Ecological patterns of polychaete assemblages associated with the Mediterranean stony coral *Cladocora caespitosa* (Linnaeus, 1767): a comparison of sites in two biogeographic zones (Adriatic and Aegean Sea)

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Contributing Editor: Joachim LANGENECK

Received: 12 February 2021; Accepted: 12 July 2021; Published online: 10 September 2021

Abstract

The Mediterranean stony coral *Cladocora caespitosa* (Linnaeus, 1767) is a well-known habitat builder, and as such hosts a diversified faunal assemblage. Although polychaetes are one of the most abundant and diverse macrobenthic groups associated with *C. caespitosa* colonies, our knowledge of their ecological features in this association is still limited. The aim of this paper was to gather and compare the most comprehensive data available on polychaetes associated with *C. caespitosa* in the Adriatic and the Aegean Seas, and to test for differences between these geographic areas. To this end, differences were tested in terms of: (i) richness and structure of polychaete assemblages; (ii) feeding and functional traits of assemblages; (iii) the main factors influencing those aspects, (iv) the relationship between polychaete assemblages richness and *Cladocora* colony size, estimated richness. Differences were observed between the Adriatic and the Aegean assemblages, in terms of richness, species composition and relative proportion of the dominant feeding guild (filter feeders most abundant in the Aegean and carnivores in the Adriatic) and motility mode (sessile most abundant in the Aegean and motile in the Adriatic). Conversely, cosmopolitan and Atlanto-Mediterranean species dominated the assemblages in both geographic areas, and the same Species-Area Relation model proved to be effective for richness estimation in both geographic areas.

Keywords: Benthic ecology; Habitat builder species; Polychaeta; Mediterranean Sea.

Introduction

The Mediterranean stony coral *Cladocora caespitosa* (Linnaeus, 1767) is the only native colonial and obligate zooxanthellate coral in the Mediterranean Sea (Zibrowius, 1980); it is present throughout the basin but is only locally abundant (Peirano et al., 1998). It lives in different environments, from shallow photophilic algal communities to deeper circalittoral zones (e.g., Chefaoui et al., 2017; Kersting et al., 2017). The species is particularly sensitive to different types of environmental changes, either anthropogenic or natural (Rodolfo-Metalpa et al., 2005; Kruzić et al., 2012; Kersting et al., 2015) and is vulnerable to catastrophic events due to slow growth dynamics (Kersting et al., 2014). Population declines have been recorded in many areas of the Mediterranean Sea (Kersting et al., 2013; Kruzić et al., 2014). Consequently, the species has been classified as “Endangered” in the IUCN Red List (Casado de Amezua et al., 2015). This species is a well-known habitat builder; it is physiologically and morphologically similar to the typical tropical reef-building corals, and as such hosts a diverse faunal assemblage (Zibrowius, 1980; Peirano et al., 1998). Given the endangered state of the host, a method to estimate species richness for associated macrofauna in a non-destructive way was recently proposed (Pitacco et al., 2017; Pitacco et al., 2019). This method consists in the application of a Species-Area Relationship (SAR) model, based on the Arrhenius equation (Arrhenius, 1921), which describes one of the most fundamental ecological relationships, i.e., a positive correlation between the size of an area and the number of species encountered in it. This method has been widely used for biodiversity estimates, in particular in large-scale terrestrial environments (Neigel, 2003). However, estimating the richness of coral associated macrofauna based on the colony size is also efficient (Pitacco et al., 2017, 2019). Nevertheless, available literature about macrobenthic fauna associated with *C. caespitosa* is still fragmented, and often limited to a single taxonomic group (e.g., echinoderms,
Zavodnik, 1976; polychaetes, Arvanitidis & Koukouras, 1994), and few areas of the Mediterranean, i.e., the Adriatic (e.g., Sciscioi & Nuzzaci, 1970; Pitacco et al., 2014, 2019), the Ionian (Lumare, 1965) and the Aegean Seas (Koukouras et al., 1998). Very few works have analyzed the entire macrobenthic associated community to species level: one in the Ionian Sea (Lumare, 1965), two in the Adriatic Sea (Pitacco et al., 2014, 2019) and two in the Aegean Sea (Koukouras et al., 1998; Antoniadou & Chintiroglou, 2010). Those works note that polychaetes are one of the most abundant and diverse macrobenthic groups associated with C. caespitosa colonies. Moreover, polychaetes also represent one of the most important taxonomic groups associated with C. caespitosa in terms of biomass (Schiller, 1993). Due to this high abundance and diversity and to the well-known functional diversity of polychaetes in general, this group likely plays important ecological roles in C. caespitosa colonies. Nonetheless, there are very few studies concentrated on the polychaete fauna of Mediterranean stony coral (Sciscioi & Nuzzaci, 1970; Arvanitidis & Koukouras, 1994; Chintiroglou, 1996). Thus, the aim of this paper is to increase our knowledge of polychaete assemblages associated with C. caespitosa in the Mediterranean from the following aspects: (i) structure of polychaete assemblages; (ii) feeding and functional traits of assemblages; (iii) main factors influencing those aspects; and (iv) relationship between polychaete assemblages and colony size, and SAR model application.

### Materials and Methods

#### Study areas and sampling methods

Due to the aforementioned lack of available literature, the only comparable studies in terms of methodology and taxonomic resolution were restricted to the Adriatic and the Aegean Seas. Data on polychaete fauna associated with C. caespitosa from the Northern Adriatic Sea were obtained from Pitacco et al. (2019), whereas data from the Aegean Sea were retrieved from the following papers: Arvanitidis & Koukouras (1994), Chintiroglou (1996), and Koukouras et al. (1998) (Table 1). The datasets were merged and the species list was updated according to the current nomenclature of the World Register of Marine Species (WoRMS Editorial Board, 2019). After the merger, methodological differences that could bias the comparison were considered. In the Adriatic Sea, the exact abundance of species of the subfamily Spirorbinae was not calculated; therefore, this group was not included in the quantitative comparisons. Moreover, data from Pitacco et al. (2014) were considered only for qualitative analyses (species composition and frequency), since colony size was not comparable.

Data from seven different sampling sites were analyzed (Fig. 1), five from the Gulf of Trieste (Northern Adriatic Sea) and two from a site off the Chalkidiki peninsula (Northern Aegean Sea), with five colonies sampled at each site in the Gulf of Trieste, and seven along the Chalkidiki peninsula.

### Table 1. Codes, geographic coordinates, depths, water temperature (T), total volume of colonies (V<sub>tot</sub>) and sampling dates of sampling sites and referent publication.

| Region     | Site       | Code | Latitude (N) Longitude (E) | Depth (m) | T (°C) | V<sub>tot</sub> (cm³) | Sampling date | Reference |
|------------|------------|------|---------------------------|-----------|--------|------------------------|--------------|-----------|
| Adriatic Sea | Debeli Rtič | DR   | 45°35'28'' 13°42'88''     | 5-6       | 22 - 23 | 100 - 940              | 19.9.2012    | Pitacco et al. (2019) |
|            | Cape Ronek | RR   | 45°32'25'' 13°36'56''     | 6-9       | 21 - 25 | 85 - 680               | 9.7.2012     | Pitacco et al. (2019) |
|            | Strunjanček | ST   | 45°32'5'' 13°36'10''      | 4-6       | 24 - 26 | 150 - 535              | 22.8.2012    | Pitacco et al. (2019) |
|            | Pacug      | PA   | 45°31'34'' 13°35'24''     | 5-7       | 23 - 23 | 110 - 820              | 10.9.2012    | Pitacco et al. (2019) |
|            | Piranček   | PR   | 45°31'38'' 13°34'30''     | 7-9       | 21 - 25 | 140 - 1715             | 24.7.2012    | Pitacco et al. (2019) |
|            | Ronek bank | GR   | 45°32'34'' 13° 37'01''    |           |        |                        | 5.11.2010    | Pitacco et al. (2014) |
| Aegean Sea  | Pirgadikia | Pir  | 40°20'01'' 23°43'2''      | 3-5       | 26 - 27 | 460 - 4670             | 19.7.1987    | Arvanitidis & Koukouras (1994), Chintiroglou (1996), Koukouras et al. (1998) |
|            | Vourvourou | Vou  | 40°13'29'' 23°46'09''     | 15-19     | 24 - 26 | 465 -1970             | 23.7.1987    | Arvanitidis & Koukouras (1994), Chintiroglou (1996), Koukouras et al. (1998) |
Sampling was performed by SCUBA diving, in the Gulf of Trieste in 2012, at 4-9 m depth, and off the Chalkidiki peninsula in 1987 at 3-5 and 15-19 m depth (Table 1). The sampling and processing methods are described in Pitacco et al. (2019) and Koukouras et al. (1998). In both cases, research focused on the entire invertebrate community, with both sessile and motile species associated with coral. The additional site (Ronek bank, Fig. 1) in the Adriatic Sea, considered for qualitative analyses only, was close to Cape Ronek, but at greater depths, between 12 and 21 m depth (Pitacco et al., 2014).

**Environmental variables and Cladocora colonies biometry**

Sampling depth, water temperature, number of sampled colonies (n), and total volume of colonies (V$_{tot}$) were recorded for all sampling sites. Colony microhabitat variables, i.e., percentage of living polyps (LP), interstitial volume (V$_{int}$), percentage of algal cover (alg), sponge cover (spg), and percentage of sediments trapped inside the colony with respect to V$_{int}$ (sed), were available only for the Adriatic sites.

**Classification in functional and biogeographic groups**

Each polychaete species was assigned to one of the following 12 categories derived from a combination of motility pattern, feeding mode and the morphology of feeding structure, following Fauchald & Jumars (1979) and Jumars et al. (2015): HMJ = herbivore motile jawed, BMX = burrowing motile non-jawed, BSX = burrowing sessile non-jawed, CMJ = carnivore motile jawed, CMX = carnivore motile non-jawed, CDJ = carnivore discretely motile jawed, FST = filter-feeders sessile tentaculate, FSP = filter-feeders sessile pumping, SMJ = surface deposit feeders motile jawed, SMT = surface deposit feeders motile tentaculate, SDT = surface deposit feeding discretely motile tentaculate, SST = surface deposit feeding sessile tentaculate. Overall 5 different feeding guilds: subsurface deposit feeders/burrowing (B), carnivores (C), herbivores (H), filter feeders (F), surface deposit feeders (DF), and 3 motility patterns: motile (M), discreetly motile (D) and sessile (SE) were found.

A biogeographic analysis was performed in order to estimate whether geographic distance could explain the differences in species composition. The species were assigned to the following biogeographic categories, according to the relevant literature (Bianchi, 1981; Barnich & Fiege, 2003; Musco & Giangrande, 2005; Bakalem et al., 2020): aa = amphi-Atlantic, am = Atlantic-Mediterranean, amip = African Atlanto- Mediterranean and Indo-Pacific, amr = Atlantic-Mediterranean and Red Sea, amp = Atlant-
to-Mediterranean and Pacific, amrip = Atlanto-Mediterranean, Red Sea and Indo-Pacific, c = cosmopolitan, d = disjunct distribution, iam = Indo-Atlantic-Mediterranean, m = endemic Mediterranean, imrip = Mediterranean, Red Sea and Indo-Pacific.

Taxa assigned to two or more groups, or that could not be assigned to a group, were marked as NA (Not Assigned) in the subsequent analyses.

Data analysis

In order to enable comparisons between the two geographic areas, the sampling depths were classified into arbitrary ranges: 3-6 m, 6-8 m and 15-19 m.

Frequency of occurrence (%F) was calculated for each species. The identities of the most frequent species (>50% of frequency) were compared, between the Adriatic and the Aegean Seas, and between different sampling depths.

Species richness (S), abundance (N), the Shannon & Wiener diversity index (H'), and the Pieltou index of equitability (J) (Clarke & Warwick, 2001) were calculated for each colony. In this paper, we chose to use total volume (V\text{tot}) as the Cladocora colony size descriptor, being the only possible one to compare data reported from the Adriatic and the Aegean Seas. Feeding richness (Sf) was calculated as the number of feeding groups per colony, and feeding diversity (Hf) was calculated with the Shannon diversity index, using feeding richness instead of taxa richness.

To test whether the biometric characteristic of the colonies and the diversity descriptors analyzed (S, N, H', J', Sf, Hf) varied among the two geographic areas, depth ranges, and colony size classes, the Chi square test applied to the Kruskal-Wallis test (KW) by ranks and the pairwise post-hoc Wilcoxon test (W) were performed. The non-parametric Spearman Rank-order coefficient (r) (Spearman, 1907) was used to check for collinearity between depth and colony size.

PERMANOVA and PERMDISP analyses were performed to test the significance of the differences in structure of polychaete assemblages between geographic areas (2 factors, fixed: Adriatic and Aegean Seas), depth range (three factors, random: 3-6 m, 6-8 m, 15-19 m), and colony size classes (two factors, fixed: small: <1 dm³, big: >1 dm³). The threshold between small and big colonies was chosen on the basis of the cumulative curve for polychaete richness with increasing sampling volume, which reached the asymptote for a sampling volume of 1 dm³. The same statistical analyses were performed using the abundances of each feeding, functional and biogeographical group. The analyses were based on the Bray-Curtis similarity of square root transformed data, and on the Jaccard similarity index, with presence-absence data to test the variability of beta diversity. To calculate the p values for PERMANOVA and PERMDISP, we used 9999 permutations. Non-metric MDS graphs were created based on Bray-Curtis similarity of square root transformed data. Groups obtained from clusters built using the group average method were included in the MDS graphs. The species best explaining the dissimilarity among the obtained cluster groups were identified through SIMPER analysis.

Distance-based linear models (DISTLM) were used to test whether the variations in polychaete communities are explained by abiotic data. DISTLM does a partitioning of variation in a data cloud described by a resemblance matrix, according to a multiple regression model (Legendre & Anderson, 1999). Depth and colony volume were used as predictor variables, and the resemblance of species/abundance, functional traits and biogeography matrices were used as response variables.

Since a positive relationship between colony size and richness of polychaete assemblages has already been reported for both the Adriatic (Pitacco et al., 2019) and the Aegean Sea (Arvanitidis & Koukouras, 1994), in this work the two datasets were combined. Regression analysis was performed using log-transformed variables (polychaete richness $S_{\text{tot}}$ and colony size $V_{\text{tot}}$), after checking against strong deviations from the assumptions of normality with the Shapiro test (Shapiro & Wilk, 1965). The 95% confidence interval and prediction intervals were calculated and plotted for the entire dataset. The relationship between diversity indices, richness and abundance of the main feeding/functional groups and colony size were tested with the non-parametric Spearman Rank-order coefficient (r) (Spearman, 1907).

A p-value < 0.05 was chosen as a significance threshold. Calculations were performed with the PRIMER v6 + PERMANOVA software package (Clarke & Gorley, 2006; Anderson et al., 2008), and vegan package (Oksanen et al., 2008) for R software package v3.6.1 (R Development Core Team, 2008).

Results

Environmental and biometric data

The main abiotic and biotic characteristics of sampling sites are presented in Table 1. Colony size ($V_{\text{tot}}$) did not show significant differences between samples from the Adriatic and the Aegean Seas (KW chi-squared = 0.415, p > 0.05), or between depth ranges (KW chi-squared = 0.261, p > 0.05) or sampling sites (KW chi-squared = 3.390, p > 0.05). Colony size ($V_{\text{tot}}$) was not significantly correlated with depth in neither the Adriatic ($r_s = -0.015$, $p = 0.943$) nor the Aegean ($r_s = -0.053$, $p = 0.856$).

Polychaete assemblage composition and structure

In the Northern Adriatic Sea, 110 polychaete taxa from 22 families were reported, with 90 determined to species level. 99 taxa (82 species) were recorded from shallow Cladocora beds (4 - 9 m), while 43 taxa (27 species) from the deeper biogenic bank (12 - 21 m). In the Aegean Sea, 87 taxa from 27 families, with 75 taxa determined to species level were recorded. Altogether, 124 species of polychaetes from 30 families were reported from both areas.
with 40 species co-occurring in colonies from both the Adriatic and Aegean Sea sampling sites (Supplementary Material, Table S1). The most diverse families in both areas were: Syllidae (overall 32 species; 11 Aegean, 28 Adriatic), Serpulidae (16 species; 10 Aegean, 10 Adriatic), Polynoidae (10 species; 5 Aegean, 9 Adriatic), Eunicidae (10 species; 7 Aegean, 6 Adriatic) and Terebellidae (9 species; 7 Aegean, 9 Adriatic) (Fig. 2). At the Aegean sites, the most abundant family was Serpulidae (42% of the total abundance), followed by Syllidae (11%) and Sabellidae (8%), while at the Adriatic sites the most abundant families were Eunicidae and Syllidae, each representing 18% of total abundance, followed by Serpulidae (16%) and Nereididae (12%) (Fig. 2).

Species frequency differed between sites in both geographic areas (Table 2). Some species such as Vermiliopsis infundibulum (Philippi, 1844) and Pseudopotamilla reniformis (Bruguière, 1789) were frequent only at the Aegean sites while other species, such as Spirobranchus triqueterr (Linnaeus, 1758), Serpula concharum Langerhans, 1880, and Harmothoe areolata (Grube, 1860) were frequent only at the Adriatic sites. Conversely, some species were frequent in both areas; for instance, Hydroides pseudouncinata pseudouncinata Zibrowius, 1968, Vermiliopsis striaticeps (Grube, 1862), Serpula vermicularis Linnaeus, 1767, Ceratonereis costae (Grube, 1840), Harmothoe spinifera (Ehlers, 1864), Notomastus latericeus Sars, 1851 and Haplosyllis spongicola (Grube, 1855) (Table 2). The composition of the most frequent species also differed between sampling depths within the sampling areas (Table 2), but the pattern was not consistent in both geographic areas.

Significant differences in polychaete assemblage richness (S), abundance (N), and diversity (Shannon index, H’) were observed between the sites from different geographic areas (Fig. 3, Supplementary Material, Table S8). On average, richness of polychaete taxa (S) was higher at the Adriatic Sea sites (37 ± 9 SD) compared to the Aegean Sea sites (28 ± 7 SD), and the same pattern was observed for abundance (Adriatic: 227 ± 168 SD; Aegean: 135.5 ± 67.5) and Shannon diversity index (Adriatic: 2.9 ± 0.3 SD, Aegean: 2.7 ± 0.2 SD). In the Adriatic, richness (45 ± 7 SD), abundance (320 ± 132 SD) and diversity (3.16 ± 0.16 SD) were significantly higher in bigger than 1 dm³ colonies than in smaller colonies (less than 1 dm³) (S = 29 ± 7 SD, N = 142 ± 86 SD, H’ = 2.80 ± 0.30 SD), whereas in the Aegean the figures did not vary significantly with colony size (Fig. 3, Supplementary Material, Table S8). Colonies bigger than 1 dm³ at the Adriatic sites displayed significantly higher richness, abundance, and diversity than colonies bigger than 1 dm³ in the Aegean (S = 27 ± 8 SD, N = 124 ± 49 SD, H’ = 2.76 ± 0.29 SD), whereas richness, abundance and diversity associated with small colonies did not vary between the two geographic areas (Fig. 3, Supplementary Material, Table S8). Richness, abundance, and diversity did not differ significantly between sampling depths, for both the Adriatic and the Aegean Sea (Fig. 3, Supplementary Material, Table S8), but the shallower samples from the Adriatic (3-6 m) showed significantly higher diversity (3.03 ± 0.33) than the samples from the Aegean at the same depth (2.77 ± 0.16).

**Fig. 2:** Cumulative species richness (S) and abundance (N) of polychaetes for the dominant polychaete families in the Adriatic (right) and the Aegean Sea (left).
Table 2. Frequency of the most frequent species (>50% of frequency) found in the two areas analyzed, at the different sampling depths. n = number of samples.

| Geographic area          | Adriatic sea | Aegean Sea |  |  |
|--------------------------|--------------|------------|---|---|
| **Depth range**          | 4 - 9 m      | 12 - 21 m  | 3 - 5 m | 15 - 19 m |
| **n**                    | 25           | 3          | 7   | 7   |
| **Reference**            | Pitacco et al., 2019 | Pitacco et al., 2014 | Arvanitidis & Koukouras 1994; Chintiroglou, 1996 | Arvanitidis & Koukouras 1994; Chintiroglou, 1996 |
| **Most frequent species**|              |            |      |      |
| Ceratonereis costae      | 84%          | 100%       | 86% |
| (Grube, 1840)            |              |            |      |      |
| Cirriformia tentaculata  | 72%          | 67%        | 71% |
| (Montagu, 1808)          |              |            |      |      |
| Dodecaceria concharum    | 92%          | 100%       | 86% |
| Örsted, 1843             |              |            |      |      |
| Eunice vittata           | 96%          | 100%       | 86% |
| (Delle Chiaje, 1828)     |              |            |      |      |
| Haplosyllis spongicola   | 64%          | 100%       | 71% |
| (Grube, 1855)            |              |            |      |      |
| Harmothoe areolata       | 56%          | 100%       | 86% |
| (Grube, 1860)            |              |            |      |      |
| Harmothoe extenuata      | 84%          | 67%        | 100%|
| (Grube, 1840)            |              |            |      |      |
| Harmothoe spinifera      |              | 67%        | 100%|
| (Ehlers, 1864)           |              |            | 86% |
| Hydrodus pseudouncinata  | 56%          | 67%        | 100%|
| pseudouncinata           |              |            | 86% |
| Zibrowius, 1968          |              |            |      |      |
| Leodice torquata         | 92%          | 100%       | 86% |
| (Quatrefages, 1866)      |              |            |      |      |
| Lepidonotus clava        |              |            | 86% |
| (Montagu, 1808)          |              |            |      |      |
| Lumbrineris coccinea     | 68%          | 100%       | 86% |
| (Renier, 1804)           |              |            |      |      |
| Lumbrineris laterilli    | 60%          | 100%       | 86% |
| Audouin & Milne Edwards, 1833 |        |            |      |      |
| Lysidice ninetta         | 96%          | 100%       | 86% |
| Audouin & H Milne Edwards, 1833 |      |            |      |      |
| Lysidice unicornis       | 88%          | 67%        | 71% |
| (Grube, 1840)            |              |            |      |      |
| Nereis rava Ehlers, 1868 | 80%          | 100%       | 71% |
| Notomastus latericeus    | 88%          | 67%        | 71% |
| Sars, 1851               |              |            |      |      |
| Palola siciliensis       | 68%          | 100%       | 86% |
| (Grube, 1840)            |              |            |      |      |
| Polycirrus aurantius     |              |            | 86% |
| Grube, 1860              |              |            |      |      |
| Psamathie fusca Johnston | 100%         |            |      |      |
| Johnston, 1836           |              |            |      |      |
| Pseudopotamilla reniformis | 57%         | 71%        |      |
| (Bruguère, 1789)         |              |            |      |      |
| Scoletoma impatiens      | 60%          | 67%        | 86% |
| (Claparède, 1868)        |              |            |      |      |
| Serpula concharum        | 84%          | 100%       | 86% |
| Langerhans, 1880         |              |            |      |      |
| Serpula vermicularis     | 67%          | 71%        | 86% |
| Linnaeus, 1767           |              |            |      |      |
| Spirobranchus polytrema  | 100%         |            |      |      |
| (Philippi, 1844)         |              |            |      |      |
| Spirobranchus triqueter  | 84%          | 100%       | 86% |
| (Linnaeus, 1758)         |              |            |      |      |
| Syllis alternata Moore   | 56%          |            |      |      |
| 1908                     |              |            |      |      |
| Syllis ferrani Alós & San Martin, 1987 | 72% | 100% |
| Syllis gerlachi (Hartmann-Schröder, 1960) | 72% | 100% |
| Syllis hyalina Grube, 1863 |              | 86%        |      |      |
| Syllis spp.              | 100%         |            |      |      |
| Syllis variegata Grube, 1860 | 96% |      |      |
| Trypanosyllis zebra (Grube, 1860) | 68% |      |      |
| Vermiliopsis infundibulum (Philippi, 1844) | 100% | 100% | 100% |
| Vermiliopsis striaticeps (Grube, 1862) | 84% | 100% | 100% | 100% |
**Fig. 3:** Boxplot showing variability in the average values of diversity descriptors of polychaete assemblages between geographic areas (left), depth ranges (central) and colony sizes (right). $S =$ polychaete richness, $N =$ polychaete abundance, $J =$ Pielou equitability index, $H' =$ Shannon diversity index.

**Fig. 4:** Non-metric MDS ordination plot comparing the structure of polychaete assemblages for samples from the Adriatic and the Aegean Sea, based on (A) species abundances data, (B) abundances of feeding guilds, and (C) abundance of biogeographic groups. Groupings derived from cluster analyses are shown (grey line). For the Aegean Sea $n=7$, for the Adriatic Sea $n=5$. 
Equitability (Pielou index, J) did not vary significantly with depth, colony size or geographic area (Fig. 3, Supplementary Material, Table S8).

Cluster analysis (Fig. 4A) did not reveal a clear difference in the structure of polychaete assemblages associated with C. caespitosa between the Adriatic and Aegean sites and this was confirmed by the PERMANOVA results (Table 3). No difference in data dispersion between the two areas was observed (PERMDISP, Table 3). To test the effect of depth and colony size on polychaete assemblage structure, the two areas were considered separately. In the Aegean Sea there was a significant difference in polychaete assemblage structure between depth ranges (PERMANOVA, Table 3), but not between the two size classes (PERMANOVA, Table 3). In both cases, no difference in dispersion was observed (PERMDISP, Table 3). Conversely, in the Northern Adriatic Sea, significant differences were observed between colony size classes, but not between depths (PERMANOVA, Table 3). Data dispersion also differed between size classes (PERMDISP, Table 3), with higher dispersion in small colonies (35.2 ± 1.6 SE) compared to bigger ones (27.4 ± 0.6 SE), indicating that the observed significant differences in polychaete abundance between Cladocora colony size classes, could be biased by the differences in the dispersion of the samples. The MDS graph (Supplementary Material, Fig. S1) confirmed differences in terms of both position and dispersion between size classes. The same patterns were observed for presence-absence data (PERMANOVA and PERMDISP based on the Jaccard similarity index, Table 3). In the Adriatic Sea, presence-absence data and data dispersion differed only among size ranges (Table 3), with the highest dispersion observed in colonies smaller than 1 dm³ (35.2 ± 1.6 SE) rather than in bigger colonies (27.4 ± 0.7 SE). Again, significant PERMDISP analyses indicate that the observed differences

Table 3. PERMANOVA and PERMDISP testing results for differences in structure of polychaete assemblages based on abundance (Bray-Curtis similarity) and presence-absence data (Jaccard similarity). df = degrees of freedom; SS = sums of squares; MS = mean squares; Pseudo-F = pseudo-F ratio; res = residuals; F = F-ratio; P = permutational probability. Significant P-values (p < 0.05) are in bold.

| Source                | Bray-Curtis similarity | Jaccard similarity |
|-----------------------|------------------------|--------------------|
|                       | Permanova              | Permanova          |
|                       | df  | SS      | MS      | P     | df  | SS    | MS     | P     |
| **Total data**        |     |         |         |       |     |        |        |       |
| Area                  | 1   | 25930   | 25930   | 19    | 0.0001 | 1   | 25730  | 25730  | 13.6  | 0.0001 |
| Res                   | 37  | 51632   | 1395.5  | 37    |        | 70153 | 1896   |        |       |
| Total                 | 38  | 77561   | 38      | 95883 |        |       |        |       |
| **Aegean data**       |     |         |         |       |       |       |        |       |
| Size classes          | 1   | 1359.7  | 1359.7  | 0.98  | 0.485 | 1   | 1747   | 1746.7 | 0.9   | 0.619 |
| Depth ranges          | 1   | 3096.1  | 3096.1  | 22    | 0.0256 | 1   | 3224   | 3223.8 | 16    | 0.067 |
| Depth x Size          | 1   | 1956.8  | 1956.8  | 1     | 0.1555 | 1   | 1917   | 1916.7 | 1     | 0.513 |
| Res                   | 10  | 13917   | 1391.7  | 10    |        | 19689 | 1968.9 |        |       |
| Total                 | 13  | 19871   | 13      | 26600 |        |       |        |       |
| **Adriatic data**     |     |         |         |       |       |       |        |       |
| Size classes          | 1   | 6258.5  | 6258.5  | 58    | 0.0001 | 1   | 5041   | 5041.1 | 30    | 0.0001 |
| Depth ranges          | 1   | 1312.5  | 1312.5  | 12    | 0.2268 | 1   | 1972   | 1972.2 | 12    | 0.222 |
| Depth x Size          | 1   | 1491    | 1491    | 14    | 0.1302 | 1   | 1874   | 1873.5 | 1     | 0.297 |
| Res                   | 21  | 22813   | 1086.3  | 21    |        | 34725 | 1653.6 |        |       |
| Total                 | 24  | 31761   | 24      | 43554 |        |       |        |       |

| factor | PERMDISP | PERMDISP |
|--------|----------|----------|
|        | df  | F     | P     | df  | F   | P     |
| **Total data** | 1  | 1.35 | 0.303 | 1  | 0.95 | 0.395 |
| **Aegean data** |     |       |       |     |       |       |
| Depth ranges   | 1  | 0.94 | 0.401 | 1  | 2.26 | 0.177 |
| Size classes   | 1  | 0.002 | 0.977 | 1  | 1.98 | 0.28  |
| **Adriatic data** |     |       |       |     |       |       |
| Depth ranges  | 1  | 0.002 | 0.969 | 1  | 0.002 | 0.97  |
| Size classes   | 1  | 19.37 | 0.0001 | 1  | 25.61 | 0.0001 |
could be due to data dispersion.

The differences in the polychaete assemblage' structure between the Adriatic and the Aegean Sea were both due to the different abundances of the most frequent species (SIMPER, Supplementary Material, Table S2), such as S. concharum, H. pseudouncinata pseudouncinata, V. infundibulum, Syllis variegata Grube, 1860 and others, and to different species composition in the two areas. In fact, some species were present only in the Aegean Sea, such as Psamathie fusca Johnston, 1836, Spirobranchus polytrema (Philippi, 1844) and others, while others were found only in the Adriatic Sea, such as Syllis ferrani Alós & San Martin, 1987, Harmothoe extenuata (Grube, 1840) and others.

In the Aegean Sea, the differences between sampling depths were mostly due to different abundances of the species present at both depths (SIMPER, Supplementary Material, Table S3), in particular, H. pseudouncinata pseudouncinata, N. latericeus, P. reniformis, S. vermicularis and S. polytrema that were more abundant at 3-5 m depth, and C. costae that was more abundant at 15-19 m depth. In the Aegean, H. pseudouncinata pseudouncinata, C. costae, S. vermicularis and P. reniformis were slightly more abundant in colonies smaller than 1 dm³, while V. striaticeps was slightly more abundant in colonies bigger than 1 dm³ (SIMPER, Supplementary Material, Table S3).

In the Adriatic Sea, the difference between small and big colonies was mainly due to the different abundances of the following species: N. latericeus, C. costae, Eunice vittata (Delle Chiaje, 1828), S. ferrani, Nereis rava Ehlers, 1868, Syllis gerlachi (Hartmann-Schröder, 1960), Lysidice unicornis (Grube, 1840), Lysidice ninetta Audouin & H Milne Edwards, 1833 and several unidentified Terebellidae species, which were more abundant in big colonies, and S. concharum that was more abundant in small colonies (SIMPER, supplementary Material, Table S4). Moreover, N. latericeus, S. ferrani and S. gerlachi were much more frequent (up to 100%) in bigger colonies than in smaller ones (about 50-60%). S. concharum, C. costae, N. rava, and L. ninetta were more abundant at 3-6 m, whereas N. latericeus, E. vittata and S. triqueter were more abundant at 6-8 m depth (SIMPER, Supplementary Material, Table S4).

The results of DISTLM analysis (Supplementary Material, Table S5) show that variations in polychaete assemblages, when considering total species abundance, can be only partially explained by sampling depth and colony volume. A correlation was in fact found between the species/abundance matrix and both depth and volume (p < 0.05), but the sequential test showed that together they explained only a small portion of total variation (13%). The same analysis, performed on the two datasets separately, showed that for the samples from the Aegean sites, depth was the main factor influencing polychaete assemblages (p < 0.05), while colony volume was the main factor affecting polychaete assemblages in samples from the Adriatic sites (Supplementary Material, Table S5).

**Functional diversity**

Motile jawed carnivores (CMJ), discretely motile jawed carnivores (CDJ), and sessile filter-feeders (FST) were the dominant functional groups in terms of abundance at the sampling sites in both geographic areas. However, while at the Aegean sites filter feeders represented the most abundant feeding guild (51.3% of total abundance), colonies in the Northern Adriatic were dominated by carnivores, in particular by CMJ (33.8%), followed by CDJ (22.7%) (Fig. 5A). As regards taxa richness instead, CMJ dominated both at the Aegean (28.6%) and the Adriatic sites (36.1%), followed by FST (20.8% in the Aegean and 10.2% in the Adriatic) and CDJ (16.9% in the Aegean and 18.5% in the Adriatic) (Fig. 5A). The dominant motility mode differed in terms of abundances between all the sites, with sessile species were most abundant in the Aegean Sea (56%) and motile polychaetes were most abundant in the Northern Adriatic (48%). Conversely, motile polychaetes dominated in terms of taxa richness in both geographic areas, with 43.2% at the Aegean sites and 64.5% at the Adriatic sites (Fig. 5B).

The most frequent and abundant carnivores were E. vittata, S. variegata, Leodice torquata (Quatrefages, 1866) and L. ninetta in the Adriatic Sea, and H. spinifera, Lepidonotus clava (Montagu, 1808), Syllis hyalina Grube, 1863, L. ninetta, Lumbrineres laterelli Audouin & Milne Edwards, 1833 and C. costae in the Aegean Sea. The most frequent and abundant filter feeders were S. concharum, S. triqueter and V. striaticeps in the Adriatic Sea, V. striaticeps, V. infundibulum, and H. pseudouncinata pseudouncinata in the Aegean Sea. The most frequent and abundant surface deposit feeders were Dodecaceria concharum Ørsted, 1843 and Cirriformia tentaculata (Montagu, 1808) in the Adriatic Sea, and P. fusca in the Aegean Sea, while the dominant subsurface deposit feeders was N. latericeus in both the Adriatic and the Aegean Sea.

Among motile species, the most frequent and abundant polychaetes at the Adriatic sites were E. vittata, S. variegata, L. torquata and L. unicorns, while H. spinifera and L. clava were the most frequent and abundant at the Aegean sites. As regards sessile species in the Adriatic, the most frequent were D. concharum, S. concharum, and S. triqueter, whereas V. infundibulum and H. pseudouncinata pseudouncinata were the most frequent species in the Aegean Sea, and V. striaticeps in both the Adriatic and the Aegean Sea. Among discretely motile polychaetes at the Adriatic sites, the most frequent were C. costae and N. rava, whereas L. laterelli and P. fusca were the most frequent at the Aegean sites. The motile polychaete L. ninetta was frequent and abundant in both geographic areas.

The richness and diversity of feeding guilds (Fig. 6) were significantly higher at the Adriatic than the Aegean sites (Supplementary Materials, Table S6). In both the Adriatic and the Aegean Sea, richness and abundance of feeding guilds did not differ significantly with depth, but at the deeper sites in the Aegean the values were significantly lower than at the Adriatic sites (Fig. 6, Supplementary Material, Table S6).
In the Aegean, feeding richness did not vary significantly between the two colony size classes, while in the Adriatic it was higher in bigger colonies (Fig. 6, Supplementary Materials, Table S6, S7). Feeding richness in big colonies in the Adriatic was higher than in the Aegean colonies of both size classes (Fig. 6, Supplementary Materials, Table S6, S7). Feeding diversity did not differ between small and big colonies in both the Adriatic and the Aegean, but feeding diversity in big Adriatic colonies was higher than in the Aegean colonies of both size classes (Fig. 6, Supplementary Materials, Table S6, S7).

Considering the abundance of the different feeding guilds, cluster analysis revealed that polychaete assemblages were divided into three groups: one group composed solely of the Northern Adriatic samples, one group consisting of samples from both the Aegean and the Adriatic Sea, and the last one represented only by site RR5 (Fig. 4B). The results of DISTLM analysis (Supplementary Material, Table S5) show that sampling depth and colony volume partially explain the variations between polychaete feeding guilds. A correlation was in fact found between functional group matrix and both depth and volume ($p < 0.05$), but the sequential test showed that together they explained only a small portion of the total variations (25%).

**Fig. 5:** Cumulative richness (S) and abundances (N) of feeding groups (A) and motility modes (B) in the Aegean (left) and the Adriatic Sea (right). HMJ = herbivore motile jawed, BMX = burrowing motile non-jawed, BSX = burrowing sessile non-jawed, CMJ = carnivore motile jawed, CMX = carnivore motile non-jawed, CDJ = carnivore discretely motile jawed, FST = filter-feeders sessile tentaculate, FSP = filter-feeders sessile pumping, SMJ = surface deposit feeders motile jawed, SMT = surface deposit feeders motile tentaculate, SDT = surface deposit feeding, discretely motile tentaculate, SST = surface deposit feeding sessile tentaculate; M = motile, D = discretely motile, and S = sessile.
Fig. 6: Average feeding richness (Sf) and feeding diversity (Hf) overall in the two geographic areas (left), at the different depth ranges (central) and in colonies with different sizes (right).

Fig. 7: Cumulative richness (S) and abundances (N) of the polychaetes assigned to the different biogeographic categories in the Aegean (left) and the Adriatic Sea (right). aa = amphi-Atlantic, am = Atlanto-Mediterranean, amip = African Atlanto-Mediterranean and Indo-Pacific, amr = Atlanto-Mediterranean and Red Sea, amp = Atlanto-Mediterranean and Pacific, amrip = Atlanto-Mediterranean, Red Sea and Indo-Pacific, c = cosmopolitan, d = disjunct distribution, iam = Indo-Atlanto-Mediterranean, m = endemic Mediterranean, mrip = Mediterranean, Red Sea and Indo-Pacific.
Biogeography

Cosmopolitan polychaetes (c) dominated the assemblage in both studied areas (Fig. 7), as regards both richness (32% in Aegean sites, 30% in Adriatic sites) and abundance (46% in Aegean sites, 39% in Adriatic sites), followed by Atlantic-Mediterranean species (iam), showing higher percentages of both richness and abundance at the Aegean sites (27% of richness, 40% of abundance) than at the Adriatic sites (18% of richness, 26% of abundance). Amphitropical (aat), Indo-Atlantic-Mediterranean (iam), and Mediterranean, Red Sea and Indo-Pacific (mpip) polychaetes were found only at the Adriatic sites, while there was no biogeographic group exclusive of the Aegean sites (Fig. 7). The most abundant species found exclusively at the Aegean sites (P. reniformis, P. fusca and S. hyalina) are cosmopolitan (c), whereas the most abundant species found exclusively at the Adriatic sites are endemic of the Mediterranean (m) (S. ferrani), cosmopolitan (c) (S. gerlachi) and Atlantic-Mediterranean and Pacific (amp) (H. extenuata).

Multivariate analyses showed that considering the abundance of the different biogeographical groups, polychaete assemblages were divided into groups, corresponding, to the two geographical areas analysed, with few exceptions (sites DR1, DR4 and PR2 grouped with Aegean sites, and sites S3 and S6 grouped with Adriatic ones) (Fig. 4C). A significant difference between the Aegean and Adriatic Sea sites was confirmed by the PERMDISP results (df = 1, Pseudo-F = 13.7, p = 0.0001), and no difference in data dispersion between the two areas was observed (PERMDISP: df = 1, F = 0.936, p = 0.363). SIMPER results (SIMPER, Supplementary Material, Table S8) show that those differences were mainly due to the different abundance of the two most dominant groups present in both areas (cosmopolitan and Atlantic-Mediterranean), and that the dissimilarity between the Aegean and Adriatic sites was low (33.90). The results of DISTLM analysis (Supplementary Material, Table S5) show that sampling depth and colony volume partially explain biogeographical group variations. A correlation was in fact found between biogeographic matrix and both depth and volume (ρ < 0.05), but the sequential test showed that together they explained only a small portion of the total variations (23%).

Colony size effect

Polychaete species richness increased with increasing colony size (Table 4), and this relationship did not seem to be significantly influenced by geographic area (Fig. 8A) and sampling depth (Fig. 8B). The regression line (log(S) = 0.186*log(Vtot) + 2.206) was successfully fit for the complete dataset (Adjusted R² = 0.225, p = 0.001). Data distribution did not deviate significantly from the assumption of normality (Shapiro test, p > 0.05), and the model did not show significant deviations from the homogeneity of residuals. Almost all observed values fitted between the upper and lower limits of the prediction interval (Fig. 8), with the only exception being two samples collected at the Vou site (Aegean Sea), between 15 and 19 m depth.

Table 4. Spearman coefficients (r_s), p-value and significance levels of the correlations between colony size (Vtot) and biotic indices and functional traits of polychaete assemblages. Ntot = total richness, Ntot = total abundance, H’ = diversity index, J’ = Pielou index, Sf = feeding richness, Hf = feeding diversity. Richness of the different functional groups: M = motile, D = discretely motile, SE = sessile, C = carnivores, DF = surface deposit feeders, B = subsurface deposit feeders/burrowing, F = filter feeders, H = herbivores, Abundances of the different functional groups: M = motile, D = discretely motile, SE = sessile, C = carnivores, DF = surface deposit feeders, B = subsurface deposit feeders/burrowing, F = filter feeders, H = herbivores.

| Indices | r_s | p   | Indices | r_s | p   |
|---------|-----|-----|---------|-----|-----|
| Sf vs Vtot | 0.51 | < 0.001 | Ntot vs Vtot | 0.48 | < 0.01 |
| H’ vs Vtot | 0.49 | < 0.01 | J’ vs Vtot | -0.01 | > 0.05 |
| Sf vs Vtot | 0.30 | > 0.06 | Hf vs Vtot | 0.20 | > 0.06 |

| Motility | Richness | Abundances | Abundances |
|----------|----------|------------|------------|
| M vs Vtot | 0.34 | < 0.05 | M vs Vtot | 0.53 | < 0.001 |
| D vs Vtot | 0.71 | < 0.001 | D vs Vtot | 0.53 | < 0.001 |
| SE vs Vtot | 0.11 | > 0.05 | SE vs Vtot | 0.19 | > 0.05 |

| Feeding | Richness | Abundances | Abundances |
|---------|----------|------------|------------|
| C vs Vtot | 0.47 | < 0.01 | C vs Vtot | 0.464 | < 0.01 |
| DF vs Vtot | 0.353 | < 0.001 | DF vs Vtot | 0.474 | < 0.001 |
| B vs Vtot | 0.29 | > 0.05 | B vs Vtot | 0.559 | < 0.001 |
| F vs Vtot | 0.13 | > 0.05 | F vs Vtot | -0.13 | > 0.05 |
| H vs Vtot | 0.08 | > 0.05 | H vs Vtot | 0.08 | > 0.05 |
The richness and abundances of motile (M) and discretely motile (D) polychaetes increased with colony size, while richness and abundance of sessile polychaetes (SE) were not significantly related with colony size (Table 4). The richness and abundance of carnivores (C), surface deposit feeders (DF) and abundance of subsurface deposit feeders/burrowers (B) increased with colony size (Table 4). Conversely, no significant relationship was found between the richness and abundance of filter feeder polychaetes (F) and herbivorous (H) polychaetes and colony size (p > 0.05). Moreover, no significant relationship was found between feeding richness (Sf) and feeding diversity (Hf) on the one hand and colony size on the other hand (Table 4).

**Discussion**

Polychaete assemblages associated with *C. caespitosa* showed quite high overall richness in both the the Adriatic and the Aegean Seas, compared to other Mediterranean corals. Given the differences in sampling and data processing, our results are not directly comparable with the data reported for other Mediterranean coral species; however, at least from a qualitative point of view, *C. caespitosa* seems to be the Mediterranean coral supporting the richest polychaete assemblage so far. As regards shallow water corals, Terrón-Sigler et al. (2014) have listed 27 polychaete taxa associated with *Astroides calycularis* (Pallas, 1766) at Marina del Este beach (Spain). Regarding mesophotic and deep water corals, Kipson et al. (2009) have reported 45 taxa of polychaetes associated with a coralligenous community dominated by the red gorgonian *Paramuricea clavata* (Risso, 1826) in the central part of the Eastern Adriatic Sea (Croatia). Mastrototaro et al. (2010) have listed 24 species of polychaetes associated with white coral banks dominated by *Madrepora oculata* (Linnaeus, 1758) and *Lophelia pertusa* (Linnaeus, 1758) in the Ionian Sea, off Cape Santa Maria di Leuca (Italy). Chimienti et al. (2020) found 29 polychaete species associated with *Antipathella subpinnata* llis and Solander, 1786 at Tremiti Islands (Italy), while Chimienti (2020) reported 5 polychaete species associated with *Eunicella verrucosa* (Pallas, 1766) in the Ligurian Sea (Italy). The high diversity of *Cladocora* associated polychaete assemblages in our study is likely due to the complex structure of the coral. In fact, we distinguished three main microhabitats in the colonies, namely, hard substrate suitable for epilithic and endolithic species, interstitial space for small motile organisms, and trapped sediment for the more typical soft bottom species (Pi-
tacco et al., 2014). In general, scleractinian corals host the richest and most diversified associated polychaete assemblages because of their typical three-dimensional structure (Molodtsova et al., 2016). High richness of polychaete assemblage associated with C. caespitosa could be related to the low toxicity of polyps (Chintiroglou, 1996). Martins Garcia et al. (2008) suggested that the position of the sting cells in the gastro-vacular cavity of scleractinian corals could explain the bigger diversity of their associated fauna, compared to the fauna associated with the so-called “branching fire coral” (Millepora alcicornis Linnaeus, 1758), a colonial hydrozoan whose polyps create a barrier to larval colonization, given that the sting cells are located in the epidermis.

According to a recent review, the most diverse and abundant polychaete families found associated with C. caespitosa, correspond to the most common and rich cnidarian-associated families (Molodtsova et al., 2016): Polynoidae, Syllidae, Serpulidae, and Eunicidae. These families are also typical of hard bottoms in the Mediterranean, with Syllidae ranking first place (Somaschini, 1988; Tena et al., 2000; Giangrande et al., 2003; Giangrande et al., 2004; Mikac et al., 2020). The richest families were the same in both studied areas, but the diversity of Syllidae was much higher in the Adriatic Sea.

As regards polychaetes, some individuals with less than half the average adult size (e.g., S. vermicularis and L. torquata), the stolons of some species of genera Syllis and Trypanosyllis and some individuals of Pileolaria spp. incubating eggs in the operculum, were observed (personal observations), indicating the importance of C. caespitosa colonies for the recruitment of polychaetes. Previous research has shown that colonies of C. caespitosa play an important role as a nursery habitat for molluscs (Pitacco et al., 2017).

Considering species composition and abundance data, the polychaete assemblages associated with C. caespitosa varied clearly between the Adriatic and the Aegean sites. Those variations were due to the different abundance of common species, but also to different species composition, with some species found exclusively in one of the two areas. In fact, only 40 species were found in the fauna of both areas.

Part of the discordance in the composition of polychaete fauna in the two areas could be due to the fact that there is a difference of almost twenty years between the two research projects. The Aegean samples were taken in 1987 and published for the first time in 1994. Thus, the knowledge on taxonomy of Mediterranean polychaetes available the latest by 1994 was used to identify the polychaetes from the Aegean Sea. On the other hand, the samples from the Slovenian coast were taken in 2010 (Pitacco et al., 2014) and in 2012 (Pitacco et al., 2017, 2019), and published for the first time in 2014. In fact two species reported for the Adriatic Sea in this research were only described after 1994, i.e., Flabelliderma cinari Karhan, Simboua & Salazar-Vallejo, 2012 and Parasabella tomatasi (Giangrande, 1994). Other species, such as sabellid Parasabella langerhansi (Knight-Jones, 1983), and syllids Syllis beneliahuae (Campoy & Alquézar, 1982), Syllis columbretensis (Campoy, 1982), Syllis ferrani Alós & San Martin, 1987 and Syllis gerundensis (Alós & Campoy, 1981) were described just few years before the Aegean polychaetes were analysed. Consequently, knowledge on their taxonomy and distribution was scarce at the time. While P. langerhansi was recorded by Giangrande for the first time in the Mediterranean as late as 1994, the four syllids mentioned above were described from the Spanish coast of the Mediterranean Sea. Important identification manuals (such are San Martin, 2003 and Barnich & Fiege, 2000) were published in the meantime, shedding light on the taxonomic status and distribution of some species already present in the Mediterranean and reporting species previously not mentioned in the Mediterranean. Differences in the datasets in this research might partly be due to the differences in the identification manuals used; this could be particularly true for species such as Harmothoe fragilis Moore, 1910, Harmothoe gilchristi Day, 1960 and the aforementioned syllids.

The analyses of biogeographical groups confirmed the difference between the two areas; however, the dissimilarity between them was low. The assemblages were dominated by cosmopolitan and Atlantic-Mediterranean species at both the Aegean and Adriatic sites, and the differences between the two areas were mainly due to their different abundances. Three biogeographical groups, Amphip-Alantic (aa), Indo-Atlantic-Mediterranean (iam), and Mediterranean, Red Sea and Indo-Pacific (mrp), were found exclusively in the Adriatic Sea, and all of them were represented by one or two species only. Our results are consistent with the biogeographical analysis of Mediterranean polychaetes performed by Arvanitidis et al. (2002); in the Mediterranean and the Black Sea, the most represented were cosmopolitan and Atlantic-Mediterranean polychaetes. Conversely, Arvanitidis et al. (2002) did not find a significant difference in the proportion of biogeographical groups among different areas of the Mediterranean, and high similarity in the biogeographical affinity of polychaetes between the Adriatic and the Aegean Sea. Musco & Giangrande (2005) observed a similar pattern for Mediterranean syllids. This similarity between the two areas was explained, in part, by the co-occurrence of similar ecological features, such as shallow water, distance from Gibraltar, low temperature and salinity (Arvanitidis et al., 2002). Thus, currently available literature on the biogeographical affinity of polychaetes does not explain the differences in species composition between the two areas observed during this study. Some species were not assigned to a group due to the lack of knowledge on species distribution such as, e.g., Flabelliderma cinari Karhan, Simboua & Salazar-Vallejo, 2012 to date known only from few locations in Slovenian and Turkish waters (Pitacco & Karhan, 2019). Currently, there are doubts about the assignment of cosmopolitan status to so many polychaete species. According to Hutchings & Kupriyanova (2018), some studies suggest that cosmopolitan polychaetes do exist, but are rare. In fact, the cosmopolitan distribution of several species found herein (i.e., Lyside nitetta Audouin & H Milne Edwards, 1833, Perinereis cultrifera
(Grube, 1840), Arabella iricolor (Montagu, 1804), Phyllo-dochus madeirensis Langerhans, 1880, Haplosyllis spon- gicolata (Grube, 1855), Syllis alternata Moore, 1908, Syl-
lis gracilis Grube, 1840 and Trypanosyllis zebra (Grube, 1860) should be questioned since their morphology is
hardly distinguishable (Scaps et al., 2000; Maltagliati et
al., 2001; Iannotta et al., 2006, 2009; Lattig et al., 2007;
Lattig & Martin, 2009; Carr et al., 2011; Zanol & Ruta,
2015; Álvarez-Campos et al., 2016, 2017; Faulwetter et
al., 2017; Ravara et al., 2017; Langeneck et al., 2020).
On the other hand, the cosmopolitan status of some other
species is currently questioned as they might represent
species complexes, i.e., Ditrupa arietina (O. F. Müller,
1776), Exogone naidina Örsted, 1845, Salvatoria clavata
(Claparède, 1863), Syllis armillaris (O. F. Müller, 1776),
Trypanosyllis aelolis Langerhans, 1879) (López et al.,
2001; San Martin, 2003; Hartley, 2014; Álvarez-Campos
et al., 2017; Langeneck et al., 2018). Moreover, some
species classified as cosmopolitan have complicated tax-
onomy or are purely identified and therefore erroneously
reported in different geographic sectors (i.e., Heteromas-
tus filiformis (Claparède, 1864), Lumbrineris coccinea
(Renier, 1804), Lumbrineris latreilli Audouin & Milne
Edwards, 1833) (Carrera-Parra, 2006; Capaccioni-Azzati
& El-Haddad 2015). In-depth integrated studies would
be necessary to solve the status of the above listed spe-
cies and, presumably, their cosmopolitan status will like-
ly be derelict in the future based on further research and
knowledge.

The total number of polychaete taxa associated with
C. caespitosa reported for the Adriatic Sea was higher
than for the Aegean Sea. This could partly be attributed
to the fact that some species present only in the Adriatic Sea
were originally described or reported from the Mediterr-
anean Sea or included in the important identification man-
nals after 1994, as already discussed above. Moreover, the
higher number of Adriatic Sea colonies analyzed could
explain the higher total number of species recorded. Av-
erage polychaete richness was higher at sites in the Adri-
atic than in the Aegean Sea, as well. This could be partly
due to a superimposed sampling depth effect, since some
colonies sampled deeper in the Aegean Sea showed the
lowest species richness. Variations in the richness and di-
versity ($H'$) of polychaete assemblages in the Adriatic Sea
were related primarily to colony size, while those in the
Aegean to sampling depth. DistLM analyses performed
on the data from the two areas confirmed that depth was
the main factor structuring polychaete assemblages in the
samples from the Aegean, whereas colony size was the
main factor influencing polychaete assemblages in the
samples from the Adriatic. These results are undoubt-
dedly due to the different focus of the compared studies, and
the different distribution of the Mediterranean stony cor-
al itself in the two areas. In Slovenian waters, most of the
Cladocora colonies are located within the first 10m
depth; sampling encompassed a narrower depth range,
but a wider range of colony size, thus enabling testing of
the differences of the polychaete fauna between dif-
ferent sized colonies. On the other hand, in the Aegean
Sea, Cladocora colonies are distributed in a wider depth
range and, therefore, it was possible to test the differences
between associated polychaete fauna living in colonies at
different depths (shallower, 3-5 m and deeper, 15-19 m
colonies). DistLM analyses performed on the whole data-
set confirmed the importance of both factors, i.e., depth
and colony size, in structuring the polychaete assemblag-
es; however, together they explained only a small portion
of the total variance of polychaete assemblages.

In the Adriatic Sea, polychaete assemblages associ-
ated with colonies bigger and smaller than 1 dm$^3$, dif-
fered in terms of species richness, diversity, abundance
patterns, and dispersion of presence/absence data, with
bigger colonies hosting richer, more diverse and more
abundant polychaete assemblages. The index of equita-
bility ($J'$) did not reveal any relationship with colony size,
implying that the polychaete assemblages are well-struc-
tured even in small colonies, and that the variability of
overall diversity was mainly related to the variability of
species richness. Beta diversity was higher for small col-
onies, than for bigger ones. A previous study on decapod
crustaceans associated with the tropical coral Pocillopora
damicornis (Linnaeus, 1758) has highlighted the impor-
tance of small colonies for associated fauna, showing that
two small colonies can host more species than a single
big colony with a volume equal to the sum of the two
smaller ones (Abele & Patton, 1976). The explanation
provided by the authors was based on the Equilibrium
Theory of Island Biogeography (MacArthur & Wilson,
1967), considering coral colonies as island-like habitats
and assuming that the frequency of occurrence is a good
indication of dispersal ability. If the number of good col-
onizers (i.e., the most frequent) is higher than the equi-
librium number (total number of species resulting from
the equilibrium between immigration and extinction) in
the small colonies, then those colonies are expected to
host the same species (i.e., the most frequent), and bigger
colonies are expected to host a higher number of species.
Conversely, Abele & Patton (1976) found few species
that are considered good colonizers (>80% of frequen-
cy), less than the equilibrium number for most colonies
(even the smaller ones). Consequently, a different species
composition between two small colonies and their cumu-
lative number of species higher than a single colony of
comparable volume were expected.

The dominat feeding modes considering both abund-
dances and taxa richness were CMJ, CDJ, and FST in
all cases. The same dominance was observed at different
depths in the Aegean Sea (Chintiroglou, 1996), and at a
deeper site of the Gulf of Trieste (Pitacco et al., 2014).
Motile carnivores dominated the assemblages in terms of
taxa richness in samples from both geographic areas.
Nevertheless, while carnivores were the most abundant
group in the Adriatic, filter feeders were the most abun-
dant in the Aegean Sea. Colonies of C. caespitosa are
known to hold in their interstitial spaces high nutrient
levels (Schiller, 1993) and a rich microbial community
(Rubio-Portillo et al., 2018), deriving mainly from coral
produced mucus. The combined effect of coral-produced
food availability and reduced water flow velocity among
coralites create a specific environment more or less in-
dependent from surrounding waters (Schiller, 1993), providing food for deposit feeders and shelter for juveniles, and this availability of prey attracts carnivores. The dominance of carnivores could be also related to the age of the colony, and indicative of a stable environment. In fact, investigations on polychaete colonization on tropical dead coral showed that the percentage of carnivores is low at the beginning of colonization, and then increases with time (Hutchings & Peyrot-Clausade, 2002). The high abundance of sessile filter feeders, was also reported for other phyla associated with temperate corals, such as molluscs (Crocetta & Spanu, 2008; Pitacco et al., 2017), and could be related to food availability in the water column. The distribution of C. caespitosa in shallow water is known to be related to both seabed morphology and to the supply of nutrients and carbonate (e.g., Kružić & Benković, 2008; Kersting & Linares, 2012; Zunino et al., 2018). A number of authors (e.g., Hovland et al., 2002; Mastrototaro et al., 2010) have reported that deep-sea coral reefs establish themselves where there is a continuous and regular supply of concentrated food and nutrients, and that this flow is a crucial factor not only for corals themselves, but also for associated suspension feeders. The coexistence of suspension feeders of different taxa, typically associated to corals, requires a certain level of trophic specialization for the distribution of resources (Sarà, 1986).

Composition in terms of feeding guilds is consistent with composition in terms of motility modes. Motile polychaetes (mainly carnivores) were dominant in terms of taxa richness in both areas. Sessile polychaetes (mainly filter feeders) were most abundant in the Aegean and motile polychaetes in the Adriatic. The high presence of sessile species is due to the fact that the coral provides hard substrate to settle. The different proportions found in the Adriatic and the Aegean Seas could be related to different factors, such as larval dispersal, timing of colonization or competition for space or for food after settlement (Sarà, 1986). Moreover, sessile filter feeders consisted mainly of Serpulidae, which are typically gregarious. Gregariousness is a cooperative behaviour that could increase colonization success, thus contributing to the unpredictability of hard bottom colonization dynamics (Sarà, 1986). Differences observed in terms of richness and diversity of feeding modes (Sf and Hf), reflected a pattern of general richness and diversity: they were higher in the Northern Adriatic and in shallow areas.

In previous studies it was reported that in the Adriatic Sea macrobenthic assemblages associated with C. caespitosa followed SAR (Species/Area Relationship) models based on the Arrhenius equation (Arrhenius, 1921), thus enabling to estimate the richness of associated macrofauna in a non-destructive way, based solely on colony size (Pitacco et al., 2017, 2019). Colony size was the best predictor of the richness of associated invertebrates, and the same SAR model was predictive even when the richness of associated mollusc and polychaete assemblages were considered separately (Pitacco et al., 2019). In this research, despite the difference in richness between the Adriatic and the Aegean Sea, colony size in terms of V_m proved to be a good proxy for polychaete richness, and the regression line obtained from the complete dataset was predictive for both areas, with only few exceptions represented by some of the deepest samples. The independence of SAR models from the geographic area was proved also for decapod crustaceans associated to the tropical coral P. damicornis in two distinct regions of Panama (Abele, 1976). The common pattern of the Species-Volume Relation, SVR sensu Belmaker (2009), found in the Northern Adriatic and the Aegean Sea, suggests that polychaete richness in corals of comparable colony size is similar between the two studied areas, even if species composition differs. Although the present data come from two restricted areas, and information from other Mediterranean regions would undoubtedly be necessary to validate this method, our results suggest that the same SAR model could be applied successfully to polychaetes associated with C. caespitosa in other areas of the Mediterranean Sea. Colony size distribution and colony morphology of C. caespitosa is not universally homogeneous in the Mediterranean Sea, and differences between sites are likely related to different hydromorphological conditions, in particular sea currents, wave action and sedimentation rate (Schiller, 1993; Kružić & Benković, 2008). Those differences in colony biometrics have been documented for different sites along the Slovenian coast in the Adriatic (Zunino et al., 2018) but no recent information on coral biometry is available for the Aegean, notwithstanding the important presence of this species in the form of both banks and beds (Peirano et al., 1998; Chefaoui et al., 2017). It has been reported for the Adriatic Sea (Kružić et al., 2008, 2014; Zunino et al., 2018), and for other areas of the Mediterranean (Rodolfo-Metalpa et al., 2005; Kersting et al., 2013, 2015), that populations of C. caespitosa are affected by different types of anthropogenic pressures. Those pressures, such as the colonization of non-indigenous algae that cause colony recession (Kružić et al., 2008) and thermal anomalies that provoke bleaching and mortality events (Jiménez et al., 2014; Kružić et al., 2014; Kersting et al., 2015), could lead to a severe decline. Given those threats and the ecological importance of C. caespitosa populations, their mapping and monitoring of their ecological status should be extended to other areas of the Mediterranean.

Acknowledgements

This study was part of a PhD financially supported by the Ministry of Agriculture and Environment of Slovenia. Part of this work was possible thanks to the MARS travel award received in 2015 and the financial support of Slovenian Research Agency (research core funding No. P1-0237). Special thanks are due to the staff of Marine Biology Station in Piran (Slovenia), in particular Dr. Borut Mavrič, Tihomir Makovec, Jernej Uhán, Ariana Stojnič and Aleksandra Popovič for their help in the fieldwork; to Domen Trkov for his precious help during laboratory work; to Dr. Martina Orlando-Bonaca for her support and advice. Special thanks are also due to Dr. Floriana Aleffi.
(ARPA FVG, Italy), Prof. Adriana Giangrande (University of Salento, Italy), Dr. Maria Cristina Gambi (Zoological Station Anton Dohrn, Italy), and Prof. Maria Flavia Gravina (University of Tor Vergata, Italy), and the biodiversity team at the Hellenic Centre for Marine Research in Crete (Greece), namely, Prof. Christos Arvanitidis, Niki Keklikoglou, Sarah Faulwetter, Katerina Vasileiadou and Christina Pavloudi, for their help in dealing with the uncertainty of the taxonomic position of some polychaetes. Finally, we would like to thank Milijan Šiško and Ana Rotter for their help with statistics and R programming.

References

Abele, L.G., 1976. Comparative species richness in fluctuating and constant environments: coral-associated decapod crustaceans. *Science*, 192 (4238), 461-463.

Abele, L.G., Patton, W.K., 1976. The size of coral heads and the community biology of associated decapod crustaceans. *Journal of Biogeography*, 3 (1), 35-47.

Álvarez-Campos, P., Giribet, G., Riesgo, A., 2016. The *Syllis gracilis* species complex: a molecular approach to a difficult taxonomic problem (Annelida, Syllidae). *Molecular Phylogenetics and Evolution*, 109, 138-150.

Álvarez-Campos, P., Giribet, G., San Martin, G., Rouse, G., Riesgo, A., 2017. Straightening the striped chaos: systems and evolution of *Trypanosyllis* and the case of its pseudocryptic type species *Trypanosyllis krohni* (Annelida, Syllidae). *Zooological Journal of the Linnaean Society*, 179 (3), 492-540.

Anderson, M.J., Gorley, R.N., Clarke, K.R., 2008. *PERMANOVA+ for PRIMER: Guide to Software and Statistical Methods*. PRIMER-E, Plymouth, United Kingdom, 214 pp.

Antoniadou, C., Chintiroglou, C., 2010. Biodiversity of zoobenthos associated with a *Cladocora caespitosa* bank in the north Aegean Sea. *Rapport Commission Internationale pour l’Exploration Scientifique de la mer Méditerranée*, 39, 432.

Arrhenius, O., 1921. Species and area. *Journal of Ecology*, 9 (1), 95-99.

Arvanitidis, C., Bellan, G., Drakopoulos, P., Valavonis, V., Dounas, C. et al., 2002. Seascape biodiversity patterns along the Mediterranean and the Black Sea: lessons from the biogeography of benthic polychaetes. *Marine Ecology Progress Series*, 244, 139-152.

Arvanitidis, C., Koukouras, A., 1994. Polychaete fauna associated with the *Cladocora caespitosa* (L.) in the eastern Mediterranean. *Memoires du Museum National d’Histoire Naturelle*, 162, 347-353.

Bakalem, A., Gillet, P., Pezy, J.-P., Daunin, J.-C., 2020. Inventory and the biogeographical affinities of Annelida Polychaeta in the Algerian coastline (Western Mediterranean). *Mediterranean marine science*, 21 (1), 157-182.

Barnich, R., Fiege, D., 2000. Revision of the Mediterranean species of *Harmothoe* Kinberg, 1856 and *Logico* Malmgren, 1865 (Polychaeta: Polynoidae: Polynoinae) with descriptions of a new genus and a new species. *Journal of Natural History*, 34, 1889-1938.

Barnich, R., Fiege, D., 2003. The *Aphroditoidae* (Annelida: Polychaeta) of the Mediterranea Sea. Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft, Band 559, 167 pp.

Belmaker, J., 2009. Species richness of resident and transient coral-dwelling fish responds differentially to regional diversity. *Global Ecology and Biogeography*, 18 (4), 426-436.

Bianchi, C.N., 1981. *Policcheti serpuloidi*. *Guide per il riconoscimento delle specie animali delle acque lagunari e costiere italiane*. Consiglio Nazionale delle Ricerche, Genova, 5, 187 pp.

Capaccioni-Azzati, R., El-Haddad, M., 2015. *Familia Capitellidae*. p. 257-352. In: *Fauna Iberica*. vol. 41. *Annelida. Polychaeta IV*. Ramos, M.A. (Ed.). Museo Nacional de Ciencias Naturales, CSIC, Madrid.

Carr, C.M., Hardy, S.M., Brown, T.M., Macdonald, T.A., Herbert, P.D.N., 2011. A tri-oceanic perspective: DNA barcoding reveals geographic structure and cryptic diversity in Canadian polychaetes. *PLoS ONE*, 6 (7), e22232.

Carrera-Parra, L.F., 2006. Revision of *Lumbrineris* de Blainville, 1828 (Polychaeta: *Lumbrineridae*). *Zootaxa*, 1336, 1-64.

Casado de Amezua, P., Kersting, D., Linares, C.L., Bo, M., Caroselli, E. et al., 2015. *Cladocora caespitosa*. The IUCN Red List of Threatened Species 2015: e. T133142A75872554.

Chefaoui, R.M., Casado-Amezúa, P., Tempладo, J., 2017. Environmental drivers of distribution and reef development of the Mediterranean coral *Cladocora caespitosa*. *Coral Reefs*, 36 (4), 1195-1209.

Chimenti, G., 2020. Vulnerable Forests of the Pink Sea Fan *Eunicella verrucosa* in the Mediterranean Sea. *Diversity*, 12 (5), 176.

Chimenti, G., De Padova, D., Mossa, M., Mastrototaro, F., 2020. A mesophotic black coral forest in the Adriatic Sea. *Scientific Reports*, 10 (1), 1-15.

Chintiroglou, C.C., 1996. Feeding guilds of polychaetes associated with *Cladocora caespitosa* (L.) (*Anthozoa*, *Cnidaria*) in the North Aegean Sea. *Israel Journal of Ecology and Evolution*, 42 (3), 261-274.

Clarke, K., Warwick, R., 2001. *Change in marine communities: an approach to statistical analysis and interpretation* (2nd Edition). PRIMER-E Ltd, Plymouth, United Kingdom, 256 pp.

Clarke, K.R., Gorley, R.N., 2006. *PRIMER v6: User Manual/ Tutorial*. PRIMER-E, Plymouth, United Kingdom, 190 pp.

Crocetta, F., Spanu, M., 2008. Molluscs associated with a *Sardegna* deep water population of *Corallium rubrum* (Linne, 1758). *Mediterranean marine science*, 9 (2), 63-86.

Faulwetter, S., Simboura, N., Katsiaras, N., Chatzigergiou, G., Arvanitidis, C., 2017. Polychaetes of Greece: an updated and annotated checklist. *Biodiversity Data Journal*, 5, e20997.

Giangrande, A., 1994. The genus *Demonax* (Polychaeta, Sabel-lidae) in the Mediterranean Sea, with description of *D. tom-nasi* n. sp. *Bollettino di Zoologia*, 61 (3), 229-233.

Giangrande, A., Delos, A., Fraschetti, S., Musco, L., Licciano, M. et al., 2003. Polychaete assemblages along a rocky shore on the South Adriatic coast (Mediterranean Sea): patterns of
spatial distribution. *Marine Biology*, 143, 1109–1116.

Giagrande, A., Delos, A.L., Musco, L., Licciano, M., Pierri, C., 2004. Polychaete assemblages of rocky shore along the South Adriatic coast (Mediterranean Sea). *Cahiers de Biologie Marine*, 45, 85-95.

Hartley, J., 2014. A review of the occurrence and ecology of dense populations of *Ditriga arietina* (Polychaeta: Serpulidae). *Memoirs of Museum Victoria*, 71, 85-95.

Hovland, M., Vasshus, S., Indreede, A., Austdal, L., Nilsen, Ø., 2002. Mapping and imaging deep-sea coral reefs off Norway, 1982-2000. *Hydrobiologia*, 471 (1-3), 13-17.

Hutchings, P., Kupriyanova, E., 2018. Cosmopolitan polychaetes—fact or fiction? Personal and historical perspectives. *Invertebrate systematics*, 32 (1), 1-9.

Hutchings, P.A., Peyrot-Clausade, M., 2002. The distribution and abundance of boring species of polychaetes and sipunculans in coral substrates in French Polynesia. *Journal of Experimental Marine Biology and Ecology*, 269 (1), 101-121.

Iannotta, M., Gambi, M., Patti, F., 2009. Molecular evidence of intraspecific variability in *Lysidice ninetta* (Polychaeta: Eunicidae) in the Mediterranean Sea. *Aquatic Biology*, 6, 121-132.

Iannotta, M.A., Patti, F.P., Ambrosino, M., Procaccini, G., Gambi, M.C., 2006. Phylogeography of two species of *Lyssidice* (Polychaeta, Eunicidae) associated to the seagrass *Posidonia oceanica* in the Mediterranean Sea. *Marine Biology*, 150 (6), 1115-1126.

Jiménez, C., Hadjoannou, L., Petrou, A., Nikolaidis, A., Evriavidou, M. et al., 2014. Mortality of the scleractinian coral *Cladocora caespitosa* during a warming event in the Levantine Sea (Cyprus). *Regional environmental change*, 16 (7), 1963-1973.

Jumars, P.A., Dorgan, K.M., Lindsay, S.M., 2015. Diet of worms emended: an update of polychaete feeding guilds. *Annual review of marine science*, 7, 497-520.

Kersting, D., Cebrian, E., Verdura, J., Ballesteros, E., 2017. A new *Cladocora caespitosa* population with unique ecological traits. *Mediterranean marine science*, 18 (1), 38-42.

Kersting, D.K., Bensoussan, N., Linares, C., 2013. Long-term responses of the endemic reef-builder *Cladocora caespitosa* to Mediterranean warming. *PLoS ONE*, 8 (8), e70820.

Kersting, D.K., Cebrian, E., Casado, C., Teixidó, N., Garrahou, J. et al., 2015. Experimental evidence of the synergistic effects of warming and invasive algae on a temperate reef-builder coral. *Scientific Reports*, 5, 18635.

Kersting, D.K., Linares, C., 2012. *Cladocora caespitosa* bioconstructions in the Columbretes Islands Marine Reserve (Spain, NW Mediterranean): distribution, size structure and growth. *Marine Ecology*, 33 (4), 427-436.

Kersting, D.K., Teixidó, N., Linares, C., 2014. Recruitment and mortality of the temperate coral *Cladocora caespitosa*: implications for the recovery of endangered populations. *Coral Reefs*, 33 (2), 403-407.

Kipson, S., Novosel, M., Radić, I., Kružić, P., Požar-Domac, A., 2009. The biodiversity of macrobenthos within the coralligenous community dominated by the red gorgonian *Paramuricea clavata* in the central part of the Eastern Adriatic Sea (Croatia): preliminary results. p. 14-16. In: 1st Mediterranean Symposium on the Coralligenous and other calcareous bio-concretions of the Mediterranean Sea, *Tabarka*, 15 -16 January 2009. RAC/SPA, Tunis.

Koukouras, A., Kühlmann, D., Voultsiadou, E., Vafidis, D., Doumas, C., et al., 1998. The macrofaunal assemblage associated with the scleractinian coral *Cladocora caespitosa* (L.) in the Aegean Sea. *Annales de l’Institut Océanographique*, Paris, 74 (2), 97-114.

Kružić, P., Benković, L., 2008. Bioconstructional features of the coral *Cladocora caespitosa* (Anthozoa, Scleractinia) in the Adriatic Sea (Croatia). *Marine Ecology*, 29 (1), 125-139.

Kružić, P., Sršen, P., Benković, L., 2012. The impact of seawater temperature on coral growth parameters of the colonial coral *Cladocora caespitosa* (Anthozoa, Scleractinia) in the eastern Adriatic Sea. *Facies*, 58 (4), 477-491.

Kružić, P., Lipej, L., Mavrič, B., Rodić, P., 2014. Impact of bleaching on the coral *Cladocora caespitosa* in the eastern Adriatic Sea. *Marine Ecology Progress Series*, 509, 193-202.

Kružić, P., Žuljević, A., Nikolić, V., 2008. The highly invasive alga *Caulerpa racemosa* var. *cylindracea* poses a new threat to the banks of the coral *Cladocora caespitosa* in the Adriatic Sea. *Coral Reefs*, 27 (2), 441-441.

Langeneck, J., Musco, L., Busini, G., Conese, I., Aliani, S. et al., 2018. *Syllidae* (Annelida: Phyllodocida) from the deep Mediterranean Sea, with the description of three new species. *Zootaxa*, 4369 (2), 197–220.

Langeneck, J., Scarpa, F., Maltagliati, F., Sanna, D., Barbieri et al., 2020. A complex species complex: the controversial role of ecology and biogeography in the evolutionary history of *Syllis gracilis* Grube, 1840 (*Annelida, Syllidae*). *Journal of Zoological Systematics and Evolutionary Research*, 58, 66-78.

Lattig, P., Martin, D., 2009. A taxonomic revision of the genus *Haplosyllis* Langerhans, 1887 (Polychaeta, Syllidae, *Syllidae*). *Zootaxa*, 2220, 1-40.

Lattig, P., San Martin, G., Martin, D., 2007. Taxonomic and morphometric analyses of the *Haplosyllis spongicola* complex (Polychaeta: Syllidae: *Syllidae*) from Spanish seas, with re-description of the type species and descriptions of two new species. *Scientia Marina*, 71 (3), 551-570.

Legendre, P., Anderson, M.J., 1999. Distance-based redundancy analysis: testing multispecies responses in multifactorial ecological experiments. *Ecological Monographs*, 69, 1–24.

López, E., Martin, D., Britayev, T., San Martin, G., 2001. New symbiotic associations involving *Syllidae* (Annelida: Polychaeta), with taxonomic and biological remarks on *Pionosyllis magnifica* and *Syllis* cf. *armillaris*. *Journal of the Marine Biological Association of the United Kingdom*, 81, 399-409.

Lumare, F., 1965. Sulla scogliera a *Cladocora* (Anthozoa, Scleractinia) in the Aegean Sea. *Annales de l’Institut Océanographique*, Paris, 71, 85-95.

MacArthur, R.H., Wilson, E.O., 1967. The theory of island biogeography, Princeton University Press, Princeton, USA, 203 pp.

Maltagliati, F., Camilli, L., Lardicci, C., Castelli, A., 2001. Evidence for morphological and genetic divergence in *Peri- nereis cultiforma* (Polychaeta: Nereididae) from two habitat types at Elba Island. *Journal of the Marine Biological Association of the United Kingdom*, 81 (3), 411-414.

Martins Garcia, T., Cascon, H., Franklin-Junior, W., 2008. Macrofauna associated with branching fire coral. *Thals-
Supplementary data

The following supplementary information is available online for the article:

*Fig. S1:* Non-metric MDS ordination plot, based on species abundance data, comparing structure of polychaete assemblages between samples with different colony size from the Adriatic Sea.

*Table S1.* Taxon list with feeding guilds (TG) and biogeography groups assigned, and mean abundance and standard error (SE) of each taxa at the two sites in the Aegean (PIR, VOU) and the five sites in the Adriatic (RR, PR, STR, PA, DR).

*Table S2.* Results of SIMPER analyses (cut-off 90%) used to identify taxa that mostly contribute to (A) polychaete similarity within geographic areas, (B) polychaete dissimilarity between geographic areas.

*Table S3.* Results of SIMPER analyses (cut-off 90%) used to identify taxa that mostly contribute to (A) polychaete similarity within the same depth and size class, (B) polychaete dissimilarity between depths and size classes in the Aegean Sea.

*Table S4.* Results of SIMPER analyses (cut-off 90%) used to identify taxa that mostly contribute to (A) polychaete similarity within the same depth and size class, (B) polychaete dissimilarity between depths and size classes in the Adriatic Sea.

*Table S5.* Results of DISTLM analyses testing the response of biological data to environmental variables.

*Table S6.* Results of KW chi-squared testing differences of biological indices between areas, depths and colony sizes.

*Table S7.* Results of pairwise comparisons testing differences of biological indices between areas.

*Table S8.* Results of SIMPER analyses (cut-off 100%) used to identify biogeographic groups that mostly contribute to similarity (A) within Aegean and Adriatic, and (B) dissimilarity between Aegean and Adriatic Sea.