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RESEARCH ARTICLE

Macroinfaunal invertebrates associated to *Cladocora caespitosa* (Cnidaria: Anthozoa) in Gökçeada (northern Aegean Sea)

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Abstract

Macro-invertebrates associated with stony coral *Cladocora caespitosa* were studied around Gökçeada Island (northern Aegean Sea) up to a depth of 15.5 m during the spring of 2019. Twelve dead/partially dead colonies were collected, to which 68 infaunal taxa were found to be associated. The overall number of associated taxa were updated to 397 (406 with macroalgae included). The present study added 26 taxa to the total number of associates. The most abundant group was Polychaeta (61 %), followed by Mollusca (16 %) and Crustacea (9 %). The most abundant species in the area were *Syllis gracilis, Perinereis cultrifera*, *Vermiliopsis striaticeps* and *Serpula vermicularis*. Similar patterns of aggregation were recognized between polychaetes and biota data via PCO plots. DISTLM procedure indicated that 94 % of biota variation was explained by the number of recently necrotized polyps and living polyps. The impact of temperature on biota was underlined in the present study (ANOSIM), however the extent of influence by sea surface temperature on the associated biota remains unclear.

Keywords: *Cladocora caespitosa*, stony coral, macro-infauna, polychaetes, multivariate analysis

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Introduction

Cladocora caespitosa is a temperate stony zooxanthellate scleractinian, endemic to the Mediterranean Sea (Kružić and Benković 2008). This species is unique among Mediterranean scleractinians by forming reefs (Kersting *et al.* 2013a). *Cladocora caespitosa* is one of the few hermatypic coral species living in the Mediterranean (Zibrowius 1974; Laborel 1987), alongside other scleractinians such as *Oculina patagonica* (Çınar *et al.* 2021) and the non-indigenous species *Oulastrea crispata* (Hoeksema and Vicente 2014). This stony coral is confined to the euphotic zone from a few metres below sea surface to around 40-50 m (Peirano *et al*. 1998). It is able to withstand a range of thermal conditions, from 8°C in winter to 28°C in summer (Schiller 1993a, b). Its colonies may take many extreme forms from encrusting, phaceloid (Pitacco 2016) with short corallites to loosely branched, dendroid with long slender corallites. Like many reef-building coral species (Fox *et al.* 2019), *C. caespitosa* can perform heterotrophic and autotrophic metabolisms. The ecological and morphological plasticity of the coral is probably due to its capacity to up-regulate heterotrophy in the face of lower autotrophy rate in dim light conditions (Ferrier-Pagès *et al.* 2013).

Cladocora caespitosa can reproduce asexually via budding, mostly extra-tentacular (Schiller 1993a, b) and sexually (Harrison and Wallace 1990) through hermaphroditic polyps (Kružić 2005). Bio-erosional activities caused by burrowing and boring organisms may also contribute to the reproducibility via fragmentation (Highsmith 1982; Karlson 1986). The stony coral can take many forms, from solitary colonies to small sub-spherical bush-like colonies of small size (Antoniadou and Chintiroglou 2010), in dense population known as "beds". Large formations reaching several metres in height and reaching several square metres in surface were also described and named "banks" (Peirano *et al.* 1998). Nonetheless, *C. caespitosa* colonies are in rapid regression in the Mediterranean (Morri *et al.* 2001; Jiménez *et al.* 2016) and their biomass has become scarce (Kružić and Benković 2008; Kersting and Linares 2012), with only small-sized biostructures remaining.

Due to its decline and low capacity to recover from disturbances (Kersting *et al.* 2014), it is classified as "Endangered" in the IUCN Red List (Casado-Amezúa *et al.* 2015). Major declines of coral population in the Mediterranean were recorded over the last few decades under the present climate-warming trend (Kružić *et al.* 2014). Monitoring of *C. caespitosa* colonies in Fiascherino (Ligurian Sea) reported that about 50% of colonies were completely dead within three years (Peirano *et al.* 2005). In Columbretes Islands Marine Reserve (Balearic Sea), *C. caespitosa* population lost 55% to 80% of its cover (Kersting and Linares 2012). In Mjlet National Park (Adriatic Sea), necrosis affected 10% of colonies of the coral bank (Kružić *et al.* 2012). In the Sea of Marmara, about 50% of *C. caespitosa* colonies were impacted by necrosis (B. Özalp pers. obs. in Casado-Amezúa *et al.* 2015). In Gökçeada (northern Aegean Sea), about 15% of the colonies were affected by mortality, of which 67% recently died (Güreşen *et al.* 2015). Mass mortalities have already claimed 55% of colonies cover across the Mediterranean (Casado-Amezúa *et al.* 2015).

Major events such as global warming (Salinger 2005; Rodolfo-Metalpa *et al.* 2005; Garrabou *et al.* 2009; Kersting *et al.* 2013b; Kružić *et al.* 2014; Jiménez *et al.* 2016), acidification (Rodolfo-Metalpa *et al.* 2011) and anthropogenic perturbations present a serious threat for *C. caespitosa* and its associated macro-fauna. Furthermore, invasive species such as *Caulerpa racemosa* (Kružić and Benković 2008; Kersting *et al.* 2014), pathogenic contamination (Ben-Haim *et al.* 1999; Harvell *et al.* 1999; Cerrano *et al.* 2000), industrial and aquaculture waste, urban sewage discharge and coastal works/urbanisation (Kružić and Požar-Domac 2002) will undeniably affect the taxonomic composition of coral associates (Cerrano *et al.* 2000; Rodolfo-Metalpa *et al.* 2006). Several mortality events of *C. caespitosa* have already occurred (Kersting *et al.* 2013b), affecting sessile invertebrates' assemblages (Cerrano *et al.* 2000; Perez *et al.* 2000). Hence collecting baseline data on the distribution and health status of *C. caespitosa* populations is highly needed (Topçu 2015) for the establishment of a set of measures to protect vulnerable marine ecosystems formed by cnidarian (coral) communities in the Mediterranean Sea (Resolution GFCM/43/2019/6).

Despite their scarcity, there are some studies on hard corals along the Turkish coasts. Sixty-eight anthozoans (42 hexacoral and 26 octocoral) have been reported from the Sea of Marmara (Topçu and Özalp 2016; Ocaña and Çınar 2018). Nevertheless, the number of marine surveys dedicated to anthozoans in the Marmara Sea remains limited, even though progress has been made with the recent ecological and demographical assessment of scleractinian populations along the Marmara Sea coasts via BRUZEYS marine surveys, supported by TUBITAK (Topçu and Özalp 2016). Ocaña and Çınar (2018) also described two new genera, six new species and three new records of anthozoans in the Sea of Marmara. Among the subclass of Hexacorallia, 13 species of stony corals were found in the same area. Few studies have been focused on the Çanakkale Strait. Around 41 species (90 in the Greek Aegean coasts) were reported along Turkish Aegean coasts, including 34 hexacorals and 7 octocorals (Topçu 2015). This decreased value for anthozoans species may be linked to the lower research effort in Turkish waters (Coşar 1974; Yurtsever 2002; Geldiay and Kocataş 1972; Öztürk *et al.* 2004; Gökalp 2011). Notwithstanding this trend, a recent study was undertaken in Aegean Sea reporting new anthozoan species (5 new records), which underlines the constant need for faunal inventories during marine surveys (Çınar *et al.* 2014).

The first report of *C. caespitosa* in the Turkish coast was from Forbes (1844). Zibrowius (1979) also reported *C. caespitosa* along the Turkish coast during their substantial surveys of Levantine fauna. Sporadic reports of *C. caespitosa* presence were mainly made along the Turkish Aegean coasts (Öztürk *et al.* 2000; Çınar

2003; Öztürk *et al.* 2004), in Çanak Bay (Cihangir *et al.* 2011) and at Gökçeada (Güreşen *et al.* 2015). During the most recent survey in 2019, over 440 healthy colonies were counted around Bozcaada by Özalp (Özalp 2019). Colonies were described for the first time in the Marmara Sea in 2009 with 5 colonies at 7 m (Özalp and Alparslan 2011). Later, Özalp and Alparslan (2016) undertook an extensive study of the dense facies of *C. caespitosa* in the Çanakkale Strait (Dardanos, up to 24 m), as a result 61 colonies were found. Later count in 2021 accounted for 92 adult colonies and 560 juvenile colonies over an area of 2000 m^2 (UNDP 2021). Afterward, the same area was declared as a marine protected area, also known as the first formal hard coral reserve in the Turkish Seas (Çanakkale Dardanos Cladocora Reef Site) by the General Directorate of Fisheries and Aquaculture (official gazette: 27 August 2021-no: 2021/31) (UNDP 2021).

Cladocora caespitosa is well-known for being an engineer species in the Mediterranean Sea with a significant interstitial space. Hence it is expected that temperate and cold-water coral reefs are home to a diversified associated fauna. However, little is known about the ecological features of such benthic assemblages (Chintiroglou 1996; Koukouras *et al.* 1998; Pitacco *et al.* 2021). So far, 406 taxa (from 15 phyla, 397 if only invertebrates taken into account) were reported in various studies performed in the Mediterranean. Macrofaunal assemblages associated to *C. caespitosa* are particularly diversified (Lumare, 1965; Pitacco *et al.* 2017). However, the focus of most studies has been limited to single taxonomic groups (Sciscioli and Nuzzaci 1970; Zavodnik 1976; Ergen 1976; Arvanitidis and Koukouras 1994; Chintiroglou 1996; Öztürk *et al.* 2000; Çınar and Ergen 2002; Çınar 2003; Krapp *et al.* 2008; Açik 2008; 2011; Pitacco *et al.* 2017, 2021) and the number of studies on overall associated fauna is very limited (e.g. Lumare 1965; Koukouras *et al.* 1998; Pitacco *et al.* 2014; Antoniadou and Chintiroglou 2010; Pitacco 2016). Coral associated species hold a crucial ecological function as food source for other invertebrates and benthic teleosts. Therefore, habitats with *C. caespitosa* can attract those organisms (Pitacco 2016) and can play a key role in shaping local and regional Mediterranean fishery resources.

The aim of this study is (i) to elaborate a preliminary inventory of the macroinfauna associated to *C. caespitosa* dead colonies and (ii) to study patterns between coral colonies and macro-infauna diversity around Gökçeada Island in the northern Aegean Sea. Gökçeada is subjected to illegal harvesting activities, which are particularly lucrative as artificially bleached coral colonies are sold as aquarium decoration (Güreşen *et al.* 2015). Thus, there is a need to protect these coral population. The establishment of Gökçeada Marine Park in 1999 by TUDAV is an example of such an initiative.

Materials and Methods

Study site and sampling strategy
Gökçeada Island is in the north-eastern part of the Aegean Sea. Inflows from the Marmara Sea via the Çanakkale Strait, shift northward in winter and southward during summer in the Aegean Sea (Poulos *et al.* 1997). Due to high concentrations in nutrients provided by the Meriç River, rich primary production and great diversity of pelagic teleosts can be found in the northern Aegean Sea (Ulutürk 1987). Annual sea surface temperature of Gökçeada coastal waters varies from 11.5 to 30.2 °C and its sea surface salinity ranges between 34.8 to 35.3 ‰ (Gönülal and Güreşen 2014). The northern part of Gökçeada includes a narrow continental shelf, with a sharp slope and rocky substratum; while the southern part of the island possesses a broader continental shelf, with a low bathymetric gradient and a sandy substratum.

The field study consisted of sampling dead colonies along transects (2x20 m) at seven stations (Figure 1) by SCUBA diving during 2019 spring (April-May). Northern stations were Yıldızkoy (N1) and Kaşkaval (N2), eastern stations were Kanyer (E1), Eğri Meşe (E2) and Aydıncık Burnu (E3) and southern stations were Yüzen Taşlar (S1) and İncesu (S2). Only colonies that exhibited a mortality rate above 50% were sampled for ethical reasons since the species is listed as Endangered in IUCN Red List. A minimum of two dead colonies, when possible, were collected from each station. *In situ* temperature displayed in the diving computer was noted at each colony removal. A total of 12 dead colonies were taken as samples (Table 1). Plastic bags were used to store calcareous skeletons in order to avoid infauna losses during sampling. This method of coral colonies removal proved to be efficient for infaunal macro-invertebrates living in tropical corals (Abele and Patton 1976). Collected colonies were then brought to the laboratory. *In situ* extraction of skeleton was achieved via physical fragmentation.

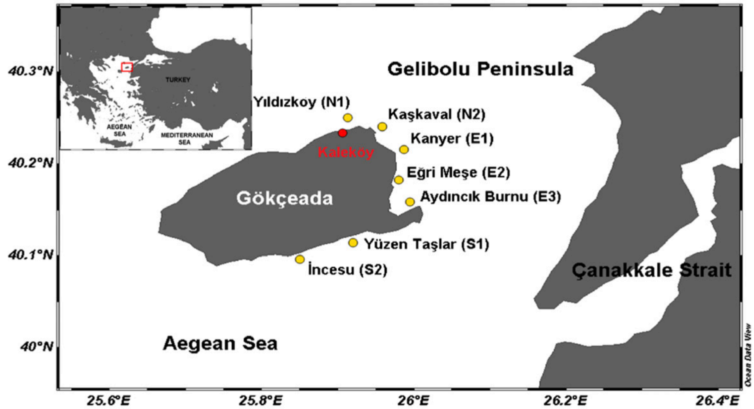

Figure 1. Gökçeada Island in the northern Aegean Sea with sampling stations plotted in yellow and research station plotted in red (Kaleköy)

Table 1. Information about stations locations, code, stations orientations (northern, eastern or southern coastline of Gökçeada), number of samples, substrata of samples (sandy or rocky), bottom temperature (via diving computer) in the vicinity and depth of dead coral colonies.

Station	Code	Orientation	Nuber of samples	Habitat	Temperature (°C)	Depth (m)
Kanyer	E1	East	4	Sandy	16	7.4
Eğri Meşe	E2	East	2	Sandy	13.1	11
Aydıncık	E3	East	3	Rocky	13.2	11
Yıldızkoy	N1	North	2	Rocky	19	9.8
Kaşkaval	N2	North	1	Rocky	19	15.5
Yüzen Taşlar	S1	South	0	Sandy	15	5
İncesu	S2	South	0	Sandy	17	8.5

Work in laboratory

Bags were closed and stored in stagnating seawater in containers for 10 h. The decrease of dissolved oxygen drove out many motile inhabitants. Coral (minor and major axis, height, surface, volume, dry biomass of colonies, number of living/recently necrotized/old necrotized polyps, interstitial space volume and sphericity index), epifloral (wet biomass) and infaunal parameters (wet infaunal biomass, number of infaunal species and infaunal abundance) were measured in laboratory. Once samples were collected, coral parameters were measured. The height (H), major axis (D_1) and minor axis (D_2) of each colony were measured with a ruler. Individual colonies were hemispherically shaped. The base was either spherical (diameter D) or elliptical (greater diameter D_1 and lesser diameter D_2). Different formulae given in (Maragos 1978; Peirano *et al.* 2001) were used to quantify the surface and volume of colonies.

If $H = D.\frac{1}{2}$ then the colony surface is $S = 2.\pi.H^2$

If $H \neq D.\frac{1}{2}$ then the colony surface is $S = c.\pi.\left(c + \frac{a^2}{\sqrt{c^2-a^2}}.\log\frac{\sqrt{c^2-a^2+c}}{a}\right)$

Where $a = D_1$ and $c = H$ if $H > D.\frac{1}{2}$ and

Where $a = H$ and $c = D.\frac{1}{2}$ if $H < D.\frac{1}{2}$

If the colony's base is circular, then the volume is equal to

$$V = \frac{2}{3}.\pi.H.\left(\frac{D}{2}\right)^2$$

If the colony's base is elliptical, then the volume is equal to

$$V = \frac{2}{3}.\pi.H.\frac{D_1}{2}.\frac{D_2}{2}.$$

Colony volumes were also estimated with the water displacement method by using laboratory glassware (a known amount of water volume was poured in the glassware, then the sample was immersed, and the volume difference was measured). The interstitial volume or space was quantified in the same way (coral colonies were tightly wrapped in aluminium foil and placed in a water-filled cylinder). Volume measurements were performed prior to the physical fragmentation of colonies. The index of sphericity Is-index was used to describe the closeness of the colony shape to a hemispherical object, according to Riegl's formula (Riegl 1995).

The number of living, new necrotized and old necrotized polyps were counted three times in order to estimate the overall percentage of dead polyps (living polyps with brown colour and intact polyps attached to corallites, newly necrotized polyps with white colour and bare calcareous skeleton visible, old necrotized polyps with epibiontic colonization). The biomass of wet colonies with epiflora/infauna and the biomass of the broken skeleton (bleach applied for 24 h, then dried for 24 h) without epiflora/infauna were weighed with an analytical balance (sensitive down to 0.01 g). Pictures of living, new necrotized and old necrotized polyps were taken with a stereoscopic microscope (Nikon SMZ745T, model C-CLEDS, 100/240 V-0.2 A-50/100 Hz, n°223763) combined with a Full-HD Toupcam Camera (XCAM Alpha 1080B) and LED polarized ring light (Figure 2).

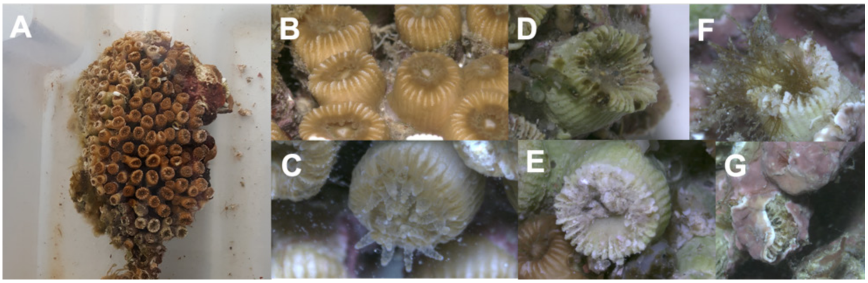

Figure 2. A fractured hemispherical colony (A) with living polyps (B, C), new necrotized polyps (D,E) and old necrotized polyps (F,G). Living tissues are visible in the frame A while necrotized ones are located behind the outline of the colony.

Several epifloral species were observed on the surface of colonies, most were rhodophytes (*Botryocladia botryoides, Lithophyllum incrustans, Jania rubens* and *Herposiphonia tenella*) and other species were from Chlorophyta (*Halimeda tuna*) and Ochrophyta (*Padina pavonica*) phyla. Epifloral wet biomass was measured with an analytical balance (sensitivity of 0.01 g). Biomass of epiflora and corals were measured with an analytical balance. The wet biomass of the infauna was estimated by subtracting the biomass of the bleached-dried colony from the biomass of the wet colony devoid of epiflora. Living infaunal individuals were observed and photos/videos were taken with a Nikon stereomicroscope.

Each colony was isolated in individual seawater containers in order to gather the infauna. Fragmentation of colonies was performed down to corallites. Organisms were considered infaunal; regardless of whether they were found inside or outside of the skeleton. A lead weight was used as a hammer to break colonies apart. Physical fragmentation was performed with an acute caution considering the fragility of the infauna (risk to harm infaunal organisms with calcareous skeleton). Vibrations drove out motile organisms. During fragmentation, aggregations of roots and sedimentary particles contained in the skeleton were disseminated in the seawater. As a result, the turbidity increased and visibility decreased significantly in the containers. The seawater content was sieved again through a 0.5 mm mesh, in order to collect any leftover or forgotten infauna. The infauna was sorted via stereomicroscope. Since observed organisms were mostly translucent, thin and had a length superior to 0.5 mm, crystalline seawater was mandatory to collect them with a stereomicroscope. The infauna was carefully collected with fine pipettes and brushes. Living specimens were fixed in 10 % formalin solution for 24h and then were put in storage glass-containers filled with 70 % ethanol. Specimens were deposited in the Marine Biology Department, the Faculty of Aquatic Sciences, Istanbul University.

Univariate and multivariate statistical analyses
Individual dead colonies were identified from colony n°1 to n°12, Yüzen Taşlar and İncesu stations were excluded from further statistical analysis due to low number of samples. IBM SPSS Statistics v.25 was used to calculate and display descriptive statistics while multivariate analyses were done with PRIMER v.6 (Plymouth Marine Laboratory). Correlation coefficient of Pearson was calculated to study the relationships between variables (most of variables were parametric). Shapiro-Wilk test was used for normality check, Levene test was applied for homoscedasticity check. Finally, Mann-Whitney test and t-test were used to compare northern and eastern stations. For the search of patterns between macroinfauna and corals, the normal analysis or quantitative type analysis (q-type) was used. Data were divided into two categories: biotic (biota and individual taxa) and habitat (coral, epiflora and infauna) data. Factors were defined by station location, temperature nearby sampled colonies, depth of sampling and northern or eastern orientation. Fourth root transformation was applied, as it was deemed more suitable for abundance variable. Each category was subjected to HCA, SIMPROF, PCO, PERMANOVA, ANOSIM, DISTLM and DIVERSE procedures. Permutational Multivariate Analysis of Variance (PERMANOVA) was used to investigate discriminative patterns significance displayed by PCO plots for coral, epiflora and infauna data. PERMANOVA was configured with a fixed model of 9999 permutations.

Results

In total, 68 infaunal taxa belonging to seven phyla, namely Annelida, Crustacea, Echinodermata, Mollusca, Nemertea, Pycnogonida and Sipuncula, were observed within twelve dead colonies (Annex 1). Only 38 of them could be identified to species level. Overall, 50 % of total number of species belonged to Annelida, 19.12 % to Mollusca, 13.23 % to Crustacea and less than 17.65 % to Sipuncula. In terms of abundance, 1268 individuals were observed. Overall, 60.96 % of total number of individuals belonged to Annelida, 16.17 % to Mollusca, 8.96 % to Crustacea and less than 13.91 % to Echinodermata.

Yıldızkoy was defined by high abundance and richness of molluscs/polychaetes (62.50% and 23.86% for abundance, 41.29% for each phylum's richness). *Modiolus barbatus* and *Striarca lactea* made up 19.32% and 13.64% of molluscs, respectively. Furthermore, *Syllis gracilis* (8.42%)*, Serpula vermicularis* (4.07%) and *Vermiliopsis striaticeps* (3.98%) were found as the most abundant species within Annelida. Kaşkaval was found to be a station with high abundance and richness of polychaetes/molluscs (50.25% and 24.63% for abundance, 44.06% and 21.53% for richness, respectively). Similar dominant species composition was observed for Kaşkaval (18.23% for *S. gracilis*, 18.23% for *M. barbatus*, 13.30% for *S. vermicularis* and 10.54% for *V. striaticeps*) as in Yıldızkoy. Kanyer was characterized by Annelida and Crustacea taxa (62.53% and 15.73% for abundance, 42.65% and 16.39% in terms of richness). Among polychaetes the most dominant species were *S. gracilis* (31.47%), *Platynereis dumerilii* (4.14%) and *Perinereis cultrifera* (3.93%). For crustaceans *Alpheus dentipes* and *Maera grossimana* were the most present in Kanyer (5.59% and 5.80%, respectively). Eğri Meşe station showed high abundance and richness of polychaetes/crustaceans (85.58% and 5.65% for abundance, 66.67% and 9.09% for richness, respectively). Species with the most contribution to Eğri Meşe abundance were *S. gracilis* (41.13%), *Lysidice ninetta* (6.55%) and *P. cultrifera* (6.45%) among Annelida, whereas *Gnathia dentata* (3.23%) was the most abundant species among Crustacea. Echinoderms were also highly abundant (4.03% for *Ophiothrix fragilis*). Aydıncık Burnu most abundant taxa were also Annelida and Echinodermata (67.19% and 13.57%), while the richest groups were polychaetes and molluscs (50.94% and 14.69%). Dominant species were *S. gracilis* (30.97%), *P. cultrifera* (5.31%), *Leodice torquata* (4.72%) for polychaetes and *Paracentrotus lividus* (7.67%) for echinoderms (Figures 3 and 4).

Besides, a high number of tube-building worm remains were seen within coral colonies (*Spirobranchus polytrema* and *Serpula vermicularis* were most likely to rank amongst the most abundant species of worms). Ribbon worms were the most numerous at Kanyer and Aydıncık (2.32% and 2.26%) with low abundance in other stations. Pycnogonids' maximal abundance was reached at Aydıncık (1.36%), this taxon was absent anywhere else.

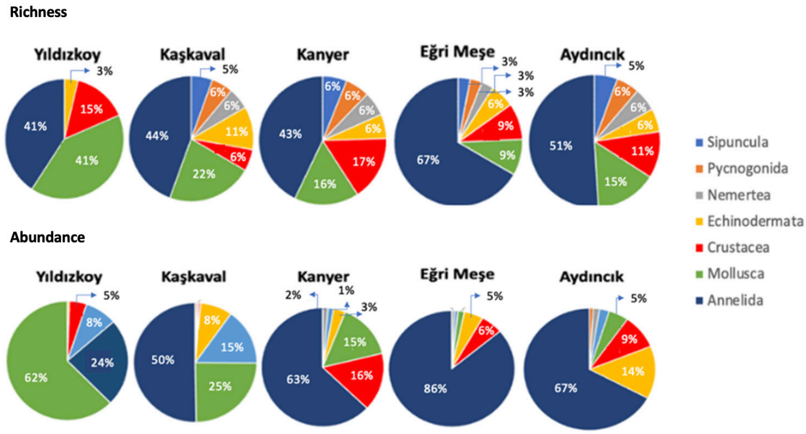

Figure 3. Proportions of dominant infaunal species within *Cladocora caespitosa* dead colonies

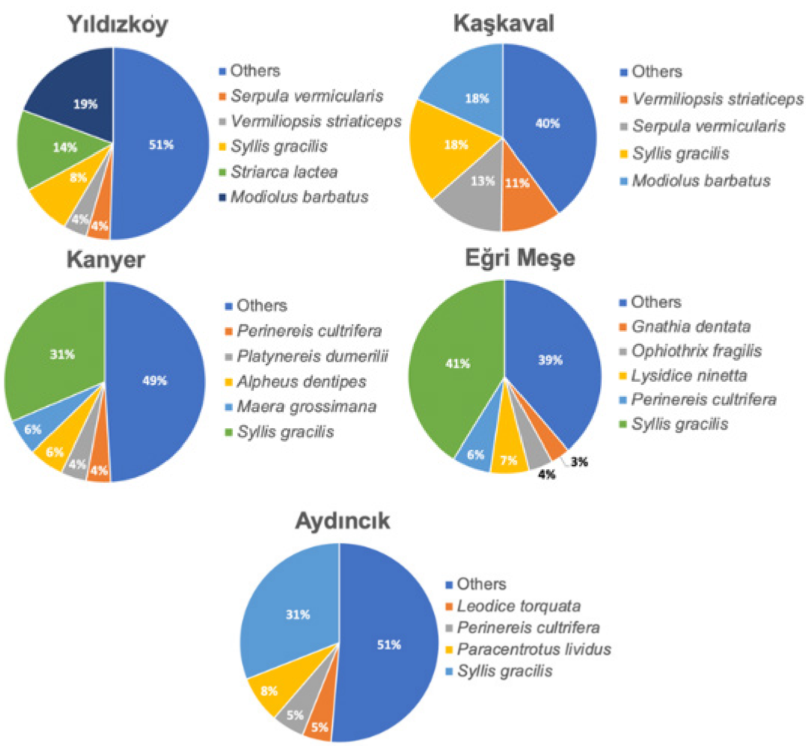

Figure 4. Composition of associated fauna within *Cladocora caespitosa* dead colonies

DIVERSE procedure was used on biota data without pre-treatment, in order to compute absolute specific diversity indexes (Margalef and Shannon-Wiener) and evenness index (Pielou). Diversity index did not display any significant trends (Tables 2 and 3). Overall evenness index depicted an even distribution of individuals among observed species and no tendencies were observed.

Table 2. Descriptive statistics of infaunal diversity and evenness indexes.

Variables	Mean	Standard deviation	Maximum	Minimum
Margalef	6.29	2.17	8.93	3.20
Shannon-Wiener	1.17	0.13	1.30	0.99
Pielou	0.77	0.03	0.80	0.73

Table 3. ANOVA test results for diversity and evenness indexes between northern and eastern colonies ($p > 0.05$; $N = 12$).

Variables	Index	P-value
Diversity	Margalef	0.052
	Shannon-Wiener	0.200
Evenness	Pielou	0.056

Table 4 shows the descriptive statistics for the measurement of 12 colonies sampled as well as the reslts of statistical tests performed. Significant differences were highlighted between northern and eastern colonies for NON and T (V_F, V_G, NL, B_{CD}, B_{EW} and T were non-parametric variables). Among dead colonies, northern coral colonies were subjected to significantly more old necrosis event ($H_{NON} = 0.046$; $H_T = 0.009$; $p < 0.05$; $N = 12$). No statistical differences were detected for the rest of variables (temperature sampling was at best punctual, statistical significance here for T suggested warmer waters in the northern coastline).

Correlations among coral, epifloral and infauna variables are summarized in Table 5. As expected, physical parameters of coral colonies were positively correlated among themselves (height, diameters, volumes and dry weight). Health indicators of coral colonies showed different results; NON was positively correlated to minor axis, coral volumes, coral dry weight and infaunal wet weight, while it was negatively correlated to NL. Number of living polyps was negatively correlated to temperature. Lastly, infaunal richness (Sp) was positively correlated to old necrosis of polyps in dead colonies (Table 5).

Table 4. Descriptive statistics and tests results for *Cladocora caespitosa* dead colonies variables between northern and eastern coastlines ($p < 0.05$; $N = 12$; bold font showed significant difference) [H: colony's height (cm), D_1: major axis (cm), D_2: minor axis (cm), S: coral surface (cm^2), V_F: coral volume measured with formula (cm^3), V_G: coral volume measured with glassware (ml), V_{IS}: interstitial volume of colony (ml), Is: index of colony's sphericity, NNN: number of newly necrotized polyps, NON: number of old necrotized polyps, NL: number of living polyps, B_{CD}: dry coral biomass, B_{EW}: wet epifloral biomass, B_{IW}: wet infaunal biomass (g), Sp: number of infaunal species, A: infaunal abundance and T: temperature (°C)].

Variable	Mean	SD	Maximum	Minimum	Statistical test	P-value
H	5.21	1.35	8.00	3.50	T-test	0.52
D_1	9.12	2.26	14.00	5.00	T-test	0.13
D_2	6.41	1.85	10.50	4.00	T-test	0.13
S	141.46	114.07	392.00	22.24	T-test	0.25
V_F	196.41	147.06	615.75	47.12	Whitney-Mann U	0.48
V_G	114.00	82.13	313.00	27.00	Whitney-Mann U	0.86
V_{IS}	15.17	7.55	29.00	4.00	T-test	0.84
Is	0.58	0.12	0.80	0.41	T-test	0.29
NNN	21.42	38.62	139.00	0	T-test	0.29
NON	155.92	103.31	358.00	15.00	T-test	**0.046**
NL	21.83	37.03	114.00	0	Whitney-Mann U	0.10
B_{CD}	147.94	60.71	297.11	53.53	Whitney-Mann U	0.73
B_{EW}	11.25	26.10	92.33	0	Whitney-Mann U	0.48
B_{IW}	54.25	28.39	109.08	7.77	T-test	0.29
Sp	35.00	13.73	51.00	17.00	ANOVA	0.81
A	265.00	145.47	483.00	124.00	ANOVA	0.42
T	15.56	2.44	19.00	13.10	Whitney-Mann U	**0.009**

HCA clustering was applied in order to sort coral, epiflora and infauna data among samples. SIMPROF procedure was used to assess if these clusters were genuine, statistically speaking. One ordination method was used, also known as Principal Coordinates (PCO). PCO plots were used, to identify any possible discrimination patterns among sampled colonies. Each variable, based on their Pearson's correlation with ordination's generated axis, was selected and represented on PCO graphs via vectors (correlation circles). These vectors were used to demonstrate patterns observed on PCO plots.

Table 5. Summary of Pearson coefficients among coral, epiflora and infauna variables (** for p < 0.01, * for p < 0.05 and - for redundant or non-significant correlations)

	H	D_1	D_2	V_F	V_G	V_{IS}	NON	NL	B_{CD}	Sp
D_1	0.74**	-	-	-	-	-	-	-	-	-
D_2	-	0.66*	-	-	-	-	-	-	-	-
V_F	0.87**	0.85**	0.72**	-	-	-	-	-	-	-
V_G	0.78**	0.72**	0.75**	0.83**	-	-	-	-	-	-
V_{IS}	0.73**	0.75**	0.62*	0.74**	0.88**	-	-	-	-	-
NON	-	-	0.74**	0.64*	0.59*	-	-	-	-	-0.65*
NL	-	-	-	-	-	-	-0.58*	-	-	-
B_{CD}	0.79**	0.64*	0.75**	0.80**	0.91**	0.82**	0.69*	-	-	-
B_{IW}	0.78**	0.65*	0.72**	0.76**	0.86**	0.74**	0.69*	-	0.82**	-
A	-	-	-	-	-	-	-	-	-	0.64*
T	-	-	-	-	-	-	0.67*	-0.62*	-	-

Dendrograms (HCA) and ordination (PCO) plots for coral, epifloral and infauna data are presented in Figure 5. In HCA plots, clustering patterns were observed for coral and epiflora data only. Within coral data, segregation was statistically supported between northern and eastern dead colonies (similarity threshold at 87.72% based on colonies physical and health variables). Two colonies were grouped apart (colonies 5 and 12 with a difference of similarities from the threshold reaching 3.42% and 1.85%, respectively). The clustering of samples is stronger for epiflora data with a threshold fixed at 81.32% for north-east segregation of epifloral biomass, with significant differences ranging from 15.18% to 81.32%. For infauna most clades were not statistically supported by SIMPROF test. PCO plots and correlation vectors underlined the following observations. Overall, the representation of habitat data was satisfactory (90.50% for coral, 92.70% for epiflora and 94.70% for infauna data variations).

Based on dendrograms plots (Figure 5), northern colonies were defined by a lack of living tissues and greater proportion of NON, while eastern colonies tended to exhibit higher NL and NNN (number of living and recently necrotized polyps). No conclusive statements could be made from epiflora's PCO plot.

Dendrograms (HCA) and ordination plots (PCO) for biota, Annelida and Mollusca data are shown in Figure 6. Overall dendrograms and PCO plots were applied to all seven phyla and to biota. However, no individual phyla or biota indicated a clear separation between northern and eastern assemblages. Overall, the representation of biotic data was mildly average (45.90% for biota, 54.50% for Annelida and 52.60% for Mollusca data variation).

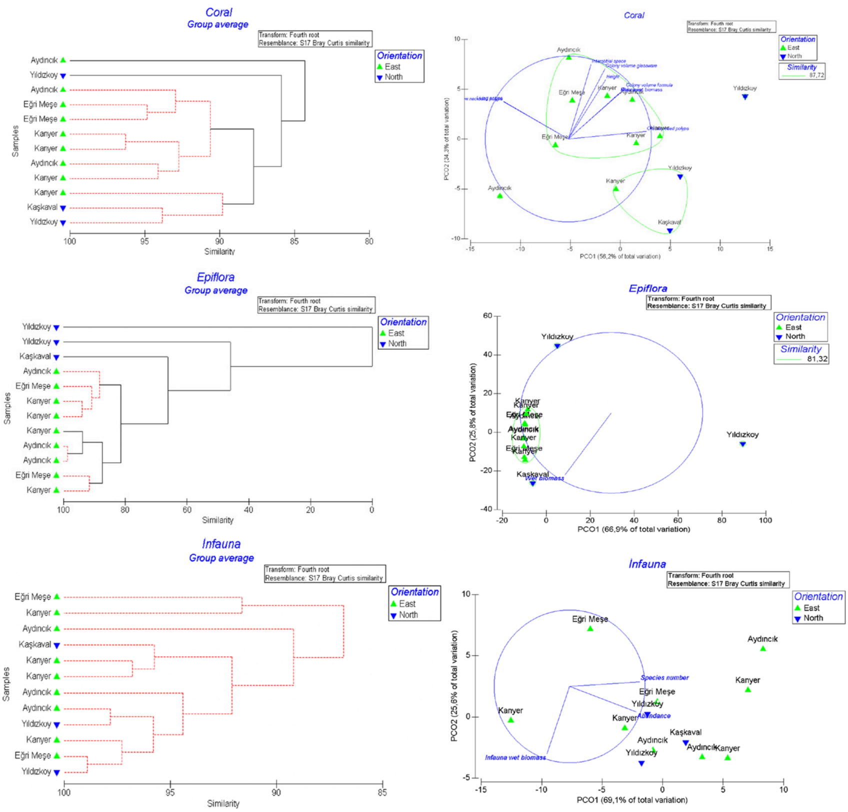

Figure 5. Hierarchical Cluster Analysis (HCA; left side) and Principal Coordinates Analysis (POC; right side) for coral, epiflora and infauna data (from top to bottom). Distance matrices were Bray-Curtis and the cluster mode was based on group average. In HCA clusters, red lines indicate not statistically supported clusters while black lines depict statistically interpretable clusters (based on SIMPROF results). In PCO graphs, blue lines represent correlation vectors (based on Pearson coefficient).

Despite a lack of significant separation between northern and eastern coastlines, PCO plots depicted distinct patterns. Two clusters were highlighted for biota data (colonies 1-3 from Aydıncık/Eğri Meşe and colonies 2-4-5-6-8-9-10-11-12 from northern stations/Aydıncık/Eğri Meşe) and one outlier (colony 7 from Kanyer). Colonies 1 and 3 were characterized by high NNN/NL, while the colony 7 was reported to have low infaunal abundance and richness. Annelida data held similar properties compared to biota data in terms of sample aggregation. The same pattern was observed for clusters and outliers. The high similarity to PCO plot of biota indicates that polychaetes were highly representative of dead *C. caespitosa* infauna in the northern and eastern coastlines of Gökçeada. Mollusca data were more dispersed compared to previous phylum. Only one cluster (colonies 2-4-5-6-8-9-10-11-12 from northern stations, Kanyer, Eğri Meşe and Aydıncık) was observed. Furthermore, four outliers were present (colonies 2, 3, 7 and 8 from the eastern coast). Outliers tended to be associated to high values of NNN and NL.

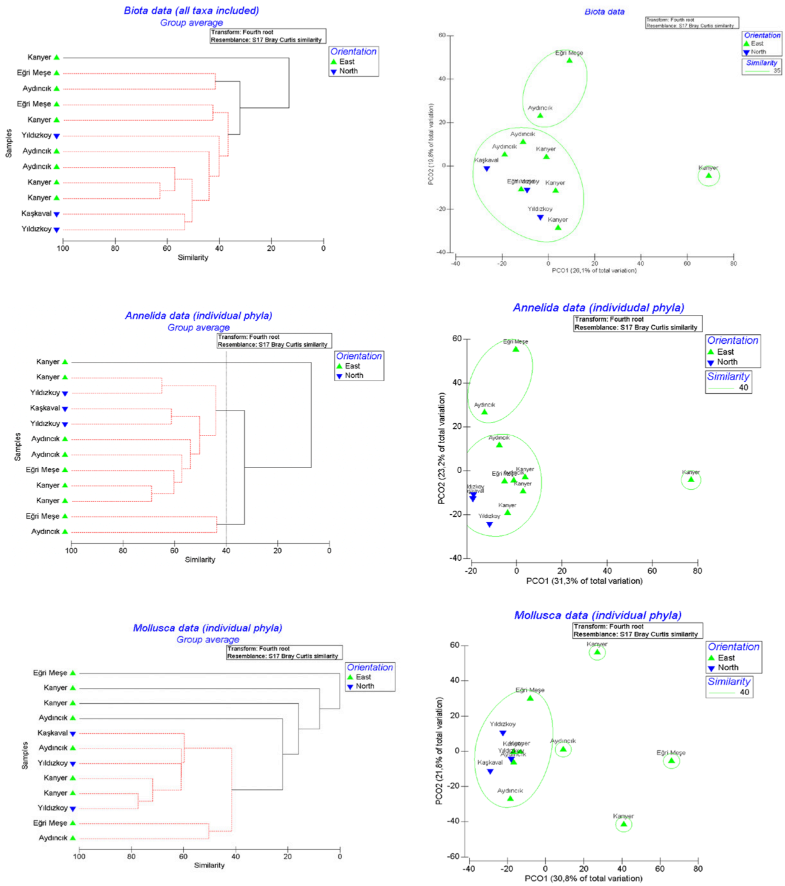

Figure 6. Hierarchical Cluster Analysis (HCA; left side) and Principal Coordinates Analysis (POC; right side) for biota, Annelida and Mollusca data (from top to bottom). Bray-Curtis distance was used for resemblance matrices and the cluster mode was based on group average. In HCA clusters, red lines indicate not statistically supported clusters while black lines depict statistically interpretable clusters (based on SIMPROF results). In PCO graphs, blue lines represent correlation vectors (based on Pearson coefficient).

Significant discrimination ($p < 0.05$) was detected only for the ordination factor against coral data and from location/depth factors toward epifloral data ($p = 0.003$ and 0.002, respectively) in our samples by PERMANOVA (Table 6).

Table 6. Statistical summary of PERMANOVA (p-values) on the significance (bold font) of factors for habitat data (coral, epiflora and infauna data)

Factors	Results		
	Coral	Epiflora	Infauna
Location	0.16	**0.003**	0.89
Temperature	0.25	0.86	0.86
Substrata	0.64	0.40	0.67
Depth	0.06	**0.002**	0.93
Orientation	**0.05**	0.23	0.87

Analysis of Similarities (ANOSIM) was used, to assess whether the patterns observed in biota data, among sampled colonies on PCO plots, were significantly discriminative. ANOSIM analysis emphasized the significant discriminative properties of temperature factor for the entire biota (R=0.23, p=0.04), of location-depth factors (R=0.33; 0.27 and p=0.04; 0.05) for crustaceans and of benthic substrata factor (R=0.12, p=0.05) for molluscs (Table 7).

Table 7. Statistical summary of ANOSIM (p-values) on the significance (bold font) of factors for individual taxa and biota

Factors	Results							
	Biota	**Sipuncula**	**Pycnogonida**	**Echinodermata**	**Crustacea**	**Mollusca**	**Annelida**	**Nemertea**
Location	0.26	0.44	0.34	0.69	**0.04**	0.37	0.47	0.27
Temperature	**0.04**	0.12	0.62	0.82	0.08	0.09	0.28	0.44
Substrata	0.13	0.12	0.45	0.56	0.58	**0.05**	0.35	0.91
Depth	0.27	0.88	0.55	0.61	**0.05**	0.55	0.40	0.27
Orientation	0.35	0.54	1	0.55	0.55	0.79	0.39	0.25

DISTLM procedure was used to see if there was significant correlation between habitat variables and biota patterns (marginal test for isolated variable, sequential test for added variables, whereas R^2 includes all variables). According to DISTLM procedure, significant correlations were found for NL, NNN and infaunal abundance. Coral variables explained 94% of biota variation while infaunal parameters only 29% of biota variation (Table 8).

Table 8. Summary of significant results for DISTLM procedure

Data comparison	Habitat variables	Marginal test	Sequential test	R^2
Biota-Coral	NL	0.03	0.01	0.94
	NNN	0.03	0.02	
Biota-Infauna	A	0.02	0.03	0.29

Discussion

Preliminary inventory of macroinfauna associated with dead colonies and comparison with other studies

With the present study, the number of invertebrates associated with the stony coral reached 397 (406 with algae included, Annex 2). Polychaetes were the most dominant and abundant group, followed by molluscs and crustaceans, which is consistent with other studies (Table 9).

Table 9. Summary of the associated macroinfauna of *Cladocora caespitosa* colonies in the Mediterranean Sea based on the previous and present publications (N/A: data deficient).

Location	Colonies	Mediterranean sector	Percentage of living polyps	Taxonomic focus	Number of associated taxa	Abundance	Depth	References
Ionian	N/A	West	N/A	Associated fauna	24	N/A	N/A	Lumare 1965
N/A	N/A	N/A	N/A	Polychaetes	N/A	N/A	N/A	Sciscioli and Nuzzaci 1970
N/A	N/A	N/A	N/A	Echinoderms	N/A	N/A	N/A	Zavodnik 1976
Aegean	N/A	East	N/A	Polychaetes	N/A	N/A	N/A	Ergen 1979
Aegean	Bank	East	N/A	Polychaetes	87	N/A	19	Arvanitidis and Koukouras 1994
Aegean	Bank	East	N/A	Polychaetes	87	1889	19	Chintiroglou 1996
Aegean	Bank	East	N/A	Associated epibionts	212	4366	19	Koukouras *et al.* 1998

Table 9. Continued

Aegean	N/A	East	N/A	Polyplacophore	3	451	6	Özürk *et al.* 2000
Aegean	N/A	East	N/A	Polychaetes	<34	18957	76	Çınar and Ergen 2002
Aegean	N/A	East	N/A	Polychaetes	29	18957	76	Çınar 2003
Aegean	N/A	East	N/A	Pycnogonida	20	N/A	2	Krapp *et al.* 2008
Aegean	N/A	East	N/A	Sipunculans	<3	3099	195	Açik 2008
Adriatic	Bank	East	2.00	Associated fauna	54	N/A	20	Antoniadou and Chintiroglou 2010
Levant	N/A	East	N/A	Sipunculans	2	20706	200	Açik 2011
Adriatic	Bank	West	60.00	Associated fauna	89	3386	21	Pitacco *et al.* 2014
Adriatic	Bed	West	77.00	Associated fauna	222	11561	10	Pitacco 2016
Adriatic	Bank	West	75.00	Molluscs	62	3034	9	Pitacco *et al.* 2017
Adriatic / Aegean	Bed	West / East	N/A	Polychaetes	124	N/A	21	Pitacco *et al.* 2021
Aegean	Discrete	East	10.96	Associated fauna	68	1268	15	Present study

Only five studies have been carried out specificallly on macrofauna associated with *C. caespitosa* (Lumare 1965; Koukouras *et al.* 1998; Antoniadou and Chintiroglou 2010; Pitacco *et al.* 2014; Pitacco 2016); while 13 others focused on specific taxonomic groups (Sciscioli and Nuzzaci 1970; Zavodnik 1976; Ergen 1976; Arvanitidis and Koukouras 1994; Chintiroglou 1996; Öztürk *et al.* 2000; Çinar and Ergen 2002; Çınar 2003; Krapp *et al.* 2008; Açik 2008, 2011; Pitacco *et al.* 2017, 2021). Another important aspect to highlight is that no difference among phyla was found between living and dead colonies. Our study targeted dead colonies while other studies were performed on large healthy banks.

Interactions between individual taxa and dead colonies

Statistical analysis (ANOSIM) underlined the discriminative properties of temperature for biota as a whole and the effect of depth and location of stations toward crustaceans. Punctual measurements of temperature were enough to underline the impact of the slightest thermal variation on the macro-infauna, possibly due to high sensitivity to temperature or spatial distribution, as was the case for the study of Terrón-Sigler *et al.* (2014) on *Astreoides calycularis* colonies.

Exploratory methods, such as clustering analysis and PCO ordination plots, also gave supplementary information and mitigated insights into infaunal structure. Both methods showed that polychaetes were important to describe community structure of *C. caespitosa* dead colonies around Gökçeada. Multiple common patterns (related to NON, NNN and NL) were detected for both polychaetes and biota as a whole.

Negative correlations between living polyps and discretely mobile, endolithic, epilithic, soft-bottom, suspension feeding, carnivore and omnivore invertebrates were computed by Pitacco (2016). Infaunal species appear to have a negative effect on the health of coral colonies. As *C. caespitosa* is well-known for up regulating its heterotrophy in case of needs, trophic competition might arise, in the context of global climate change, with suspension feeding invertebrates, at the expense of living polyps. As it was mentioned by Schiller (1993a,b), further investigations are required to describe the complex interactions between assemblages and colonies, the potential role of associated macrofauna on the maintenance of coral health and on the recovery of colonies after stressful events. Further studies should be performed to determine to what extent mortality events have cascade effects on the associated assemblages. It is not clear whether overall coral colonies benefit or suffer from its associated cryptofauna. With colonies presenting high protein contents as compared to other scleractinians (Houlbrèque *et al.* 2003), *C. caespitosa* seems to be the ideal nutritive hotspot for juvenile deposit and suspension feeders. Associated infauna may stress the coral to some extent, while others such as polychaetes and bivalves can do substantial damage (Sammarco and Risk 1990). Some coral associates could also have mutualistic and commensal interactions with their coral host. These benefits may range from preying upon the larvae of boring animals, removing detritus and coral mucus, to attacking potential predators of colonies (DeVantier *et al.* 1986; Nogueira 2003).

Conclusion

This is the first inventory of infaunal invertebrates associated with *C. caespitosa* discrete colonies around Gökçeada Island in the northern Aegean Sea. Even dead, *C. caespitosa* is known to harbour a rich community of associated macrofauna within their skeletons. Due to their IUCN status as an endangered species, live and healthy corals were not sampled in this study; therefore, the scope of this study's interpretations is particularly restricted. Nevertheless, no differences in term of infaunal phyla were found with past studies, where living colonies were sampled. Additional studies should be performed to determine to what extent mortality events have cascade effects on the associated assemblages. It is not clear whether coral colonies benefit or suffer from their associated cryptofauna. The high abundance of invertebrates during 2019 spring in Gökçeada underlines the role of *C. caespitosa*, even dead, as a nursery ground, which serve as an important ecological function to boost marine biodiversity at a local scale.

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Gökçeada'da (Kuzey Ege Denizi) *Cladocora caespitosa* (Cnidaria: Anthozoa) ilişkili makroiçfaunal omurgasızlar

Öz

Taş mercan (*Cladocora caespitosa*) ilişkili olan makroomurgasızlar, 2019 baharında Gökçeada'nın (Kuzey Ege Denizi) çevresinde 15.5 m derinliğe kadar incelenmiştir. Bu mercan türünün on iki ölü/yarı ölü kolonisi toplandı ve toplam olarak taş mercan ilişkili olan 68 infauna taksonu tespit edildi. Taş mercanla birlikte yaşayan toplam omurgasız sayısı 397 olarak güncellendi (makroalglerle 406. Bu çalışmada, taş mercanla bağlı olan toplam tür sayısına 26 yeni takson eklendi. En baskın grup Polychaeta (% 61) olup, bu grubu Mollusca (% 16) ve Crustacea (% 9) takip etmektedir. Bölgedeki en baskın türler, *Syllis gracilis*, *Perinereis cultrifera*, *Vermiliopsis striaticeps* ve *Serpula vermicularis*'dir. Poliketler ve biyota verileri (PCO grafikleri ile) benzer bir kümeleme davranışı sergilenmektedir. DISTLM süreci, biota varyasyonunun % 94'ünü yeni nekroza uğramış poliplerle ve canlı poliplerle açıklamıştır. Bu çalışmada sıcaklığın biyota üzerindeki etkisinin altı çizilmiştir (ANOSIM), ancak deniz yüzeyi sıcaklığın biyotanın üzerindeki etkisinin kapsamı hala belirsizdir.

Anahtar kelimeler: *Cladocora caespitosa*, taş mercan, makro-içfauna, poliketler,
çok değişkenli analiz

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Annex 1. Abundance of macro-invertebrates associated to *Cladocora caespitosa* dead colonies around Gökçeada Island in the Northern Aegean Sea

Phylum	Species	Yıldızkoy	Kaşkaval	Kanyer	Eğri Meşe	Aydıncık
Annelida	*Amblyosyllis* sp.	0	0	0	0	4
Annelida	*Branchiomma bombyx*	0	0	0	0	1
Annelida	Capitellidae sp.1	0	0	2	1	0
Annelida	Capitellidae sp.2	0	0	12	0	1
Annelida	*Caulleriella* sp.1	0	0	0	2	0
Annelida	*Caulleriella* sp.2	0	0	4	0	0
Annelida	*Ceratonereis costae*	0	0	0	0	1
Annelida	*Cirriformia* sp.	1	0	5	3	1
Annelida	*Dodecaceria* sp.	1	0	2	4	3
Annelida	*Dorvillea rubrovittata*	0	0	0	2	2
Annelida	*Eurysyllis tuberculata*	0	0	0	2	0
Annelida	*Haplosyllis spongicola*	0	0	0	1	0
Annelida	Hesionidae sp.1	0	0	11	1	1
Annelida	Hesionidae sp.2	1	0	0	0	1
Annelida	*Leodice torquata*	1	0	0	2	16
Annelida	*Lepidonotus clava*	0	0	6	2	3
Annelida	*Lysidice ninetta*	1	0	4	8	10
Annelida	Nereididae sp.	0	1	2	2	3
Annelida	*Odontosyllis* cf. *fulgurans*	0	0	1	1	0
Annelida	*Perinereis cultrifera*	6	8	19	8	18
Annelida	Phyllodocidae sp.	0	0	0	0	1
Annelida	*Platynereis dumerilii*	0	0	20	1	1
Annelida	*Polycirrus* sp.	0	0	1	0	5
Annelida	Polynoidae sp.	1	0	8	1	0
Annelida	*Proceraea* sp.	0	0	0	3	1
Annelida	Sabellidae sp.	0	0	1	1	3
Annelida	*Serpula vermicularis*	7	27	15	3	2
Annelida	*Sigambra* sp.	0	0	0	2	4
Annelida	*Spirobranchus polytrema*	0	2	5	0	3
Annelida	Syllidae sp.	0	0	0	0	2
Annelida	*Syllis gerlachi*	0	4	10	1	9
Annelida	*Syllis gracilis*	15	37	152	51	105
Annelida	Terebellidae sp.	1	2	9	2	7
Annelida	*Vermiliopsis striaticeps*	7	21	13	2	13
Crustacea	*Alpheus dentipes*	2	0	27	0	6

Annex 1. Continued

Phylum	Species	Yıldızkoy	Kaşkaval	Kanyer	Eğri Meşe	Aydıncık
Crustacea	*Ampelisca* sp.	0	0	5	0	0
Crustacea	*Apseudopsis latreillii*	0	0	1	0	4
Crustacea	*Biancolina algicola*	1	0	13	0	4
Crustacea	*Calathura brachiata*	1	0	1	1	12
Crustacea	*Gnathia dentata*	4	0	2	4	0
Crustacea	*Leptocheirus guttatus*	0	0	0	0	2
Crustacea	*Maera grossimana*	0	0	28	2	2
Crustacea	*Nebalia bipes*	0	1	2	0	0
Echinodermata	*Amphipholis squamata*	0	0	3	0	2
Echinodermata	*Ophiothrix fragilis*	0	2	4	5	18
Echinodermata	*Paracentrotus lividus*	1	15	8	1	26
Mollusca	*Acanthochitona fascicu-laris*	1	0	1	0	0
Mollusca	*Bittium latreillii*	24	0	17	1	0
Mollusca	*Chama* cf. *gryphoides*	2	0	0	0	0
Mollusca	*Clanculus* cf. *cruciatus*	7	0	15	0	1
Mollusca	*Elysia viridis*	0	0	0	0	2
Mollusca	*Gastrochaena dubia*	0	0	0	0	2
Mollusca	*Gibbula* cf. *magus*	1	0	0	0	0
Mollusca	*Mimachlamys* cf. *varia*	5	0	2	0	1
Mollusca	*Modiolus barbatus*	34	37	17	1	5
Mollusca	*Musculus costulatus*	4	2	1	0	1
Mollusca	*Puncturella noachina*	3	0	0	0	2
Mollusca	*Sphenia* cf. *binghami*	5	2	9	0	0
Mollusca	*Striarca lactea*	24	9	11	1	12
Nemertea	Nemertae sp.1	0	1	4	0	2
Nemertea	Nemertae sp.2	0	0	2	0	1
Nemertea	Nemertae sp.3	0	0	1	1	2
Pycnogonida	Pycnogonida sp.1	0	1	0	0	1
Pycnogonida	Pycnogonida sp.2	0	0	0	0	2
Sipuncula	*Apionsoma* sp.	0	0	0	0	1
Sipuncula	*Aspidosiphon misakiensis*	15	31	5	0	3
Sipuncula	*Phascolion (Isomya) tu-berculosum*	0	0	1	0	3
Sipuncula	*Phascolosoma stephen-soni*	0	0	1	1	1

Annex 2. Updated checklist of *Cladocora caespitosa* associated biota (0: absence of species in *C. caespitosa* bioconstruction; 1: presence; N/A: no data).

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia				
Phylum Annelida				
Acrocirrus frontifilis	0	0	1	Koukouras *et al.* 1998, Arvanitidis and Koukouras 1994, Chintiroglou 1996
Amblyosyllis spectabilis	N/A	N/A	N/A	Çınar 2003
Amblyosyllis sp.	1	0	0	Present study
Amphiglena mediterranea	0	0	1	Arvanitidis and Koukouras 1994, Koukouras *et al.* 1998, Chintiroglou 1996
Amphitrite cirrata	0	1	0	Pitacco 2016
Amphitrite variabilis	0	0	1	Arvanitidis and Koukouras 1994, Koukouras *et al.* 1998, Chintiroglou 1996, Antniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Aphelochaeta filiformis	0	1	0	Pitacco 2016
Arabella geniculata	0	1	0	Pitacco 2016
Arabella iricolor	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010
Arichlidon reyssi	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Branchiomma bombyx	1	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, present study
Branchiosyllis exilis	0	1	0	Çınar and Ergen 2002, Pitacco 2016
Brania pusilla	0	1	0	Çınar and Ergen 2002, Pitacco 2016
Capitellidae sp.	1	0	0	Present study
Caulleriella viridis	0	1	0	Pitacco 2016
Caulleriella sp.1	1	0	0	Present study
Caulleriella sp.2	1	0	0	Present study
Ceratonereis (Composetia) costae	1	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021, present study
Cirratulus cirratulus	0	1	0	Pitacco 2016
Cirriformia tentaculata	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Cirriformia sp.	1	0	0	Present study
Dasybranchus caducus	0	1	0	Pitacco 2016
Dasybranchus gajolae	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco 2016
Ditrupa arietina	0	0	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Annelida				
Dodecaceria concharum	1	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Dodecaceria sp.	1	0	0	Present study
Dorvillea rubrovittata	1	0	1	Arvanitidis and Koukouras 1994, Koukouras *et al.* 1998, present study
Euclymene oerstedii	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Eulalia viridis	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Eumida sanguinea	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Eunice schizobranchia	0	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Eunice vittata	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Euphrosine foliosa	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco 2016
Eupolymnia nebulosa	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Eupolymnia nesidensis	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Eurysyllis tuberculata	1	1	0	Çınar and Ergen 2002, Pitacco 2016, present study
Eusyllis blomstrandi	N/A	N/A	N/A	Çınar and Ergen 2002
Eusyllis lamelligera	N/A	N/A	N/A	Çınar and Ergen 2002
Exogone dispar	N/A	N/A	N/A	Çınar and Ergen 2002
Exogone naidina	0	1	0	Çınar and Ergen 2002, Pitacco 2016
Exogone rostrata	N/A	N/A	N/A	Çınar and Ergen 2002
Flabelliderma cinari	0	1	0	Pitacco 2016
Glycera alba	0	1	0	Pitacco 2016
Glycera tesselata	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco 2016
Goniada maculata	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Haplosyllis spongicola	1	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Çınar 2002, Çınar 2003, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021, present study

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Annelida				
Harmothoe areolata	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Harmothoe spinifera	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Harmothoe antilopes	0	0	1	Arvanitidis and Koukouras 1994, Koukouras *et al.* 1998
Harmothoe extenuata	0	1	0	Pitacco 2016, Pitacco *et al.* 2021
Harmothoe fragilis	0	1	0	Pitacco 2016
Harmothoe gilchristi	0	1	0	Pitacco 2016
Harmothoe impar	0	1	0	Pitacco 2016
Hesionidae sp.1	1	0	0	Present study
Hesionidae sp.2	1	0	0	Present study
Heteromastus filiformis	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Hilbigneris gracilis	0	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Hydroides pseudouncinata pseudouncinata	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Leiochrides australis	0	1	0	Pitacco 2016
Leocrates chinensis	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Leocrates claparedii	0	1	0	Pitacco 2016
Leodice harassii	0	0	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Leodice torquata	1	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021, present study
Lepidasthenia elegans	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Lepidonotus clava	1	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco 2016, Pitacco *et al.* 2021, present study
Lumbrineris coccinea	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Annelida				
Lumbrineris latreilli	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Lysidice collaris	0	1	0	Pitacco 2016
Lysidice ninetta	1	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2021, present study
Lysidice unicornis	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Şahin 2009, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Marphysa sanguinea	0	0	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Myrianida edwarsi	N/A	N/A	N/A	Çinar and Ergen 2002
Naineris laevigata	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou, 1996, Koukouras *et al.* 1998
Neoamphitrite affinis	0	1	0	Pitacco 2016
Nephtys sp.	0	0	1	Koukouras *et al.* 1998
Nereididae sp.	1	0	0	Present study
Nereis rava	1	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2021
Nereis zonata	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010
Nicolea venustula	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco 2016
Notomastus latericeus	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Notophyllum foliosum	0	0	1	Koukouras *et al.* 1998
Odontosyllis fulgurans	1	0	0	Present study
Odontosyllis gibba	N/A	N/A	N/A	Çınar and Ergen 2002
Paleanotus chrysolepis	0	1	0	Pitacco 2016
Palola siciliensis	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Paraehlersia ferrugina	0	1	0	Pitacco 2016
Parapionosyllis brevicirra	N/A	N/A	N/A	Çınar and Ergen 2002

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Annelida				
Parasabella langerhansi	0	1	0	Pitacco 2016
Parasabella saxicola	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Parasabella tommasi	0	1	0	Pitacco 2016
Paucibranchia fallax	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco 2016
Perinereis cultrifera	1	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco 2016, present study
Petaloproctus terricolus	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Phyllodoce madeirensis	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Phyllodoce mucosa	0	0	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Phyllodocidae sp.	1	0	0	Present study
Piromis eruca	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Placostegus crystallinus sensu	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Platynereis dumerilii	1	0	0	Present study
Polycirrus aurantiacus	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco *et al.* 2021
Polycirrus sp.	1	0	0	Present study
Polynoidae sp.	1	0	0	Present study
Pomatoceros triqueter	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Pontogenia chrysocoma	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996
Prionospio multibranchiata	0	0	1	Koukouras *et al.* 1998
Proceraea aurantiaca	0	0	1	Koukouras *et al.* 1998
Proceraea sp.	1	0	0	Present study
Psamathe fusca	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Pseudoleiocapitella fauveli	0	1	0	Pitacco 2016
Pseudopotamilla reniformis	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco *et al.* 2021
Pseudosyllis brevipennis	N/A	N/A	N/A	Çınar and Ergen 2002
Pterocirrus macroceros	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco 2016
Sabella spallanzani	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Annelida				
Sabellaria alcocki	0	0	1	Koukouras *et al.* 1998
Sabellaria spinulosa	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996
Sabellidae sp.	1	0	0	Present study
Salvatoria clavata	0	1	0	Çınar and Ergen 2002, Çınar 2003, Pitacco 2016
Salvatoria euritmica	N/A	N/A	N/A	Çınar and Ergen 2002
Schistomeringos rudolphi	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Sclerocheilus minutus	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Scoletoma fragilis	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco 2016
Scoletoma funchalensis	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco 2016
Scoletoma impatiens	0	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Serpula concharum	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Serpula vermicularis	1	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021, present study
Sigambra sp.	1	0	0	Present study
Simplaria pseudomilitaris	0	1	0	Pitacco 2016
Sphaerosyllis hystrix	N/A	N/A	N/A	Çınar and Ergen 2002
Sphaerosyllis pirifera	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Çinar and Ergen 2002, Koukouras, Pitacco 2016
Spirobranchus lamarcki	0	1	0	Pitacco *et al.* 2014, Pitacco 2016
Spirobranchus polytrema	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco *et al.* 2021
Spirobranchus triqueter	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021
Syllida armata	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Syllidae sp.	1	0	0	Present study
Syllides fulvus	0	1	0	Pitacco 2016

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Annelida				
Syllis alternata	0	1	0	Çınar and Ergen 2002, Pitacco 2016, Pitacco *et al.* 2021
Syllis armillaris	0	1	0	Çınar and Ergen 2002, Pitacco 2016
Syllis beneliahuae	0	1	0	Pitacco 2016
Syllis bouvieri	N/A	N/A	N/A	Çınar and Ergen 2002
Syllis columbretensis	0	1	0	Çınar and Ergen 2002, Pitacco 2016
Syllis corallicola	0	1	0	Çınar and Ergen 2002, Pitacco 2016
Syllis ferrani	0	1	0	Pitacco 2016, Pitacco *et al.* 2021
Syllis garciai	N/A	N/A	N/A	Çınar and Ergen 2002
Syllis gerlachi	1	1	0	Çınar and Ergen 2002, Çınar 2003, Pitacco 2016, Pitacco *et al.* 2021, present study
Syllis gerundensis	0	1	0	Pitacco 2016
Syllis gracilis	1	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Çınar and Ergen 2002, Çınar 2003, Pitacco 2016, present study
Syllis jorgei	N/A	N/A	N/A	Çınar and Ergen 2002
Syllis krohnii	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Pitacco 2016
Syllis prolifera	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Çınar and Ergen 2002, Çınar 2003, Antoniadou and Chintiroglou 2010, Pitacco 2016
Syllis variegata	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Çınar 2002, Pitacco 2016, Pitacco *et al.* 2021
Terebella lapidaria	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Terebellidae sp.	1	0	0	Present study
Thelepus setosus	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Trichobranchus glacialis	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Trypanosyllis coeliaca	0	1	0	Pitacco 2016
Trypanosyllis aeolis	0	1	0	Çınar and Ergen 2002, Pitacco 2016
Trypanosyllis zebra	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Çınar and Ergen 2002, Antoniadou and Chintiroglou 2010, Pitacco 2016, Pitacco *et al.* 2021
Syllis hyalina	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Çınar and Ergen 2002, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2021

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Annelida				
Vermiliopsis infundibulum	0	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco 2016, Pitacco *et al.* 2021
Vermiliopsis labiata	0	0	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998
Vermiliopsis striaticeps	1	1	1	Arvanitidis and Koukouras 1994, Chintiroglou 1996, Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Pitacco *et al.* 2021, present study
Xenosyllis scabra	0	1	0	Pitacco 2016
Phylum Bryozoa				
Schizobrachiella sanguinea	0	1	0	Pitacco *et al.* 2014, Pitacco 2016
Schizoporella errata	0	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Schizoporella unicornis	0	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Phylum Cnidaria				
Adamsia palliata	0	0	1	Antoniadou and Chintiroglou 2010
Cereus pedunculatus	0	0	1	Koukouras *et al.* 1998
Sertularella polyzonias	0	0	1	Koukouras *et al.* 1998
Phylum Crustacea				
Acanthonyx lunulatus	0	0	1	Koukouras *et al.* 1998
Achaeus cranchii	0	1	0	Pitacco 2016
Alpheus dentipes	1	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, present study
Ampelisca sp.	1	0	0	Present study
Aora spinicornis	0	0	1	Koukouras *et al.* 1998
Apocorophium acutum	0	1	0	Pitacco 2016
Apseudopsis acutifrons	0	1	0	Pitacco 2016
Apseudopsis latreillii	1	0	0	Present study
Athanas nitescens	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Balanus trigonus	0	1	0	Pitacco 2016
Biancolina algicola	1	0	0	Present study
Calathura brachiata	1	0	0	Present study
Caprella acanthifera	0	1	0	Pitacco 2016
Carpias stebbingi	0	0	1	Koukouras *et al.* 1998
Cestopagurus timidus	0	0	1	Koukouras *et al.* 1998

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Crustacea				
Chondrochelia savignyi	0	0	1	Koukouras *et al.* 1998
Clibanarius erythropus	0	0	1	Koukouras *et al.* 1998
Colomastix pusilla	0	0	1	Koukouras *et al.* 1998
Cymodoce tattersalli	0	0	1	Koukouras *et al.* 1998
Cymodoce truncata	0	0	1	Koukouras *et al.* 1998
Cymodoce tuberculata	0	0	1	Koukouras *et al.* 1998
Dexamine spinosa	0	1	0	Pitacco 2016
Eisothistos macrurus	0	1	0	Pitacco 2016
Eualus cranchii	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Eualus occultus	0	0	1	Koukouras *et al.* 1998
Galathea bolivari	0	0	1	Koukouras *et al.* 1998
Galathea intermedia	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Galathea squamifera	0	0	1	Koukouras *et al.* 1998
Gnathia dentata	1	0	0	Present study
Gnathia vorax	0	1	0	Pitacco 2016
Gourretia denticulata	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Heterotanais sp.	0	0	1	Koukouras *et al.* 1998
Jaera sp.	0	0	1	Koukouras *et al.* 1998
Janira maculosa	0	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Lembos websteri	0	0	1	Koukouras *et al.* 1998
Leptocheirus bispinosus	0	0	1	Koukouras *et al.* 1998
Leptocheirus guttatus	0	1	0	Pitacco 2016, present study
Leptocheirus pinguis	1	0	0	Present study
Leptochelia savignyi	0	1	0	Pitacco 2016
Leucothoe euryonyx	0	1	0	Pitacco 2016
Leucothoe richiardii	0	1	0	Pitacco 2016
Leucothoe serraticarpa	0	0	1	Koukouras *et al.* 1998
Leucothoe spinicarpa	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Leucothoe venetiarum	0	0	1	Koukouras *et al.* 1998
Liljeborgia dellavallei	0	1	1	Pitacco *et al.* 2014, Pitacco 2016
Liljeborgia kinahani	0	0	1	Koukouras *et al.* 1998
Lophozozymus incisus	0	0	1	Koukouras *et al.* 1998
Lysianassa costae	0	1	0	Pitacco 2016
Lysianassa pilicornis	0	0	1	Koukouras *et al.* 1998

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia				
Phylum Crustacea				
Lysianassina longicornis	0	1	0	Pitacco 2016
Lysmata seticaudata	0	0	1	Koukouras *et al.* 1998
Maera grossimana	1	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, present study
Metaphoxus simplex	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Microdeutopus anomalus	0	0	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010
Nebalia bipes	1	0	0	Present study
Orchomene humilis	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Pagurus anachoretus	0	1	0	Pitacco 2016
Paradoxapseudes intermedius	0	0	1	Koukouras *et al.* 1998
Paranthura costana	0	0	1	Koukouras *et al.* 1998
Paranthura nigropunctata	1	0	1	Antoniadou and Chintiroglou 2010
Parapseudes latifrons	0	1	0	Pitacco 2016
Periclimenes amethysteus	0	0	1	Koukouras *et al.* 1998
Periclimenes scriptus	0	0	1	Koukouras *et al.* 1998
Perioculodes longimanus	0	0	1	Koukouras *et al.* 1998
Phtisica marina	0	1	0	Pitacco 2016
Pilumnus hirtellus	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Pilumnus spinifer	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Pisidia bluteli	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Pisidia longimana	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Porcellana platycheles	0	0	1	Koukouras *et al.* 1998
Protohyale (Protohyale) grimaldii	0	0	1	Koukouras *et al.* 1998
Quadrimaera inaequipes	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Stenothoe monoculoides	0	1	0	Pitacco 2016
Stenothoe tergestina	0	0	1	Koukouras *et al.* 1998
Synalpheus gambarelloides	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Tanais dulongii	0	0	1	Koukouras *et al.* 1998
Xantho pilipes	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Phylum Echinodermata				
Amphipholis squamata	1	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, present study

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Echinodermata				
Astropecten irregularis	0	0	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Holothuria (Holothuria) tubulosa	0	0	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Ocnus planci	0	0	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Ophioderma longicaudum	0	1	0	Pitacco *et al.* 2014, Pitacco 2016
Ophiothrix fragilis	1	0	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, present study
Paracentrotus lividus	1	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, present study
Psammechinus microtuberculatus	0	0	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Phylum Mollusca				
Acanthochitona fascicularis	1	1	1	Öztürk *et al.* 2000, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, present study
Alvania cimex	0	1	0	Pitacco 2016
Alvania geryonia	0	1	0	Pitacco 2016
Alvania mamillata	0	0	1	Koukouras *et al.* 1998
Anomia ephippium	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Aplus dorbignyi	0	1	0	Pitacco 2016
Aplus scacchianus	0	0	1	Koukouras *et al.* 1998
Arca noae	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Asperarca nodulosa	0	0	1	Koukouras *et al.* 1998
Barbatia barbata	0	1	0	Pitacco 2016
Barleeia unifasciata	0	0	1	Koukouras *et al.* 1998
Bittium latreillii	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco 2016, present study
Bittium nanum	0	1	0	Pitacco 2016
Bittium reticulatum	0	1	1	Koukouras *et al.* 1998, Pitacco *et al.* 2014, Pitacco 2016
Brachidontes pharaonis	0	1	0	Pitacco 2016
Caecum trachea	0	0	1	Antoniadou and Chintiroglou 2010
Calliostoma zizyphinum	0	0	1	Pitacco *et al.* 2014
Cardita calyculata	0	0	1	Koukouras *et al.* 1998
Cerithiopsis tubercularis	1	1	1	Pitacco *et al.* 2014, Pitacco 2016

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Mollusca				
Cerithium vulgatum	0	1	0	Pitacco 2016
Chama gryphoides	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, present study
Chiton magnificus	0	0	1	Koukouras *et al.* 1998
Clanculus corallinus	0	0	1	Koukouras *et al.* 1998
Clanculus cruciatus	1	1	1	Koukouras *et al.* 1998, Pitacco 2016, present study
Conus ventricosus	0	0	1	Koukouras *et al.* 1998
Coralliohila meyendorffii	0	0	1	Koukouras *et al.* 1998
Coralliophaga lithophagella	0	1	0	Pitacco 2016
Ctena decussata	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Cyrillia linearis	0	0	1	Koukouras *et al.* 1998
Diodora cf. italica	0	0	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Diodora gibberula	0	1	0	Pitacco 2016
Diodora graeca	0	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Diplodonta rotundata	0	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Elysia viridis	1	0	0	Present study
Emarginula adriatica	0	0	1	Koukouras *et al.* 1998
Emarginula huzardii	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Emarginula sicula	0	0	1	Koukouras *et al.* 1998
Enginella leucozona	1	0	1	Koukouras *et al.* 1998
Felimare villafranca	0	0	1	Koukouras *et al.* 1998
Fissurella nubecula	0	0	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Galeomma turtoni	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Gastrochaena dubia	1	0	0	Present study
Gibbula magus	1	0	1	Pitacco *et al.* 2014, present study
Gouldia minima	0	1	0	Pitacco 2016
Haedropleura septangularis	0	0	1	Koukouras *et al.* 1998
Hexaplex trunculus	0	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Hiatella artica	1	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, Antoniadou and Chintiroglou 2010
Hiatella rugosa	0	1	1	Koukouras *et al.* 1998, Pitacco 2016

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Mollusca				
Irus irus	0	1	0	Pitacco 2016
Kellia suborbicularis	0	1	0	Pitacco 2016
Kurtiella bidentata	0	1	0	Pitacco 2016
Lepidopleurus cajetanus	0	1	1	Koukouras *et al.* 1998, Öztürk *et al.* 2000, Pitacco 2016
Leufroyia concinna	0	0	1	Koukouras *et al.* 1998
Lima lima	0	0	1	Koukouras *et al.* 1998
Limaria hians	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco 2016
Limaria loscombi	0	0	1	Koukouras *et al.* 1998
Limaria tuberculata	0	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Lithophaga lithophaga	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Mangelia stosiciana	0	1	0	Pitacco 2016
Manzonia crassa	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Marshallora adversa	0	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Mimachlamys varia	1	1	1	Koukouras *et al.* 1998, Pitacco *et al.* 2014, Pitacco 2016, present study
Modiolula phaseolina	0	1	0	Pitacco 2016
Modiolus adriaticus	0	0	1	Antoniadou and Chintiroglou 2010
Modiolus barbatus	1	1	1	Pitacco *et al.* 2014, Pitacco 2016, present study
Monophorus perversus	0	0	1	Koukouras *et al.* 1998
Monophorus thiriotae	0	1	0	Pitacco 2016
Murexsul aradasii	0	0	1	Koukouras *et al.* 1998
Muricopsis cristata	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Musculus costulatus	1	0	0	Present study
Musculus subpictus	1	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Nucula nucleus	0	0	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Ocenebra edwardsii	0	1	0	Pitacco 2016
Ostrea edulis	0	0	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Paradoris indecora	0	0	1	Koukouras *et al.* 1998
Petricola lithophaga	0	1	0	Pitacco 2016
Philbertia cordieri	0	0	1	Koukouras *et al.* 1998
Phorcus turbinatus	0	0	1	Koukouras *et al.* 1998
Platydoris argo	0	0	1	Koukouras *et al.* 1998

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Mollusca				
Pleurobranchus membranaceus	0	0	1	Koukouras *et al.* 1998
Pseudochama gryphina	0	1	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Puncturella noachina	1	0	1	Koukouras *et al.* 1998, present study
Pusia tricolor	0	0	1	Koukouras *et al.* 1998
Pusillina munda	0	0	1	Koukouras *et al.* 1998
Raphitoma alternans	0	0	1	Koukouras *et al.* 1998
Raphitoma laviae	0	0	1	Koukouras *et al.* 1998
Rhyssoplax olivacea	0	1	0	Pitacco 2016
Rissoina bruguieri	0	1	1	Koukouras *et al.* 1998, Pitacco 2016
Rocellaria dubia	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016
Sphenia cf. binghami	1	0	0	Present study
Striarca lactea	0	1	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014, Pitacco 2016, present study
Talochlamys multistriata	0	1	1	Koukouras *et al.* 1998, Pitacco *et al.* 2014, Pitacco 2016
Tritia incrassatus	0	0	1	Koukouras *et al.* 1998
Tylodina perversa	0	0	1	Koukouras *et al.* 1998
Vermetus triquetrus	0	0	1	Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Phylum Nemertea				
Nemertea sp.1	1	0	0	Present study
Nemertea sp.2	1	0	0	Present study
Nemertea sp.3	1	0	0	Present study
Nemertea sp.4	0	0	1	Koukouras *et al.* 1998
Nemertea sp.5	0	0	1	Koukouras *et al.* 1998
Nemertea sp.6	0	0	1	Koukouras *et al.* 1998
Nemertea sp.7	0	0	1	Koukouras *et al.* 1998
Phylum Platyhelminthes				
Turbellaria sp.1	0	0	1	Koukouras *et al.* 1998
Turbellaria sp.2	0	0	1	Koukouras *et al.* 1998
Phylum Porifera				
Agelas oroides	0	0	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010
Aplysina aerophoba	0	1	0	Pitacco 2016
Chondrilla nucula	0	1	1	Koukouras *et al.* 1998, Pitacco 2016

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia				
Phylum Porifera				
Chondrosia reniformis	0	0	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Cotricium candelabrum	0	0	1	Koukouras *et al.* 1998
Dercitus (Stoeba) plicatus	0	0	1	Koukouras *et al.* 1998
Diplastrella bistellata	0	0	1	Antoniadou and Chintiroglou 2010
Dysidea fragilis	0	0	1	Koukouras *et al.* 1998
Geodia conchilega	0	0	1	Koukouras *et al.* 1998
Geodia cydonium	0	0	1	Pitacco *et al.* 2014
Haliclona (Reniera) mediterranea	0	0	1	Pitacco *et al.* 2014
Halocynthia papillosa	0	0	1	Antoniadou and Chintiroglou 2010
Hippospongia communis	0	0	1	Pitacco *et al.* 2014
Ircinia variabilis	0	0	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010, Pitacco *et al.* 2014
Mycale (Mycale) massa	0	0	1	Koukouras *et al.* 1998
Petrosia (Petrosia) ficiformis	0	0	1	Antoniadou and Chintiroglou 2010
Plakortis simplex	0	0	1	Koukouras *et al.* 1998
Pseudosuberites sulphureus	0	0	1	Koukouras *et al.* 1998
Sarcotragus fasciculatus	0	0	1	Pitacco *et al.* 2014
Scalarispongia scalaris	0	0	1	Koukouras *et al.* 1998
Spirastrella cunctatrix	0	0	1	Koukouras *et al.* 1998
Spongia (Spongia) officinalis	0	0	1	Koukouras *et al.* 1998
Spongia virgultosa	0	0	1	Koukouras *et al.* 1998
Stryphnus mucronatus	0	0	1	Koukouras *et al.* 1998
Tethya aurantium	0	0	1	Pitacco *et al.* 2014
Phylum Pycnogonida				
Callipallene spectrum	0	0	0	Krapp 2008
Pycnogonida sp.1	1	0	0	Present study
Pycnogonida sp.2	1	0	0	Present study
Phylum Sipuncula				
Apionsoma sp.	1	0	0	Present study
Aspidosiphon (Aspidosiphon) elegans	1	0	0	Açik 2011
Aspidosiphon (Aspidosiphon) sp.	1	0	0	Present study
Aspidosiphon (Aspidosiphon) muelleri muelleri	0	0	1	Koukouras *et al.* 1998, Açik 2008

Annex 2. Continued

Species	Solitary colonies	Beds	Banks	Citations
Kindgom Animalia Phylum Sipuncula				
Golfingia (Golfingia) vulgaris vulgaris	0	0	1	Koukouras *et al.* 1998, Açik 2008
Phascolion sp.	1	0	0	Present study
Phascolosoma (Phascolosoma) agassizii	N/A	N/A	N/A	Açik 2008
Phascolosoma (Phascolosoma) granulatum	0	0	1	Koukouras *et al.* 1998, Antoniadou and Chintiroglou 2010
Phascolosoma stephensoni	1	0	0	Present study
Phylum Tunicata				
Microcosmus sp.	0	0	1	Pitacco *et al.* 2014
Tunicata sp.	0	0	1	Pitacco *et al.* 2014
Kingdom Plantae Phylum Chlorophyta				
Halimeda tuna	1	0	1	Koukouras *et al.* 1998, present study
Phylum Ochrophyta				
Halopteris scoparia	0	0	1	Koukouras *et al.* 1998
Padina pavonica	1	0	1	Koukouras *et al.* 1998, present study
Phylum Rhodophyta				
Botryocladia botryoides	1	0	1	Koukouras *et al.* 1998, present study
Gelidium latifolium	0	0	1	Koukouras *et al.* 1998
Herposiphonia tenella	0	0	1	Koukouras *et al.* 1998, present study
Jania rubens	0	0	1	Koukouras *et al.* 1998, present study
Lithophyllum incrustans	1	0	1	Koukouras *et al.* 1998, present study
Phymatolithon calcareum	0	0	1	Koukouras *et al.* 1998