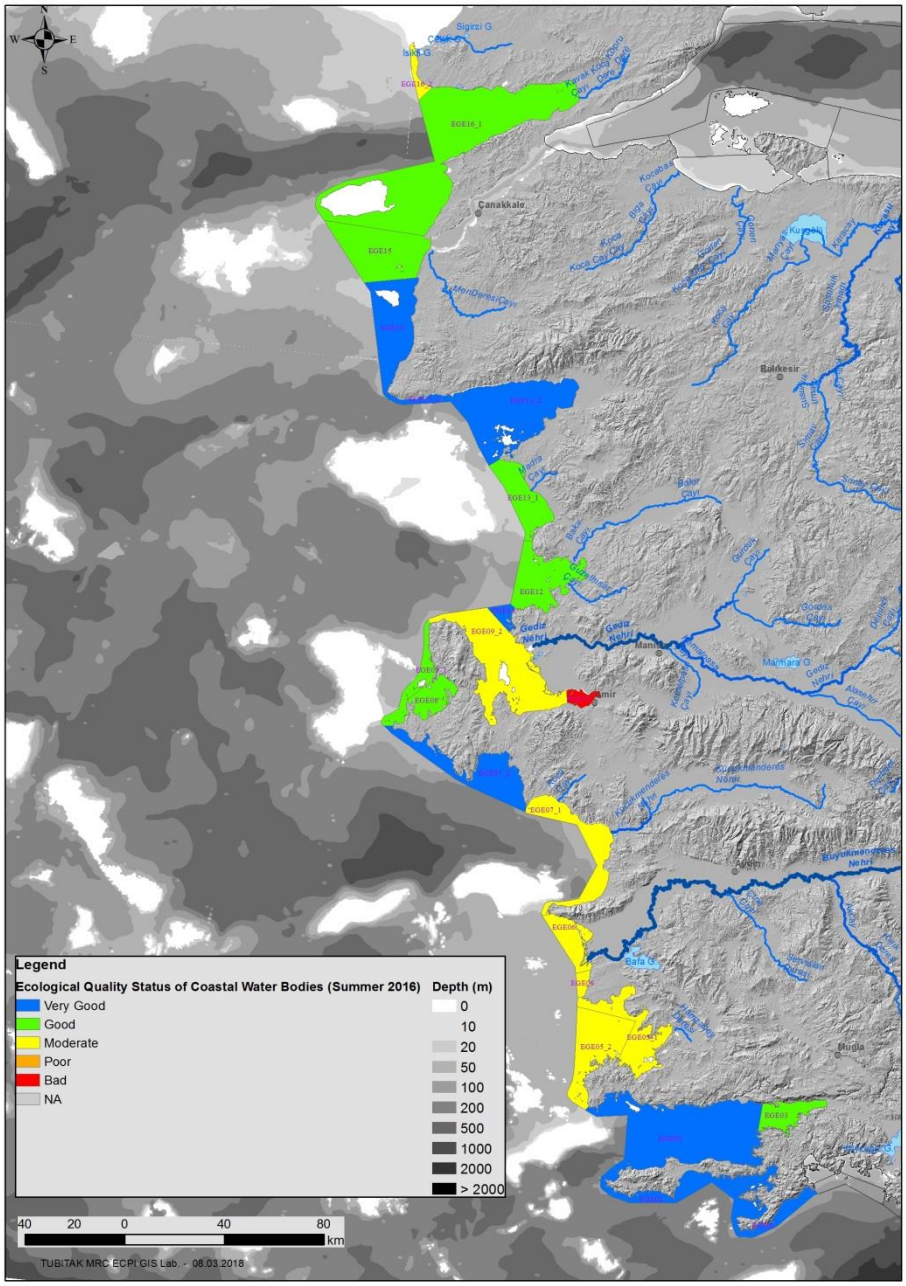

Figure 6.1 Coastal water bodies ecological quality assessment (2016)

7 APPENDICES

7.1 Appendix-1: Information on the stations in 2017

Station number	Station Code	Station location	CWB/ MAU No	Co-ordinates		Depth (m)	Distance from coast (km)
				Latitude	Longitude		
1	D7	The Dardanelles - Exit to the Marmara Sea	EGE15	40° 24' 34"	26° 42' 39"	70	1,49
2	KEPRAD	The Dardanelles - Exit to the Aegean Sea	EGE15	40° 7' 42"	26° 23' 40"	25	1,06
3	D1	The Dardanelles - Exit to the Aegean Sea	EGE15	40° 1' 23"	26° 9' 57"	56	2,35
4	GOKRAD	Gökçeada	EGE16	40° 13' 5"	26° 10' 29"	85	7,88
5	SABSWR2	Gulf of Saros	MAU 1	40° 25' 18"	26° 8' 13"	515	13,23
6	SABSWR	Gulf of Saros	EGE16	40° 31' 10"	26° 26' 23"	117	8,81
7	SABSW1	Gulf of Saros	EGE16	40° 36' 18"	26° 48' 0"	44	2,91
8	MESSW2	Edirne Enez	EGE16	40° 42' 19"	26° 1' 26"	17	2,22
9	MESSW1	Edirne Enez - Meriç River Mouth	EGE16	40° 42' 50"	26° 1' 35"	11	1,76
10	MESSWR	Edirne Enez	MAU 1	40° 40' 11"	25° 57' 32"	38	8,22
11	ADAC	Gökçeada-Bozcaada open	EGE15	40° 1' 43"	25° 54' 56"	75	21,59
12	BOZSWR	Bozcaada - open sea	EGE15	39° 55' 5"	26° 1' 7"	47	11,26
13	CSSW1	The Dardanelles. South	EGE15	38° 19' 35"	26° 17' 13"	18	0,37
14	BOZ	Bozcaada	EGE14	39° 51' 19"	26° 6' 2"	28	3,38
15	AEBSW1	Bozcaada - south	EGE14	39° 45' 10"	26° 7' 34"	21	1,27
16	TUZ		EGE14	39° 35' 47"	26° 4' 56"	48	2,28
17	MİBAD	Northern Aegean Sea	MAU 1	39° 24' 47"	25° 59' 42"	308	9,15
18	BABSWR	Cape Baba	EGE13	39° 27' 35"	26° 4' 7"	87	1,35
19	ALTSW1	Altınoluk	EGE13	39° 28' 18"	26° 22' 7"	92	1,02
20	EDRSW2	Gulf of Edremit	MAU 2	39° 34' 1"	26° 55' 7"	23	1,62
21	EDRSW1	Gulf of Edremit	EGE13	39° 33' 4"	26° 56' 10"	21	1,07
22	EDRSWR	Gulf of Edremit	EGE13	39° 33' 7"	26° 54' 4"	36	3,34
23	EDRSWR3	Gulf of Edremit	EGE13	39° 28' 26"	26° 37' 29"	81	7,89
24	EDRSWR2	Gulf of Edremit	EGE13	39° 24' 14"	26° 28' 51"	99	12,12
25	AYVSW1	Ayvalık	EGE13	39° 10' 15"	26° 44' 50"	15	1,48
26	AYVSW2	Ayvalık	EGE13	39° 7' 17"	26° 48' 14"	19	3,43
27	DIBSWR	Gulf of Dikili	EGE13	39° 4' 22"	26° 50' 18"	18	2,05
28	DIBSW1	Gulf of Dikili	EGE13	39° 4' 35"	26° 51' 25"	30	1,68
29	BARSW1	Bakırçay river mouth	EGE12	38° 55' 7"	26° 58' 25"	13	0,68
30	BARSW2	Bakırçay river mouth	EGE12	38° 54' 11"	26° 59' 34"	41	1,43
31	CABSW1	Gulf of Çandarlı	EGE12	38° 54' 19"	27° 2' 19"	29	0,51
32	CABSWR	Gulf of Çandarlı	EGE12	38° 53' 7"	26° 58' 38"	53	3,32
33	ALISW2	Gulf of Aliaga	EGE12	38° 49' 17"	26° 57' 5"	20	0,47
34	ALISW1	Gulf of Aliaga	EGE12	38° 48' 52"	26° 57' 7"	8	0,56
35	ALISWR	Gulf of Aliaga	EGE12	38° 52' 14"	26° 53' 16"	76	5,07
36	DDNEM	Gulf of Nemrut	EGE12	38° 46' 38"	26° 54' 33"	54	1,16
37	FOCASW1	Foça	EGE11	38° 42' 25"	26° 41' 56"	61	2,56
38	GEDSW2	Gediz River Mouth	EGE09	38° 33' 20"	26° 44' 8"	55	6,93
39	IZMSWR	Gulf of İzmir	EGE09	38° 28' 15"	26° 48' 31"	46	6,27
40	IZMSW3	Outer Gulf of İzmir	EGE09	38° 23' 12"	26° 46' 25"	19	1,03
41	IZMSW2	Central Gulf of İzmir	EGE09	38° 25' 17"	27° 0' 2"	11	1,41
42	IZMSW1	Inner Gulf of İzmir	EGE10	38° 26' 7"	27° 7' 28"	12	0,91
43	GEDSW1	Gediz River Mouth	EGE09	38° 34' 49"	26° 47' 41"	10	2,01
44	GEDSWR	Gediz - offshore	MAU 2	38° 40' 11"	26° 34' 16"	70	4,72
45	KARAD	Central Aegean	MAU 2	38° 45' 50"	26° 19' 8"	220	11,96
46	ILBSW1	Gulf of Ildır	EGE08	38° 25' 10"	26° 26' 19"	66	1,15
47	ILBSWR	Gulf of Ildır	EGE08	38° 23' 38"	26° 22' 26"	59	5,05
48	CESSW1	Çeşme	EGE09	38° 19' 35"	26° 17' 13"	17	0,37
49	CESSWR	Çeşme	EGE09	38° 18' 42"	26° 15' 24"	20	2,01

Station number	Station Code	Station location	CWB/ MAU No	Co-ordinates		Depth (m)	Distance from coast (km)
				Latitude	Longitude		
50	SAKCED	Central Aegean	MAU 2	38° 5' 8"	26° 19' 51"	366	15,28
51	SEGED	Central Aegean	MAU 2	38° 3' 8"	26° 42' 20"	258	10,35
52	SIBSWR	Sea	EGE07	38° 11' 25"	26° 44' 26"	45	2,06
53	SIBSW1	Gulf of Sığacık	EGE07	38° 11' 40"	26° 46' 9"	22	0,30
54	KUKED	Central Aegean	MAU 2	37° 59' 2"	26° 58' 36"	169	8,65
55	KMRSW1	K. Menderes River Mouth	EGE07	37° 57' 14"	27° 15' 25"	19	0,70
56	KMRSW2	K. Menderes River Mouth	EGE07	37° 56' 38"	27° 15' 20"	40	1,49
57	KUSSW1	Gulf of Kuşadası	EGE07	37° 52' 13"	27° 13' 1"	55	2,45
58	KUSSW2	Gulf of Kuşadası	EGE07	37° 43' 19"	27° 11' 50"	59	1,47
59	BMRSWR	B. Menderes River Mouth	EGE06	37° 32' 4"	27° 7' 56"	40	3,57
60	BMRSW2	B. Menderes River Mouth	EGE06	37° 32' 5"	27° 9' 8"	11	1,85
61	BMRSW1	B. Menderes River Mouth	EGE06	37° 31' 31"	27° 9' 17"	10	2,30
62	DIDSW1	Gulf of Didim	EGE06	37° 25' 12"	27° 12' 10"	32	1,41
63	AKBSWR	Gulf of Akbük	EGE05	37° 22' 1"	27° 22' 4"	19	0,95
64	GULSW2	Gulf of Güllük	EGE05	37° 13' 8"	27° 33' 1"	15	1,83
65	GULSW1	Gulf of Güllük	EGE05	37° 14' 30"	27° 29' 17"	37	1,02
66	GULSW3	Gulf of Güllük	EGE05	37° 7' 22"	27° 30' 19"	44	1,54
67	GULSW4	Gulf of Güllük	EGE05	37° 9' 12"	27° 24' 19"	48	1,64
68	GULSWR	Gulf of Güllük	EGE05	37° 14' 10"	27° 19' 5"	66	8,58
69	YALI	Yalıkavak	EGE05	37° 6' 29"	27° 15' 59"	45	0,58
70	TUR	Turgutreis	EGE05	37° 0' 8"	27° 13' 54"	22	2,01
71	BODSWR	Bodrum	EGE04	36° 59' 22"	27° 21' 28"	44	1,78
72	BODSW1	Bodrum	EGE04	37° 1' 23"	27° 25' 21"	23	0,28
73	DDIC	Bodrum	EGE04	37° 1' 0"	27° 26' 29"	22	0,39
74	DATSWR3	Datça	EGE02	36° 51' 31"	27° 39' 36"	707	5,50
75	GOBSWR1	Gulf of Gökova	EGE04	36° 58' 33"	27° 56' 52"	113	4,51
76	GOBSWR	Gulf of Gökova	EGE03	37° 0' 8"	28° 9' 10"	67	3,03
77	BZBSW1	Bozburun	EGE01	36° 37' 5"	27° 58' 11"	160	0,78
78	DATSWR2	Datça	EGE02	36° 43' 26"	27° 48' 5"	154	3,56
79	DATSW1	Datça	EGE02	36° 43' 19"	27° 41' 56"	41	0,52
80	DATSWR	Datça offshore	MAU 3	36° 46' 17"	27° 26' 3"	157	2,46

7.2 Appendix-2: Sampling Methods

MATRIX	PARAMETER	SAMPLING METHOD	STORAGE METHOD	REFERENCE
SEA WATER	T,S,D	*In-situ* measurement	-	CTD Manual –Software Sea Monitoring Guidelines (2017)
	DO	*In-situ* measurement / Reagent must be added from rosette to bottle without contacting with air.		Winkler CTD Manual -Software / MTS 163 Sea Monitoring Guidelines (2017)
	SD Depth	*In-situ* measurement: with a 30cm diameter white disk	-	Sea Monitoring Guidelines (2017)
	Chl-a	Roset sampling, filtering with GF/F filters	-20 ^{0}C in deep freezer	Water Pollution Control Regulation Sampling and Analysis Methods Communiqué UNEP/MAP, 2005. Sampling and Analysis techniques for the Eutrophication Monitoring Strategy of MED POL. Technical Reports Series No: 163 Sea Monitoring Guidelines (2017)
	PO_4^+	From rosette to bottle	In HDPE bottles in deep freezer at -20 ^{0}C or immediate measurement	
	TP			
	SiO_2			
	NO_3+NO_2-N			
	NH_4-N			

7.3 Appendix-3: Measurement and Analysis Methods

MATRIX	PARAMETER	METHOD	INSTRUMENT	REFERENCE	LOD/LOQ	Unit	Measurement-Analysis Laboratory
SEA WATER	T,S,D	*In-situ* measurement	CTD prop	CTD Manual –Software Sea Monitoring Guidelines (2017)	-	-	R/V TÜBİTAK MARMARA Research Vessel
	DO	Iodometric Method (Winkler Method)	Titrator	S.M. 4500 B:2005 Sea Monitoring Guidelines (2017)	-	mg/L	R/V TÜBİTAK MARMARA Research Vessel
	SD Depth	*In-situ* measurement	Secchi Disk	Sea Monitoring Guidelines (2017)	-	m	R/V TÜBİTAK MARMARA Research Vessel
	Chl-a	Spectrophotometric Method-Extraction With Aceton	Spectrophotometer	S.M 10200 H. Sea Monitoring Guidelines (2017)	0,05	µg/L	R/V TÜBİTAK MARMARA Research Vessel
	PO_4^+	Method of Determination of Orthophosphate	Autoanalyzer	S.M. 4500-P : 2005 G Sea Monitoring Guidelines (2017)	0,02/ 0,07	µmol/L	R/V TÜBİTAK MARMARA Research Vessel
	TP	Persulfate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus	Autoanalyzer, Autoclave	S.M. 4500- P J. Sea Monitoring Guidelines (2017)	0,055 / 0,183	µmol/L	TÜBİTAK MAM Environment and Cleaner Production Institute
	SiO_2	Colorimetric method	Autoanalyzer	SM 4500-SiO2- :2005 F Sea Monitoring Guidelines (2017)	0,06 /0,19	µmol/L	R/V TÜBİTAK MARMARA Research Vessel
	NO_3+NO_2-N	Cadmium Reduction Method	Autoanalyzer	S.M. 4500-NO3-I:2005 Sea Monitoring Guidelines (2017)	0,05 / 0,17	µmol/L	R/V TÜBİTAK MARMARA Research Vessel
	NH_4-N	Flow Injection Method	Autoanalyzer	S.M. 4500-NH3 H:2005 Sea Monitoring Guidelines (2017)	0,041 / 0,14	µmol/L	R/V TÜBİTAK MARMARA Research Vessel

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