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Composition and abundance of octocorals in the Sea of Marmara, where the Mediterranean meets the Black Sea

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Summary: Species composition and abundance of octocoral assemblages were investigated in the Sea of Marmara, which forms the connection between the Mediterranean and the Black Seas, two semi-enclosed seas with peculiar oceanographic conditions. Fourteen octocoral species were collected in the saline layer of the Marmara Sea (20-40 m), with a mean coral abundance of 5.21±5.11 colonies m^{-2} (mean ± SD) calculated from a total of 1390 colonies counted in transects. In spite of severe anthropogenic disturbances, dense assemblages of corals/gorgonians were observed during this study. The coralligenous communities—one of the most valuable structures of the Mediterranean Sea—harbored either *Eunicella cavolini* or *Paramuricea macrospina* as the dominant gorgonian in the Marmara Sea. Furthermore, the gorgonian assemblages of the Marmara Sea differed from those of the Mediterranean in their high abundance of *P. macrospina* and *Spinimuricea klavereni*, two species rarely encountered in the Mediterranean Sea at the studied depth range. The factors behind the observed differences are discussed in regard to the particular oceanographic conditions of the Marmara Sea. Finally, we revised the main threats to corals/gorgonians in the Marmara Sea and provided some insights on management recommendations for coral conservation in this area.

Keywords: octocoral; soft coral; gorgonian; sea pen; coralligenous; Marmara Sea.

Composición y abundancia de especies de octocorales en el mar de Mármara, donde el Mediterráneo confluye con el mar Negro

Resumen: En este trabajo se ha analizado la composición y abundancia de especies de octocorales de las comunidades bentónicas del mar de Mármara. Este mar conecta el Mediterráneo y el mar Negro, dos mares semicerrados con condiciones oceanográficas particulares. En la capa salina del mar de Mármara (20-40 m) se encontraron un total de catorce especies de octocorales. La abundancia media de colonias de las diferentes especies se obtuvo mediante la realización de transectos. En total se censaron 1390 colonias resultando en una abundancia media de corales de 5.21±5.11 colonias m^{-2} (media±DE). A pesar de que el mar de Mármara está sometido a severas perturbaciones antropogénicas, se observaron densas agregaciones de corales/gorgonias durante este estudio. En las comunidades de coralígeno—una de las comunidades más emblemáticas del mar Mediterráneo—que se desarrollan en el mar de Mármara están dominadas por dos especies de gorgonias *Eunicella cavolini* o *Paramuricea macrospina*. Además las agregaciones de gorgonias del mar de Mármara diferían de las del Mediterráneo por su alta abundancia de *P. macrospina* y *Spinimuricea klavereni*, dos especies raramente encontradas en el mar Mediterráneo en el rango de profundidades estudiado. Los factores que podrían explicar los resultados se discuten teniendo en cuenta las condiciones oceanográficas particulares del mar de Mármara y las principales amenazas para los corales/gorgonias en el mar de Mármara. Finalmente, ofrecemos algunas recomendaciones de gestión para la conservación de los corales en esta área.

Palabras clave: octocoral; coral blando; gorgonia; pluma de mar; coraligenos; mar de Mármara.

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INTRODUCTION

Octocorals in the Mediterranean Sea constitute a small group of 51 species (Vafidis in Coll et al. 2010: Table S13) but are widespread from shallow to significant depths (Freiwald et al. 2009, Mastrototaro et al. 2010) on both hard and soft substrates (Aguilar 2004) and are important components of the valuable Mediterranean coralligenous communities (Ballesteros 2006). Among them, some long-living species are considered as ''ecosystem engineers'' (Jones et al. 1994, Ponti et al. 2014) in Mediterranean marine hard-bottom communities, with significant effects on the structure, biomass and biodiversity of coralligenous communities (Ballesteros 2006). Although scientific studies and conservation efforts focus increasingly on octocorals and mainly gorgonians, our knowledge on their presence and distribution in the eastern Mediterranean is yet insufficient (Salomidi et al. 2009).

Octocoral species from the Marmara Sea have been previously reported (Demir 1954, Öztürk and Bourguet 1990, Topçu and Öztürk 2013) but studies on the abundance and distribution of the species in the Marmara Sea have been rarely addressed. Although the Marmara Sea is connected to the Mediterranean via the Çanakkale Strait (Dardanelles), it has peculiar oceanographic, ecological and geomorphologic characteristics (Öztürk and Öztürk 1996). This semi-enclosed sea, connecting the Black Sea to the Aegean Sea via the Turkish Straits System (TSS), is characterized by a two-layer stratification, with the brackish surface layer formed by the Black Sea water mass flowing into the Marmara Sea through the Istanbul Strait with a salinity of 18-24 and a temperature of 20-24°C in summer and 8-9°C in winter. More saline (up to 38.5) Mediterranean Sea water with a constant temperature of about 15°C resides 15-20 m below this layer (Beşiktepe et al. 1994). The TSS serves as an ecological barrier, a biological corridor and an acclimatization zone for the biota of the Mediterranean and the Black Sea (Öztürk and Öztürk 1996). Suspended particulate organic matter and zooplankton, which constitute the bulk of octocorals' diet, are very abundant in the whole Marmara Sea (Çoban-Yıldız et al. 2000, İşinibilir et al. 2011), although the phytoplankton and microzooplankton biomass and production show a decreasing trend from the Istanbul Strait to the Aegean Sea (Zervoudaki et al. 2011).

The aim of this study was to determine species composition and abundances of octocoral assemblages in the Marmara Sea and to compare the communities in the southern parts (closer to the Çanakkale strait connecting to the Aegean Sea) and northern parts (closer to the Istanbul Strait [Bosphorus] connecting to the Black Sea) with those in the Mediterranean Sea.

MATERIALS AND METHODS

Sampling design

Thirty-one stations were sampled by SCUBA diving in coastal areas of various islands in the Marmara Sea (Fig. 1) from April 2012 to September 2013 in order to

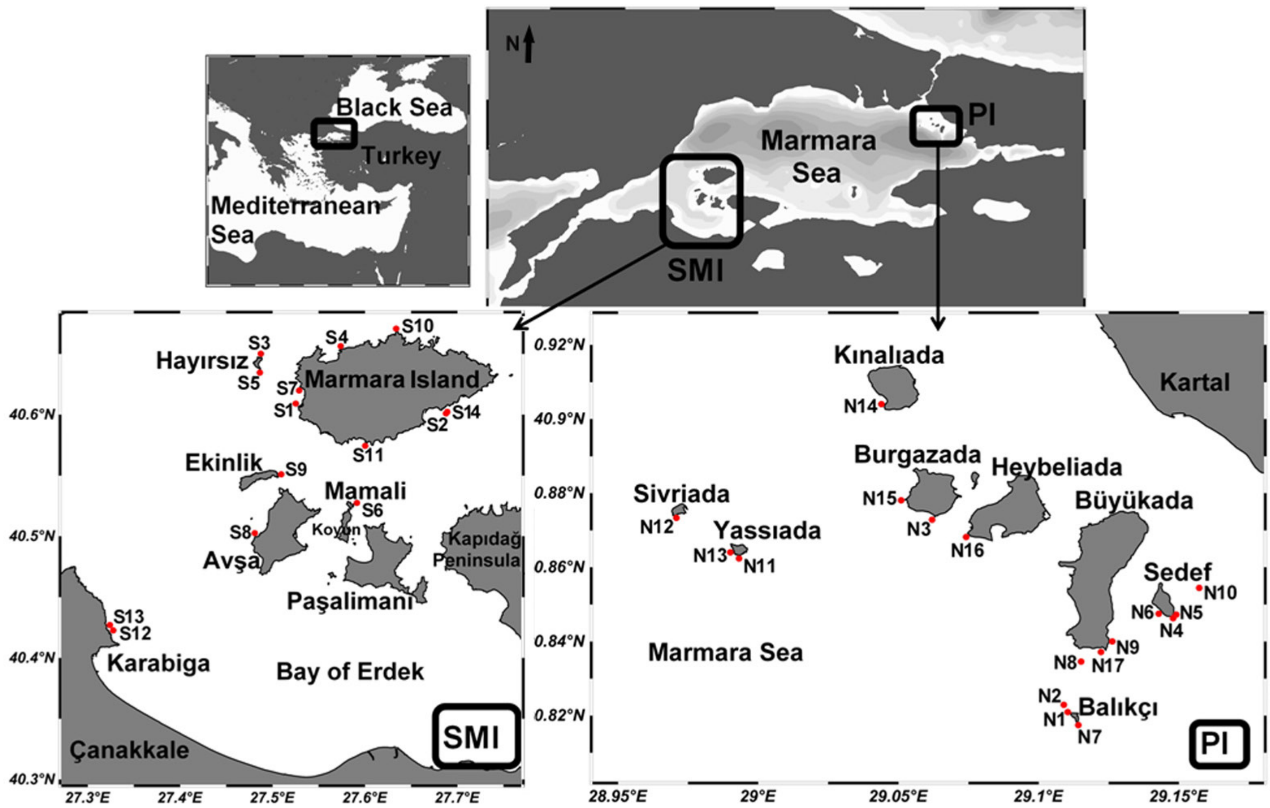

Fig. 1. – Map showing the location of the Sea of Marmara, the Prince Islands [PI] (right) and the Southern Marmara Islands [SMI] (left) and the stations.

Table 1. – Detailed description and geographical coordinates of the sampling sites. All sites were surveyed for presence of octocorals from 15/20 m to 40 m depth. The quantitative sampling was performed between 32 and 36 m, depending on the station. The type of bottom where the transect was laid is indicated by the following acronyms: hard substrate composed of hard beds and rocks (H), soft substrate composed of sandy/muddy bottom (S) and mixed substrate (M) composed of pebbles, shells and small rocks on a muddy bottom.

Code	Location	Description	Transect	Coordinates
N1	Balıkçı Adası - Tektaş	The site is composed of very large to large / medium size rocks exhibiting small caves and crevices. Among the rocks, the bottom is composed of coarse sand/gravel/dead shells with a very slight slope	H	40°49’12.95”N 29° 6’38.29”E
N2	Kufos taşı	The site is composed of large to medium size rocks. Among the rocks, the bottom is composed of coarse sand/gravel/dead shells with a very slight slope	M	40°49’15.56”N 29° 6’36.25”E
N3	Burgazada - Yelk-enkaya	The bottom is composed of sand with pebbles and dead shells, occasionally interrupted by small boulders, with a slope of approximately 15°	M	40°52’24.59”N 29° 3’45.29”E
N4	Sedef Adası	The bottom is composed of sand with pebbles and dead shells, occasionally interrupted by small boulders, with a slope of approximately 15°	M	40°50’ 47.84’’N 29° 08’ 50.37’’E
N5	Sedef Adası	The bottom is composed of sand with pebbles and dead shells, occasionally interrupted by small boulders, with a slope of approximately 15°	M	40°50’ 50.90’’N 29°08’54.05’’E
N6	Sedef Adası	The bottom is composed of sand with pebbles and dead shells, occasionally interrupted by small boulders, with a slope of approximately 15°	M	40°50’51.23’’N 29° 08’ 38.84’’E
N7	Balıkçı Adası - Liskari	The site is composed of large to medium size rocks until 35-40 m with a slope of approximately 30°. The bottom is then composed of fine sand with dead shells	H	40°49’5.01”N 29° 6’49.53”E
N8	Büyükada - Manastır	The site is 400 m from the nearest shore. Large to medium size rocks are present from 35 m and continue deep with a slight slope	H	40°50’04”N 29° 06’55.3”E
N9	Büyükada - Eşkina taşı	The site is composed of very large to large/medium size rocks with a slope of 40-50°	H	40°50’25.30”N 29° 7’31.10”E
N10	Sedef Adası-Karaev	The site is 1.3 km from the nearest shore. The very large rocks start from 35 m and continue to 50 m, surrounded by sandy bottom	H	40°51’0.97” N 29°09’3.17”E
N11	Yassıada Batı	The site is composed of large to medium size rocks with a slope of approxi-mately 40°	H	40°51’50.47”N 28°59’28.63”E
N12	Sivriada	The site is composed of very large rocks starting from 15 m, offering large walls that descend to 40-50 m where rocks are surrounded by coarse sand/ gravel/dead shells	H	40°52’26.15”N 28°58’14.30”E
N13	Yassıada Güney	The bottom is composed of sand with few pebbles and dead shells with a slope of approximately 10-15°	S	40°51’48.93”N 28°59’41.33”E
N14	Kınalıada	The bottom is composed of fine sand/mud with few pebbles with a slope of approximately 10-15°	S	40°54’10.40”N 29° 2’21.56”E
N15	Burgazada - Kal-pazankaya	The bottom is composed of fine sand/mud with a slope of approximately 10-15°	S	40°52’41.52”N 29° 3’7.36”E
N16	Heybeliada	The bottom is composed of fine sand/mud with a slope of approximately 10-15°	S	40°52’3.91”N 29° 4’29.28”E
N17	Büyükada - Kurşunburnu	The bottom is composed of fine sand/mud with a slope of approximately 10-15°	S	40°50’13.95”N 29° 7’18.67”E
S1	Paçanoz Kayalıkları	The bottom is composed of pebbles and dead shells interrupted with poly-chaete bioconcretions, with a slope of approximately 15°	M	40°36’31.47”N 27°31’31.33”E
S2	Laz Kayası	The site is 230 m off the coast. The very large rocks start from 3 m and con-tinue to 40-50 m, surrounded by coarse sand/gravels	H	40°36’11.91”N 27°41’10.94”E
S3	Hayırsız Ada Kuzey	The site is composed of a wall descending to 30 m where large to medium size rocks are present on the bottom with a 10-30° slope	H	40°38’47.71”N 27°29’12.47”E
S4	Badalan Dağaltı	The site is 200 m off the coast. Large rock starts from approximately 10 m and descends to 35 m, surrounded by gravels and dead shells	H	40°39’18.41”N 27°34’23.96”E
S5	Hayırsız Ada Güney	The site is composed of a wall descending to 30 m where the bottom is com-posed of medium size rocks with a slope of approximately 40°	H	40°38’8.48”N 27°29’19.20”E
S6	Mamali Adası	The rocks descends to 20 m where the bottom is composed of large to me-dium size rocks covered with bioconcretions with a slope of 15°	H	40°31’30.08”N 27°35’16.48”E
S7	Çınarlı	The bottom is composed of fine sand/mud with a slope of approximately 10-15°	S	40°37’11.55”N 27°31’44.35”E
S8	Avşa Adası	The bottom is composed of fine sand/mud with a slope of approximately 5-10°	S	40°30’1.47”N 27°28’53.42”E
S9	Ekinlik Adası	The bottom is composed of fine sand/mud rarely interrupted with small boul-ders on a slope of approximately 5-10°	S	40°33’10.45”N 27°30’17.53”E
S10	Domuz burnu feneri	The bottom is composed of fine sand/mud with a slope of approximately 5-10°	S	40°40’4.52”N 27°37’52.45”E
S11	Gündoğdu	The bottom is composed of fine sand/mud with a slope of approximately 5-10°	S	40°34’36.94”N 27°36’3.36”E
S12	Karabiga Cendere	The site is composed of a wall descending to 30 m where large to medium size rocks are present on the bottom with a slope of 10-30°	H	40°25’34.92”N 27°19’14.10”E
S13	Karabiga Toptaş Kumsalı	The bottom is composed of sand with pebbles and dead shells occasionally interrupted by small boulders, with a slope of approximately 15°	M	40°25’20.38”N 27°19’25.13”E
S14	Topağaç	The bottom is composed of fine sand/mud with a slope of approximately 10°	S	40°36’14.64”N 27°41’7.32”E

determine the presence of octocoral species. A total of 74 dives were performed and the first dives were dedicated to specimen collection and photography. A total of 17 stations (stations N1 to N17) were located in the northern group of islands (Prince Islands) and 14 (stations S1 to S14) in the Southern Marmara Islands (Table 1). Stations in the north were chosen to the south of the Prince Islands because there is not enough depth to reach the Mediterranean water layer on the northern coasts. Since the upper layer of the Marmara Sea is formed by Black Sea waters, all stations were surveyed for octocorals from the halocline (where the Mediterranean waters reside, starting from 15-20 m) to a maximum of 40 m depth. The presence of abandoned fishing gears was noted only at the northern stations due to the difficulty of working conditions and limited time in the south, although similar fishing pressure is active in the region. All octocoral species encountered at a station were photographed in situ before a segment of approximately 10 cm was cut from the colony. The collected specimens were preserved in ethanol and the species were identified by microscope slide preparations of sclerite morphology according to Carpine and Grasshoff (1975), Weinberg (1976, 1977), Bayer (1981) and Williams (1995).

The abundance of octocorals was assessed by measuring density of colonies for each species found along transects (see below). We considered three types of substrates: hard substrate composed of hard beds and rocks [H], soft substrate composed of sandy/muddy bottom [S] and mixed substrate [M] composed of pebbles, shells and small rocks on muddy bottom. The slope in degrees and the structure of hard bottoms (whether wall or rocks) were also noted (Table 1). The rocks were categorized as “very large” when they were larger than 3×5 m (vertical×horizontal); “large” when they were 1-3 m (vertical) and 1-5 m (horizontal); “medium” when they measured 1×1 m; and “small” when they measured less than 1×1 m. A total of 17 stations in the north and 10 in the south were quantitatively sampled for octocoral diversity and abundance. Four stations in the south were not quantitatively sampled due to the sole presence of encrusting alcyonarian and stoloniferan species or very scarce gorgonians to be enumerated. Transects were conducted following a fixed depth line that varied from 32 to 36 m depending on the station. Octocoral colonies were enumerated in 1 m^2 quadrats placed every metre (20 quadrats) on either side of the 20-m-long transect tape laid on the substrate. In case of vertical walls or large boulders, 20 quadrats were placed haphazardly on the substrate at the same depth range. The numbers of colonies in each quadrat of a station (including the quadrats with 0 colonies) were summed together, and then divided by 20 m^2 to achieve density values in units of colonies m^{-2}.

Statistical analysis

The hypothesis that octocoral density and diversity (Simpson index in the form $1/\lambda$) of stations do not differ among each other was tested by the univariate non-parametric Kruskal-Wallis (N=27) test with the SPSS software (SPSS, Chicago, IL).

To explore potential differences across geographic regions and habitat types on octocoral assemblages (composition and abundance), we used a two-factor permutational multivariate analysis of variance (PERMANOVA, Anderson 2001) in which each term was tested using 9999 random permutations. The two factors were Geographic Zone (north-south) and Habitat (Hard-Soft-Mixed). Station S14, where only one specimen of *Funiculina quadrangularis* was observed at the limit of observation (41 m), was excluded from the analyses. Species composition and abundance data were analysed separately because abundance data were not available at all stations. The analyses were based on Bray-Curtis similarity of previously transformed data (presence/absence in case of the species composition; fourth root in case of the abundances). The resemblance matrices informed principal coordinates analysis (PCO) plots in order to identify the relationships between sampling stations based on biological information. Pairwise comparisons were also carried out in order to ascertain patterns in the composition or abundances among stations. Finally, similarity percentage analysis (SIMPER) was performed to identify the taxa that best explain the variations observed among stations. All the above analyses were carried out with the Primer v6 software (Clarke and Gorley 2006).

RESULTS

A total of 14 octocoral species were collected from the Sea of Marmara (Supplementary Material Table S1), with 11 of them from the Prince Islands coasts and 14 from the Southern Marmara Islands. Abundance values were obtained for only 9 species (Table 2) because rare species were generally not encountered in transects and encrusting corals were not counted. Octocoral abundance in the Marmara Sea was 5.21±5.11 colonies m^{-2} (mean±SD) on average calculated from a total of 1390 colonies counted in transects. Total octocoral abundance varied among stations from 0.30 to 17.70 colonies m^{-2} and octocoral abundance was higher in the north of the Marmara than in the south, though not significantly. Although more species were found in the south, the north of the Marmara Sea (Simpson mean=1.98±0.88) was significantly more diverse than the south (Simpson mean=1.24±0.38) ($p<0.05$).

Species composition differed significantly between the north and the south as well as among different substrate types (Table 3). 60.5% of the variation was explained in axis 1 of the PCO plot (Fig. 2), where the discrimination of stations in the horizontal direction was by groups of substrate types.

The stations with soft substrates were not significantly different between north and south in terms of either species composition or abundance but were significantly different between hard and mixed substrates (Table 3). *Veretillum cynomorium* was responsible alone for 86% of the similarity observed between stations of soft substrates (Table 4). Both species composition and abundances differed significantly on hard substrates and mixed substrates of the north and south (Table 3).

Table 2. – Densities of the species in colonies m^{-2} and the mean density (± standard deviation) for the stations where the species was present in transect. Species acronyms: AA, *Alcyonium acaule*; AP, *Alcyonium palmatum*; EC, *Eunicella cavolini*; PC, *Paramuricea clavata*; PG, *Pteroeides griseum*; PM, *Paramuricea macrospina*; PS, *Paralcyonium spinulosum*; SK, *Spinimuricea klavereni*; VC, *Veretillum cynomorium*.

	VC	PG	AP	AA	PS	EC	PM	PC	SK
N1	0	0	0.5	0	6.1	0.9	3.9	0.5	1.4
N2	0	0	0	0	7.1	0	0.7	0	0.3
N3	0.9	0	0.1	0	0	0	0	0	0.1
N4	0.3	0	0.3	0	1.3	0.1	1.2	0	0.8
N5	0	0	1.2	0	6.9	0	2.3	0	3.1
N6	0	0	0.4	0	5.6	0	1.7	0	1.1
N7	0	0	0.2	0	2.7	0	1.7	0	0.9
N8	0	0	0.2	0	1.8	0	0.5	0.4	0.1
N9	0	0	0.2	0	0	0	0.1	0	1.1
N10	0	0	0.7	0	4.1	0.2	1.5	0.2	0.4
N11	0	0	0.6	0.1	0.5	12.8	2.0	0	0.4
N12	0	0	1.0	0	0	13.9	2.1	0.1	0.6
N13	0.4	0	0.1	0	0	0	0	0	0.1
N14	1.2	0	0	0	0	0	0	0	0
N15	1.6	0	0	0	0	0	0	0	0
N16	3.9	0	0.1	0	0	0	0	0	0.2
N17	3.6	0	0	0	0	0	0	0	0
S1	0	0	0	3.4	0	0	0	0	0
S3	0	0	0	0	1.4	0	0	0	0
S3	0	0	0	0	0	10.7	0	0.4	0.1
S6	0	0	0	2.5	0	0	0	0	0
S7	1.4	0	0	0	0	0	0	0	0
S8	0.2	0	0.2	0	0	0	0	0	0
S9	0	1.2	0	0	0	0	0	0	0
S10	4.2	1.1	0	0	0	0	0	0	0
S11	0.2	0	0.1	0	0	0	0	0	0
S13	0	0	0	0.8	0	0	0	0	0
Mean±sd	1.63±1.54	1.15±0.07	0.40±0.30	1.70±1.51	3.75±2.52	6.43±6.69	1.61±1.03	0.32±0.16	0.71±0.77

Table 3. – Results of the PERMANOVA testing for the effects of the zone (north [N] and south [S]) and substrates (hard [H]; mixed [M]; soft [S]) on the composition and abundances of Marmara soft coral assemblages.

PERMANOVA (Species Composition)

Source	df	SS	MS	Pseudo-F	P(perm)
ZO	1	7844.9	7844.9	9.9859	0.0002
SU	2	30282	15141	19.273	0.0001
ZOxSU	2	6363.1	3181.6	4.0499	0.0037
Res	24	18854	785.6		
Total	29	62502			

Pairwise comparisons

Within level 'N' of factor 'ZONE'			Within level 'S' of factor 'ZONE'		
Groups	t	P(perm)	Groups	t	P(perm)
H. M	2.1801	0.0105	H. M	2.1392	0.0339
H. S	6.2103	0.0014	H. S	3.0846	0.002
M. S	3.9635	0.0075	M. S	1.1489	0.3826

Within level 'H' of factor 'SUBS'			Within level 'M' of factor 'SUBS'			Within level 'S' of factor 'SUBS'		
Groups	t	P(perm)	Groups	t	P(perm)	Groups	t	P(perm)
N. S	2.2486	0.0032	N. S	4.723	0.045	N. S	1.3599	0.2382

PERMANOVA (Species Abundances)

Source	df	SS	MS	Pseudo-F	P(perm)
Zo	1	14303	14303	10.205	0.0001
Ha	2	29247	14623	10.434	0.0001
ZoxHa	2	9705.9	4852.9	3.4626	0.0005
Res	21	29432	1401.5		
Total	26	80938			

Pairwise comparisons

Within level 'N' of factor 'ZONE'			Within level 'S' of factor 'ZONE'		
Groups	t	P(perm)	Groups	t	P(perm)
H. M	1.2634	0.1912	H. M	1.0796	0.3997
H. S	5.7271	0.0023	H. S	1.693	0.0187
M. S	3.7129	0.024	M. S	2.5067	0.0497

Within level 'H' of factor 'SUBS'			Within level 'M' of factor 'SUBS'			Within level 'S' of factor 'SUBS'		
Groups	t	P(perm)	Groups	t	P(perm)	Groups	t	P(perm)
N. S	1.8072	0.0155	N. S	3.8565	0.049	N. S	1.2635	0.3083

Species composition on hard and mixed bottoms was significantly different from each other in the north and south but abundances of the common taxa were not significantly different from each other in both zones (Table 3). *Paramuricea macrospina, Spinimuricea klavereni, Alcyonium palmatum* and to a certain extent *Paralcyo-*

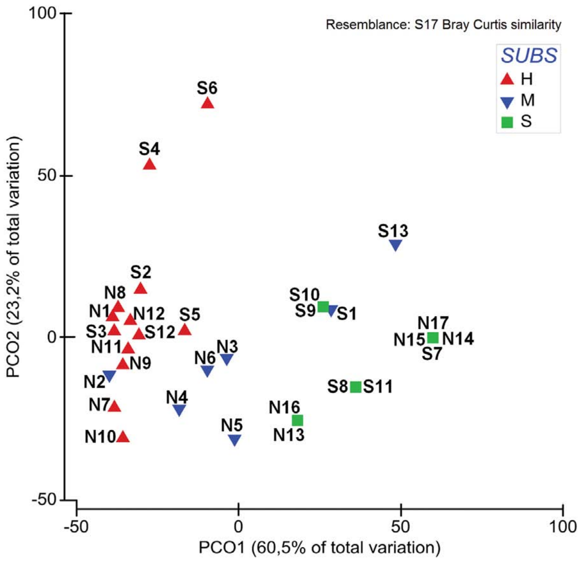

Fig. 2. – PCO plot of the relationships between sampling stations based on species composition data. The acronyms for substrate types are as follows: hard substrate composed of hard beds and rocks (H), soft substrate composed of sandy/muddy bottom (S), and mixed substrate composed of pebbles, shells and small rocks on muddy bottom (M).

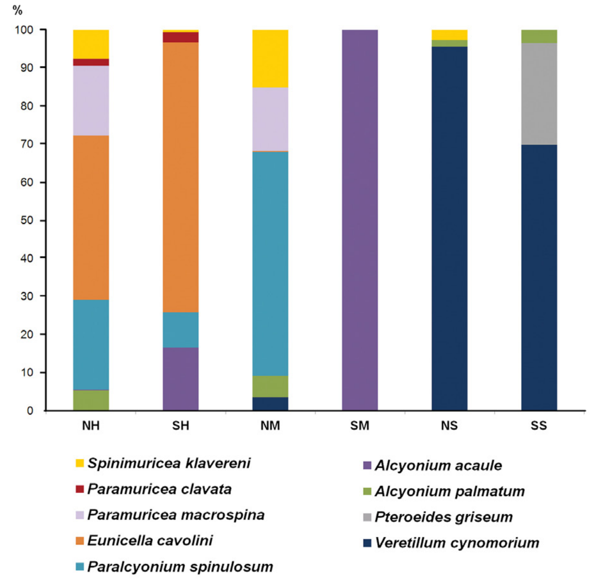

Fig. 3. – Percentage composition of the coral assemblages at hard substrate stations of the north (NH) and south (SH); at mixed substrate stations of the north (NM) and the south (SM); at soft substrate stations of the north (NS) and south (SS).

nium spinulosum seem to be the most common taxa on either hard or mixed substrates of the northern Marmara Sea (Fig. 3; Table 4) but *P. macrospina* and *S. klavereni* were rarely observed in the south. *Alcyonium acaule* was a common species on mixed and hard substrates of the south, with abundances of 0.8 to 3.4 colonies m^{-2} (Fig. 4A), whereas it was rarely observed in the north.

Abandoned fishing gears were encountered in 9 of the 17 stations (N1; N2; N4; N5; N7; N8; N9; N10; N14) on the Prince Islands coasts. The gears found most were purse seine nets, followed by set nets and fish lines.

DISCUSSION

The most extensive study concerning corals/gorgonians in the Sea of Marmara dates back to the 1950s (Demir 1954) and there are very few recent studies focusing on corals (Öztürk and Bourguet 1990, Özalp 2012, Topçu and Öztürk 2013). In this regard, this study greatly enhances the knowledge on the composition and abundance of octocorals in the Marmara Sea.

Information available for the neighbouring areas of the Marmara Sea indicate that octocorals are present and diverse in the Aegean Sea (Vafidis in Coll et al. 2010: Table S13), whereas only one species is present in the Black Sea. *Virgularia mirabilis* is found only in the

Table 4. – Results of the SIMPER analyses showing similarities within substrate groups; dissimilarities between pairs of substrate groups and the species mostly responsible for the observed differences. PM, *Paramuricea macrospina*; PC, *Paramuricea clavata*; SK, *Spinimuricea klavereni*; EC, *Eunicella cavolini*; AP, *Alcyonium palmatum*; AA, *Alcyoium acaule*; PS, *Paralcyonium spinulosum*; VC, *Veretillum cynomorium.*

Species	Sim/SD	Contrib%	Cum.%	Species	Av.Diss	Diss/SD	Contrib%	Cum.%
Group H				Groups H and M				
Average similarity: 59.10				Average dissimilarity = 42.62				
Species	Sim/SD	Contrib%	Cum.%	Species	Av.Diss	Diss/SD	Contrib%	Cum.%
PM	2.35	27.03	27.03	PS	9.76	0.81	22.89	22.89
SK	1.99	24.07	51.1	EC	8.8	0.81	20.65	43.54
AP	2.36	22.38	73.48	AA	4.9	0.4	11.5	55.05
PS	0.79	14.68	88.15	PC	4.68	0.91	10.99	66.04
EC	0.5	6.87	95.03	PM	4.36	0.8	10.23	76.27
Group M				Groups H and S				
Average similarity: 62.61				Average dissimilarity = 90.43				
SK	2.85	26.43	26.43	VC	20.47	1.95	22.64	22.64
PS	0.98	25.79	52.21	PS	13.79	0.97	15.25	37.88
PM	1.04	19.21	71.43	PM	11.48	1.46	12.69	50.57
AP	1.04	13.67	85.09	EC	11.23	0.81	12.42	62.99
AA	0.3	11.92	97.02	AP	9.23	1.19	10.2	73.19
				SK	8.91	1.13	9.85	83.04
Group S				Groups M and S				
Average similarity: 54.82				Average dissimilarity = 79.60				
VC	1.61	86.17	86.17	VC	18.5	1.41	23.24	23.24
AP	0.31	6.25	92.41	PS	14.13	1.05	17.75	40.99
				AA	13.06	0.61	16.41	57.4
				PM	10.22	1.12	12.83	70.23
				AP	9.27	1.06	11.65	81.88
				SK	8.85	1.09	11.12	93

Table 5. – Check-list of octocoral species for the Turkish coasts (Sea of Marmara, Aegean and Mediterranean (Medit.) coasts of Turkey).

Species	Marmara	Aegean	Medit.	Reference
Order Alcyonacea				
Suborder Stolonifera				
Cornularia cornucopiae (Pallas, 1766)	+			Uysal et al. 2002
Clavularia crassa (Milne Edwards, 1848)	+			Demir 1954
Sarcodictyon catenatum Forbes, 1847	+			This study
Sarcodictyon roseum (Philippi, 1842)	+			Ostroumoff 1894
Suborder Alcyoniina				
Alcyonium palmatum Pallas, 1766	+	+		Colombo 1885, Geldiay and Kocataş 1972
Alcyonium acaule Marion, 1878	+	+		Topçu and Öztürk 2013, Gözcelioğlu 2011
Alcyonium coralloides (Pallas, 1766)	+	+		Ostroumoff 1894, Çınar et al. 2014
Maasella edwardsii (de Lacaze-Duthiers, 1888)	+			Özalp 2012
Paralcyonium spinulosum Delle Chiaje, 1822	+			Topçu and Öztürk 2013
Suborder Scleraxonia				
Corallium rubrum (Linnaeus, 1758)			+	Öztürk 2010b
Suborder Holaxonia				
Bebryce mollis Philippi, 1842	+			Ostroumoff 1896
Paramuricea clavata (Risso, 1826)	+	+	+	Öztürk and Bourguet 1990, Öztürk et al. 2004
Paramuricea macrospina (Koch, 1882)	+			Ostroumoff 1896
Spinimuricea klavereni (Carpine and Grasshoff, 1975)	+			Ostroumoff 1896
Eunicella singularis (Esper, 1791)	+	+	+	Yurtsever 2002, Öztürk et al. 2004
Eunicella cavolini (Koch, 1887)	+	+	+	Yurtsever 2002, Öztürk et al. 2004
Eunicella verrucosa (Pallas, 1766)	+			Demir 1954
Order Pennatulacea				
Veretillum cynomorium (Pallas, 1766)	+	+		Ostroumoff 1894, Geldiay and Kocataş 1972
Kophobelemnon leucharti Cecchini, 1917	+			Demir 1954
Funiculina quadrangularis (Pallas, 1766)	+			Ostroumoff 1896
Virgularia mirabilis (Müller, 1776)	+	+ (sp.)		Uysal et al. 2002, Okuş et al. 2004
Pennatula phosphorea Linnaeus, 1758	+		+	Colombo 1885, Çınar et al. 2012
Pennatula rubra Ellis, 1761	+		+	Topaloğlu et al. 2004, Mutlu and Ergev 2008
Pteroeides griseum (Linnaeus, 1767)	+		+	Demir 1954, Çınar et al. 2014

small section of the southern Black Sea shelf close to the Istanbul Strait that creates a zone of high salinity and provides living conditions for many Mediterranean species (Zaitsev and Mamaev 1997). In the Marmara Sea, connecting the Aegean and the Black Seas, 23 species were found in various studies (Table 5). The high number of species in the Marmara Sea in the Turkish literature is mainly due to the lack of research effort in other areas. The number of species is higher than in the Ionian Basin (15) and similar to that in the Adriatic Sea (20 species) and in the Aegean Sea (28) (species numbers/region were obtained from Vafidis in Coll et al. 2010: Table S13). The Prince Islands form a boundary of the spatial distributions of octocorals in the Mediterranean Sea, except for *V. mirabilis*.

The soft bottoms of the Marmara Sea in the diving limits of depth seem to be colonized mainly by Pennatulaceans, most commonly *V. cynomorium,* followed by *Pteroeides griseum,* the two shallow-water species. These sea pens form large beds of a single species on the soft bottoms of the Marmara Sea, occasionally disrupted by a few alcyonaceans, as is frequently observed in the Mediterranean (Gili and Pagès 1987) and globally (Pérès 1982).

The main rocky habitats of the Marmara Sea covered by coralligenous outcrops were composed of (1) vertical walls or large rocks on steep bottom colonized mainly by *Eunicella cavolini* with high abundances (10.7-13.9 colonies m^{-2}) (Fig. 4B) and (2) large-medium size boulders on a slightly steep or flat bottom colonized by *P. macrospina*, *S. klavereni*, and *P. spinulosum* (3-13.3 colonies m^{-2}) (Fig. 4C). The first type corresponds to one of the common coralligenous assemblages for the Mediterranean Sea, dominated by *E. cavolini*, as is often the case in the (rarely) gorgonian-dominated eastern Mediterranean coralligenous assemblages (Kružić 2007, Salomidi et al. 2009, Gerovasileiou et al. 2009). *E. verrucosa* and *E. singularis* were rare observations in the southern Marmara Sea, as is also generally observed in the eastern Mediterranean.

The Sea of Marmara is highly impacted by various anthropogenic activities, such as wastewater discharge, agricultural run-off, illegal fishing and overfishing, marine litter and shipping (Öztürk et al. 2000, Öztürk 2010a). The semi-enclosed sea recently suffered from red-tides (Türkoğlu 2013) and mucilage events (Aktan et al. 2008, Balkıs et al. 2011). In spite of such severe anthropogenic disturbances, dense assemblages of endemic gorgonians in the Marmara Sea were observed during this study, although gorgonian densities were lower than those of the western Mediterranean (e.g. in Linares et al. 2008). *E. cavolini* populations can reach densities as high as 180 colonies m^{-2} in the bay of Calvi (Corsica, France) (Weinbauer and Velimirov 1996), whereas the highest density in the Marmara Sea was approximately 14 colonies m^{-2}.

P. macrospina is a Mediterranean endemic known to occur on rocks, detritic or sandy/muddy bottoms, mainly at depths of 40 to 100 m but also deeper (Carpine and Grasshoff 1975). This species is mentioned in the literature dealing mainly with deep sea fauna of the Mediterranean Sea (Watling et al. 2005, Aguilar et al. 2009, Mastrototaro et al. 2010, Bo et al. 2012, Angeletti et al. 2014) except in the Aegean Sea, where it was collected between 20 and 90 m (Vafidis et al. 1994); *P. macrospina*–dominated assemblages were abundant, especially in the north of the Marmara Sea, and this species was suggested to have greater adaptability than other gorgonians in relation to a relatively fast growing rate (Bo et al. 2012).

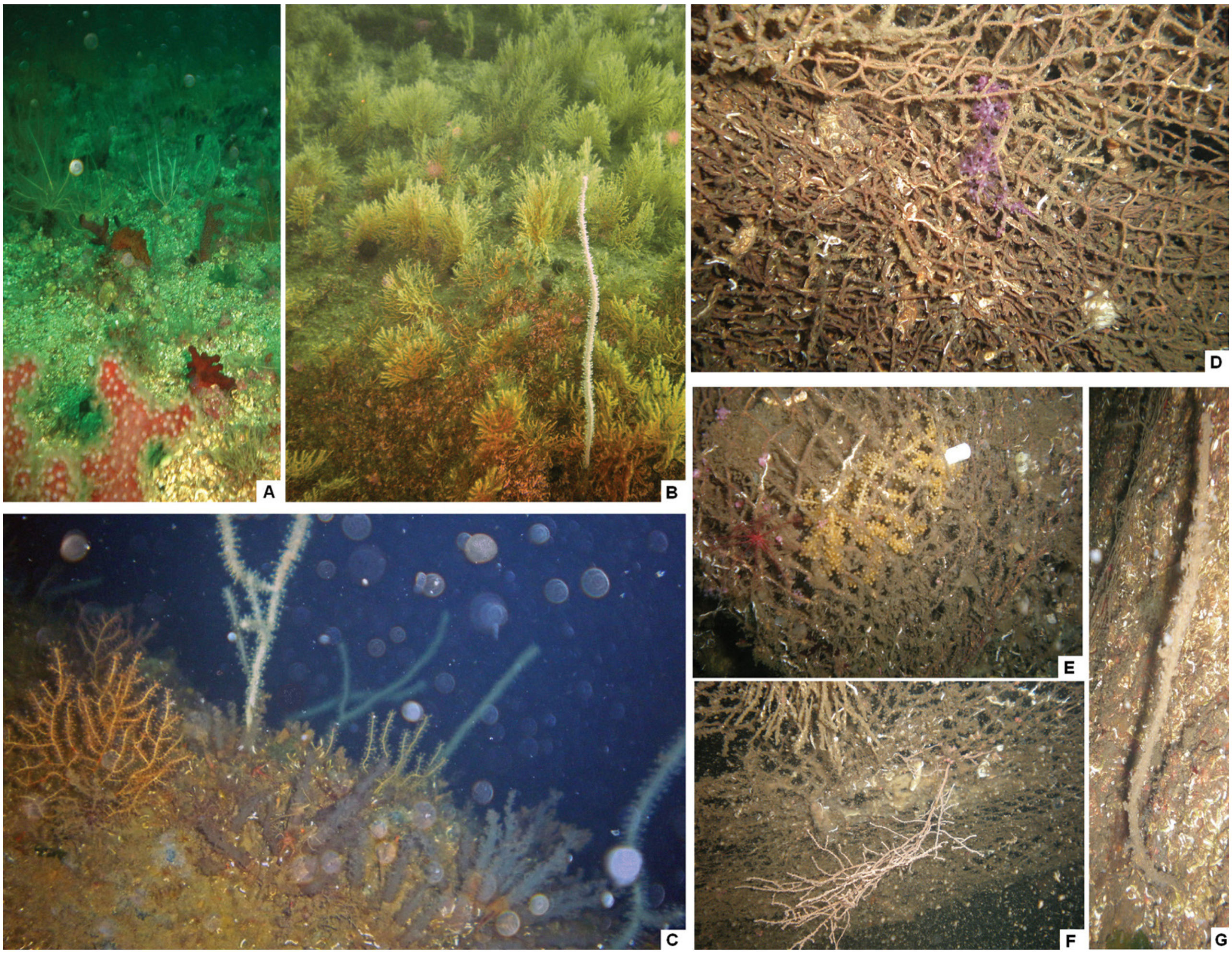

Fig. 4. – *A. acaule* assemblage at S1 station (A). *E. cavolini* dominated assemblage at N12 station. A *S. klavereni* colony is at the front of image (B). *P. macrospina, S. klavereni*, and *P. spinulosum* assemblage at station N5. The picture is covered with white spots due to the turbidity (C). Ghost purse seine nets wrapping rocky substrates and covering gorgonian colonies at stations N1 and N10 (D-F). Epibiont-covered dead *S. klavereni* colony at station N9 (G).

On the other hand, *S. klavereni,* another common species in the northern Marmara Sea, is an endemic Mediterranean species on which very limited information is available. It occurs on hard substrates of the circalittoral zone between 50-80 m deep (Carpine and Grasshoff 1975, Grasshoff 1992). It was recently reported from the Tyrrhenian Sea as a rare occurrence, on muddy substrates with patches of organogenic detritus at depths deeper than 70 m (Bo et al. 2012). In the northern Marmara Sea, it occurs on hard substrates like rocks or small pebbles/shells on sandy/muddy bottom starting from 25 m until our limit of observation (42 m), with abundances varying from 1 to 3.1 colonies m^{-2}.

The Marmara Sea faced severe disturbances, particularly from the 1980s onward, due to rapid population growth and industrial revolution in the surrounding region (Burak 2008) and in parallel to the catastrophic degradation period in the Black Sea (Bakan and Büyükgüngör 2000). In order to compare the present status of corals in the Sea of Marmara to that of the post-disturbances period (1960 to the 1970s), local divers and fishermen were questioned. Although we could not obtain quantitative data, they all agreed that they used to see more abundant dense gorgonian assemblages in the past. We also obtained a short video (Supplementary Material Video S1) taken in 1975 at Balıkçı Island by a local diver. In the video, a very dense assemblage of *Savalia savaglia*/*P. clavata* is clearly seen, revealing large colonies. Today, though both species are still present in the Marmara Sea, such dense assemblages are not encountered. Abandoned purse seine nets were pointed out by divers and small scale fishermen as the main reason behind the decrease of gorgonians and corals. In fact, this problem is continuous in the whole Marmara Sea (Yıldız and Karakulak 2010), causing serious damage to the ecosystem despite fishing net cleaning operations by local and environmental associations. Abandoned fishing gears highly impact corals and gorgonians via entanglement and overgrowth by epibionts (Bavestrello et al. 1997, Bo et al. 2014). Abandoned nets were encountered at 53% of the stations in the north of the Marmara Sea during this study (Fig. 4D, E, F), causing harm to octocoral species and other sessile fauna.

The continuous disturbances by fishing gears, together with the peculiar oceanographic conditions in the Marmara Sea, could be responsible for the abundance of the opportunistic gorgonians. The Marmara

Sea has received a significant pollution load in the last 30 years from both the Black Sea inflow and increased anthropogenic input (Tuğrul and Polat 1995). The semi-enclosed Marmara Sea is highly turbid, preventing daylight at very shallow depths (Çoban-Yıldız et al. 2000) and the temperature below 20 m is lower (approximately 14.5°C) than at depths of the same range in the Mediterranean, so the conditions are similar to those of higher depths in the Mediterranean Sea. This could be the reason for high abundances at 25-40 m of *P. macrospina* and *S. klavereni*, which are found at greater depths in the Mediterranean. These relatively fast-growing gorgonians might be colonizing more easily the habitats emptied by other species due to the disturbances by fishing gears under the highly turbid conditions of the Marmara Sea since the 1970s.

A series of thermal anomalies recently affected Mediterranean benthic assemblages, causing mass mortalities at some locations and gorgonians were among the organisms most affected (Perez et al. 2000, Garrabou et al. 2009). In the Marmara Sea, temperature variances below 20 m are very low and the temperature is generally about 15°C. Therefore, gorgonian assemblages do not risk mortality events related to thermal stress as in the Mediterranean Sea, but an important threat arises from mucilage events. Mucilage events resulting from single-cell organisms are periodically observed in the Marmara Sea (Aktan et al. 2008, Balkıs et al. 2011) and the sedimentation of the aggregates causes negative effects by covering benthic organisms (Aktan et al. 2008). The impact of mucilage on gorgonians has been previously reported, though it was caused by a different type of mucilage formed by the aggregation of filamentous algae; mucilage gets trapped on gorgonian branches positioned perpendicularly to currents and causes damage (sometimes irreparable) to gorgonians (Giuliani et al. 2005). We observed in 2011 mucilage fragments on *S. klavereni* colonies and local divers informed us that several *S. klavereni* colonies died after the severe mucilage events of 2007-2008. The dead branches can still be observed at station N9, which is covered by epibionts (Fig. 4G).

Most of the octocoral species found in the Marmara Sea, such as *A. coralloides, A. acaule, P. clavata* and *E. cavolini,* are considered typical components of Mediterranean coralligenous communities, which are stated as the most important biocoenosis in "Guidelines for the Establishment and Management of Mediterranean Marine and Coastal Protected Areas" (Lopez Ornat 2006). According to Council Regulation 1967/2006 of the European Union (EU), fishing with trawl nets, dredges, shore seines or similar nets above coralligenous habitats shall be prohibited. Recently, purse seine fisheries were prohibited around the Prince Islands Area; however that ban does not cover all of the vulnerable assemblages. In the Marmara Sea, there is no regional or national legislation for the protection of corals and gorgonians except the complete prohibition of fisheries of *Corallium rubrum* and *S. savaglia,* according to the Statements 2012/66 and 2012/65. In order to ensure the conservation of coral assemblages in the Marmara Sea, we emphasize the need for specific measures such as the removal of abandoned fishing nets, enlargement of the prohibited area for purse seining, prohibition of anchoring, placement of mooring buoys and better prosecution of offenders. This study provides scientific support to complete some tasks required by the EU Marine Strategy Framework Directive in order to achieve and maintain Good Environmental Status (GES) by 2020 in Turkish waters.

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SUPPLEMENTARY MATERIAL

The following material is available through the online version of this article and at the following link:
http://www.icm.csic.es/scimar/supplm/sm04120esm.pdf

Table S1. – Taxonomic list of collected species with data of the material examined and notes on its ecology.

Fig. S1. – Red *Alcyonium acaule* colony on rocky bottom at station S1 (A); colony on bioconcretion at station S9 (B); colony on the crab *Maja crispata* at station S6 (C); orange colony at station S6 (D); two small colonies on a dead mussel shell at station S13 (E); surface brooder colony at station S1 on august 2013 (F) and shark egg cases attached colony at station S1 (G).

Video S1. – Video taken in 1975 at Balıkçı Island by a local diver. In the video, a very dense assemblage of *Savalia savaglia*/*P. clavata* is clearly seen, revealing large colonies.

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Composition and abundance of octocorals in the Sea of Marmara, where the Mediterranean meets the Black Sea

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Supplementary material

Table S1. – Taxonomic list of collected species with data of the material examined and notes on its ecology.

14 octocoral species were collected in the study area at various stations (stations N1 to N17 in the Northern group of Islands and stations S1 to S14 in the Southern group of Islands). Biological samples were deposited at the Octocoral Collection of the University of Istanbul (IUOK).

Phylum CNIDARIA
Class ANTHOZOA Ehrenberg, 1834
Subclass OCTOCORALLIA
Order PENNATULACEA Verrill, 1865
Suborder SESSILLIFLORAE Kükenthal, 1915
Family VERETILLIDAE Herklots, 1858
Genus *Veretillum* Cuvier, 1798
Veretillum cynomorium (Pallas, 1766)

Material examined: IUOK25 (N1), IUOK54 (N3), IUOK24 (N4), IUOK68 (N5), IUOK18 (N6), IUOK31 (N7), IUOK82 (N9), IUOK01 (N13), IUOK44 (N14), IUOK51 (N15), IUOK77 (N16), IUOK12 (N17), IUOK138 (S1), IUOK133 (S7), IUOK124 (S8), IUOK96 (S9), IUOK105 (S10), IUOK112 (S11) and IUOK100 (S13).

This sea pen was common on soft substrates of both Prince Islands and Southern Marmara Islands coasts starting from right after the halocline depth. Uncontracted colonies of various sizes (approximately 5-55 cm) were encountered anytime in the day. The density of *Veretillum cynomorium* varied from 0.2 to 4.2 colonies m^{-2} among stations. *V. cynomorium* is a shallow water sea pen found from the first ten meters to 100 meters (Williams 1995, Williams 2011). The species is distributed in the Eastern Atlantic from the Southern Europe to the West Africa coasts and in the Mediterranean Sea (Williams 1995, López-González et al. 2001, Vafidis in Coll et al. 2010: Table S13).

Family PENNATULIDAE Ehrenberg, 1834
Genus *Pteroeides* Herklots, 1858
Pteroeides griseum (Linnaeus, 1767)

Material examined: IUOK110 (S9) and IUOK117 (S10).

This sea pen was found on soft substrates of only the Southern Marmara Islands coasts at 2 stations between 27-38 m. Its density was about 1-2 colonies m^{-2}. *Pteroeides griseum* is a shallow water sea pen found from the first ten meters to 200 meters (Williams 1995, Williams 2011). The species is distributed along the European coasts of the Atlantic and in the Mediterranean Sea (Williams 1995, Vafidis in Coll et al. 2010: Table S13).

Family FUNICULINIDAE Gray, 1870
Genus *Funiculina* Lamarck, 1816
Funiculina quadrangularis (Pallas, 1766)

Material examined: IUOK99 (S2).

This sea pen was observed at the limit of observation (41 m) of this study on muddy bottom. *Funiculina quadrangularis* is a deep sea species that can be found until 2000 m (Williams 1995, Williams 2011) but rarely above 30 m. The species has a cosmopolitan distribution along the Atlantic, Indo-Pacific and in the Mediterranean Sea (Williams 1995, Vafidis in Coll et al. 2010: Table S13).

Order ALCYONACEA Lamouroux, 1816
Suborder STOLONIFERA Hickson, 1883
Family CLAVULARIIDAE Hickson, 1894
Genus *Sarcodictyon* Forbes (in Johnston), 1847
Sarcodictyon catenatum Forbes, 1847

Material examined: IUOK19 (N1), IUOK92 (N2), IUOK55 (N3), IUOK28 (N6), (N8), IUOK09 (N9), IUOK40 (N12), IUOK123 (S2), IUOK101 (S3), IUOK108 (S4) and IUOK98 (S6).

This encrusting soft coral was found between 18 – 26 m among the calcareous bioconcretions of polychaete tubes in both Prince Islands and Southern Marmara Islands coasts. *Sarcodictyon catenatum* is found from the sublittoral to 100 m on stones and shells in the Mediterranean and the Northeast Atlantic coasts (Vafidis et al. 1994, Ocaña et al. 2000, Vafidis in Coll et al. 2010: Table S13).

Suborder ALCYONIINA
Family ALCYONIIDAE Lamouroux, 1812
Genus *Alcyonium* Linnaeus, 1758
Alcyonium palmatum Pallas, 1766

Material examined: IUOK02 (N1), IUOK87 (N2), (N3), IUOK23 (N4), IUOK58 (N5), IUOK35 (N6), IUOK79 (N7), IUOK15 (N8), IUOK71 (N9), IUOK34 (N10), IUOK43 (N11), IUOK26 (N12), IUOK07 (N13), IUOK48 (N16), IUOK128 (S1), IUOK126 (S2), IUOK103 (S3), IUOK121 (S5), IUOK130 (S8), IUOK95 (S9), IUOK106 (S10), IUOK137 (S11) and IUOK115 (S12).

This soft coral was the most common octocoral in the study area but did not form dense assemblages. It was found on all types of bottom attached to rocks, stones or shells from the halocline to 40 m depth with densities of 0.1-1.2 colonies m^{-2}. The colours varied from red, orange to yellow but were mainly whitish. The species is found along the Mediterranean and Northeast Atlantic coasts between 20-200 m (Vafidis et al. 1994, Watling and Auster 2005, Vafidis in Coll et al. 2010: Table S13) on sandy/muddy bottoms but attached to stones or shells (Weinberg 1977).

Alcyonium acaule Marion, 1878

Material examined: IUOK29 (N1), IUOK16 (N8), IUOK38 (N11), IUOK61 (N12), IUOK97 (S1), IUOK134 (S6), IUOK136 ve IUOK129 (S9), IUOK99 (S10), IUOK114 (S12) and IUOK119 (S13).

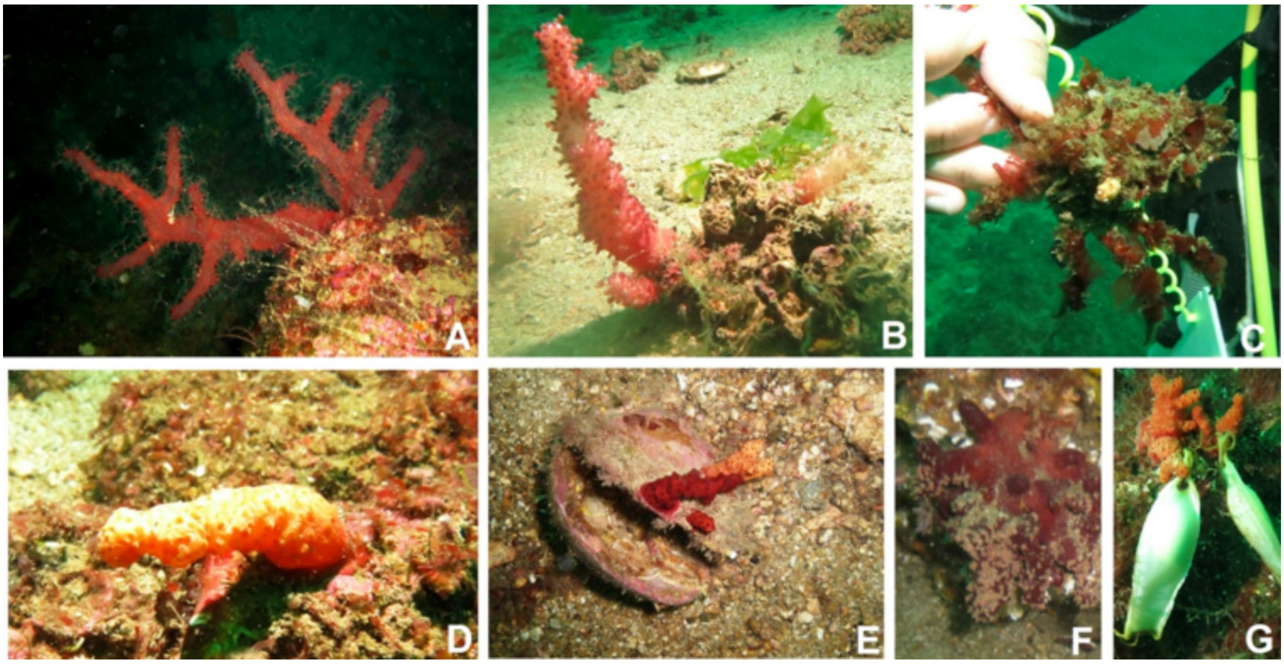

Fig. S1. – Red *Alcyonium acaule* colony on rocky bottom at station S1 (A); colony on bioconcretion at station S9 (B); colony on the crab *Maja crispata* at station S6 (C); orange colony at station S6 (D); two small colonies on a dead mussel shell at station S13 (E); surface brooder colony at station S1 on august 2013 (F) and shark egg cases attached colony at station S1 (G).

Alcyonium acaule was found on rocky bottoms and calcareous bioconcretions or attached to stones/shells on sandy bottom in both Prince Islands and Southern Marmara Islands coasts from 30 to 40 m (Fig. S1). This soft coral was rather rare in the northern stations whereas it formed assemblages in the southern stations with densities of 0.8 to 3.4 colonies m^{-2}. The colours varied from whitish cream to orange but wine red was the most common. Shark egg cases were common observations on this coral (Fig. S1). This species is distributed in the Mediterranean between 12-45 m on rocky bottoms (Weinberg 1977, Vafidis et al. 1994) but also present in the Northeast Atlantic coasts (Watling and Auster 2005).

Alcyonium coralloides (Pallas, 1766)

Material examined: IUOK33 (N1), IUOK14 (N4), IUOK63 IUOK37 (N7), IUOK90 (N8), IUOK46 (N10), IUOK74 (N11), IUOK127 (S2), IUOK107 (S3), IUOK111 (S4), IUOK132 (S5) ve IUOK104 (S12).

Alcyonium coralloides was common in both Prince Islands and Southern Marmara Islands coasts between 20-40 m. The soft coral mainly covered calcareous bioconcretions and Chaetopterid polychaetes tubes but also gorgonian skeletons; besides, lobular forms were observed on pinna and mytilus shells. In the Mediterranean it is found from 2 to 100 m mainly on gorgonian skeletons but also tunicates, shells and stones/rocks (Weinberg 1977). The species is distributed in the Mediterranean Sea but also present in the Northeast Atlantic coasts (Vafidis et al. 1994, Watling and Auster 2005, Vafidis in Coll et al. 2010: Table S13).

Family MAASELLIDAE Poche 1914
Genus *Paralcyonium*
Milne-Edwards and Haime, 1850
Paralcyonium spinulosum Delle Chiaje, 1822

Material examined: IUOK08 (N1), IUOK52 (N2), IUOK84 (N4), IUOK42 (N5), IUOK50 (N6), IUOK65 (N7), IUOK60 (N8), IUOK11 (N10), IUOK21 (N11) ve IUOK116 (S2).

This soft coral was common in the Prince Islands coasts with densities of 1-7 colonies m^{-2} and rare in the Southern Marmara Islands. It was found between 25-38 m on rocky bottom and stones/shells on soft substrates. In the Mediterranean Sea, the species is found between 22-90 m on hard bottom (Weinberg 1977, Vafidis et al. 1994). It is also present in the Northeast Atlantic coasts (Watling and Auster 2005).

Suborder HOLAXONIA Studer, 1887
Family PLEXAURIDAE Gray, 1859
Genus *Paramuricea* Koelliker, 1865
Paramuricea clavata (Risso, 1826)

Material examined: IUOK17 (N1), IUOK36 (N2), IUOK03 (N4), IUOK56 (N8), IUOK81 (N10), IUOK93 (N12), IUOK125 (S3) ve IUOK109 (S12).

Red gorgonian was found on rocky substrates in the study area between 30-40 m but did not form dense assemblages. It was generally below *Eunicella cavolini* assemblages and associated with *Savalia savaglia* colonies. All observed colonies had reddish pink coloration and were generally about 20 cm in height. In the Mediterranean, the species is found from 6 to 100 m but is most abundant between 40-60 m mainly on vertical walls and rocks (Carpine and Grasshoff 1975, Weinberg 1976). It is also present in the Northeast Atlantic coasts (Watling and Auster 2005).

Paramuricea macrospina (Noch, 1882)

Material examined: IUOK05 (N1), IUOK76 (N2), IUOK69 (N3), IUOK27 (N4), IUOK89 (N5), IUOK06 (N6), IUOK72 (N7), IUOK86 (N8), IUOK65 (N9), IUOK30 (N10), IUOK53 (N11), IUOK73 (N12) ve IUOK135 (S12).

This gorgonian was found on rocky bottoms or attached to stones/shells on sandy bottom mainly in Prince Islands coasts from 21 to 40 m with densities of 0.1-3.9 colonies m^{-2}. The colonies were generally fan shaped but sometimes less branched and the colours varied from creamy white to orange and brownish pink but were mainly yellow. In the Mediterranean sea, the species is found attached to boulders on detritic bottoms or sometimes sandy/muddy bottoms between 40-100 m until 200 m (Carpine and Grasshoff 1975). The species is distributed in the Mediterranean Sea but also present in the Northeast Atlantic coasts (Grasshoff 1992, Vafidis et al. 1994, Watling and Auster 2005).

Genus *Spinimuricea* Grasshoff, 1992
Spinimuricea klavereni
(Carpine and Grasshoff, 1975)

Material examined: IUOK10 (N1), IUOK82 (N2), IUOK47 (N3), IUOK20 (N4), IUOK39 (N5), IUOK62 (N6), IUOK22 (N7), IUOK78 (N8), IUOK45 (N9), IUOK85 (N10), IUOK59 (N11), IUOK64 (N12), IUOK94 (N13), IUOK41 (N14), IUOK88 (N16), IUOK120 (S3) and IUOK102 (S12).

Spinimuricea klavereni was found between 23-45 m on rocks, boulders and attached to pebbles/stones/shells on soft substrates. This gorgonian was common in the Prince Islands coasts with densities of 0.1 to 3.1 colonies m^{-2} but rare in the South. In the Mediterranean it is found between 25-130 m on similar bottoms (Carpine and Grasshoff 1975, Vafidis et al. 1994, Bo et al. 2012). The species is distributed in the Mediterranean Sea but also present in the Northeast Atlantic coasts (Grasshoff 1992, Vafidis et al. 1994, Watling and Auster 2005).

Family GORGONIIDAE Lamouroux, 1812
Genus *Eunicella* Verrill, 1869
Eunicella cavolini (Noch, 1887)

Material examined: IUOK04 (N1), IUOK57 (N2), IUOK75 (N4), IUOK32 (N7), IUOK70 (N8), IUOK67 (N9), IUOK91 (N10), IUOK49 (N11), IUOK80 (N12) and IUOK118 (S3).

Eunicella cavolini was found between 30-40 m on vertical walls or large rocks in both Prince Islands and Southern Marmara Islands coasts with densities of 0.1 to 13.9 colonies m^{-2}. In the Mediterranean Sea, the endemic gorgonian is found between 10-30 m on hard bottoms but can reach 150 m deep (Carpine and Grasshoff 1975, Weinberg 1976).

Eunicella singularis (Esper, 1791)

Material examined: IUOK131 ve IUOK122 (S2).

Eunicella singularis was found at 37 m on small rocks in only one station in the Southern Marmara Sea. The colonies did not harbour zooxanthellae, were bright white and their shape was more branched than generally observed for this species. In the Mediterranean Sea, this endemic gorgonian is found from 7 to 52 m on both hard and sandy/muddy bottoms (Carpine and Grasshoff 1975, Weinberg 1976).

Eunicella verrucosa (Pallas, 1766)

Material examined: IUOK13 (N1) and IUOK113 (S3).

Eunicella verrucosa was found only at two stations in the Marmara Sea on hard bottoms at 34 and 38 meters. The colours were orange-pink in the North and white in the South. The species is distributed in the Atlantic coasts where it is common (from the Scotland to Angola) and in the Mediterranean Sea as a rare occurrence between 35-200 m (Carpine and Grasshoff 1975, Grasshoff 1992).

Video S1. – Video taken in 1975 at Balıkçı Island by a local diver. In the video, a very dense assemblage of *Savalia savaglia*/*P. clavata* is clearly seen, revealing large colonies.