

Maria SINI, GARRABOU J., KOUTSOUBAS D.

Department of Marine Sciences, University of the Aegean, Mytilene, Lesvos, Greece

E-mail: mariasini@marine.aegean.gr

DIVERSITY AND STRUCTURE OF CORALLIGENOUS ASSEMBLAGES DOMINATED BY *EUNICELLA CAVOLINI* (KOCH, 1887) IN THE AEGEAN SEA

Abstract

The diversity and structure of six coralligenous assemblages dominated by Eunicella cavolini (Octocorallia - Anthozoa) were studied in three localities of the Aegean Sea (NE Mediterranean). A standardized, rapid, non-destructive method was applied at depths ranging from 18 to 35 m. Within each site, a total area of 1.5 m² was sampled using photoquadrats (25 x 25 cm) over three 0.5 m² randomly placed transects. Number and percentage cover of conspicuous macrobenthic species were measured using the image segmentation tool provided by photoQuad. A total of 95 taxa belonging to 8 taxonomic groups were identified, with sponges and coralline algae being the dominant groups in terms of cover. Results suggest that coralligenous communities dominated by Eunicella cavolini of the Aegean Sea constitute a highly diverse habitat, presenting several similarities and peculiarities to their western Mediterranean counterparts. The baseline information provided in this study allows for future monitoring and comparisons at a Mediterranean-scale level.

Key-words: Biodiversity, coralligenous assemblages, photoquadrat sampling, Aegean Sea

Introduction

Knowledge on the existence of coralligenous formations in the Aegean Sea dates back to the late 1950s (Laborel, 1960, 1961; Pérès & Picard, 1958). During the following decades, only a small number of studies dealt with coralligenous communities in the region, focusing mainly on specific taxonomic groups (Aktan, 2012; Antoniadou & Chintiroglou, 2005; Gerovasileiou *et al.*, 2009; Salomidi *et al.*, 2009; Vafidis *et al.*, 1997). Although recent assessments have outlined their widespread distribution in most parts of the Aegean Sea (Giakoumi *et al.*, 2013; Martin *et al.*, 2014), their assemblages remain largely unexplored, and there is a considerable lack of knowledge regarding their diversity and community structure. *Eunicella cavolini* (Koch, 1887) is one of the most common gorgonian species in the Mediterranean Sea. While populations of this species have been recorded in several habitat types, from shallow overhangs and caves, to deep-water reefs and the slopes of seamounts, they are primarily known for establishing dense populations and creating typical facies within coralligenous outcrops (UNEP/MAP, 2007). Focusing on this particular facies, we investigated the coralligenous assemblages in three localities of the north Aegean Sea, in order to provide comparable quantitative information regarding their species composition and structure, and enable future monitoring.

Materials and methods

Six coralligenous assemblages dominated by *E. cavolini* were investigated in three geographical localities of the north Aegean Sea (Fig. 1); Pelion (2 sites), Chalkidiki (2), and Lesvos Island (2). A rapid, non-destructive method was applied through photoquadrat sampling at depths ranging from 18 to 35 m. Voucher specimens were only collected when identification through photographs was not possible. Within each site,

the assemblages were characterized using a standardized method (Kipson *et al.*, 2012), which involves the acquisition of images (25 x 25 cm) over three 0.5 m² randomly placed transects, covering a total sampling area of 1.5 m². Number and percent cover of conspicuous macrobenthic species were measured using the image segmentation tool provided by photoQuad, a free custom software dedicated to the processing of benthic images (Trygonis & Sini, 2012).

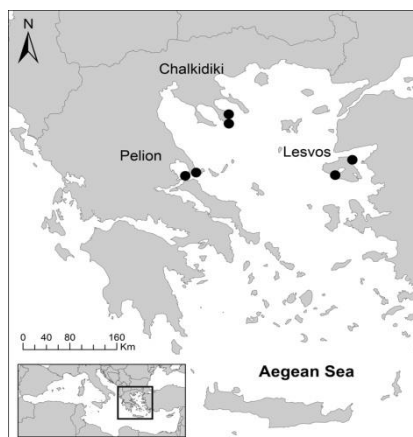


Fig. 1: Map of the Aegean Sea, sampling localities and sites

Results

A total of 144 images were analyzed, and 95 taxonomic groups were identified (see Table 1 for a list of main species), including Porifera (41), Algae (21), Anthozoa (10), Bryozoa (10), Tunicata (6), Annelida (4), Mollusca (2), and Foraminifera (1). Species richness was higher in Pelion (16.98 ± 3.3 S.D.) and Chalkidiki (15.29 ± 4.8 S.D.), compared to Lesvos (13.29 ± 3.7 S.D.). The number and cover (%) of the main taxonomic groups per locality are presented in Fig. 2a, b. Overall, 39.7% of the species were found in all localities. Porifera was the group with the highest number of species in all areas, followed by Rhodophyta. Additionally, the locality of Chalkidiki displayed a higher number of Chlorophyta (9), as well as Bryozoa (10), while Pelion had the highest number of Anthozoa species, represented primarily by scleractinians (8).

In terms of cover, algae were the dominant group in the majority of sites. Encrusting coralline algae had the highest cover (23%), being mainly represented by *Neogoniolithon mamillosum*, *Lithophyllum stictaeforme*, and *Mesophyllum alternans*, while *Peyssonnelia* species had an overall cover of 12%. Chlorophyta also presented a high overall cover (17%), mainly due to the presence of *Flabellia petiolata*, as well as several turf-forming species (e.g. *Pseudochlorodesmis furcellata*, *Cladophora pellucida*). Porifera was the second most important taxonomic group in terms of cover (28%), out of which “Encrusting Porifera” (unidentified), *Agelas oroides*, *Chondrosia reniformis*, *Crambe crambe*, and *Spirastrella cunctatrix* had the greatest contribution (21%). With the exception of *E. cavolini*, the remaining anthozoans (2.7%) were primarily represented by the zoantharian *Parazoanthus axinellae* and scleractinians (e.g. *Leptopsammia pruvoti* and *Caryophyllia inornata*), which appeared in all sites. The main bryozoans were *Adeonella calveti*, *Rhynchozoon neapolitanum*, *Schizomavella auriculata* and *Reteporella* sp. but with an overall low cover (0.7%). Finally, the tunicates that appeared in most sites were *Clavelina lepadiformis* and *Halocynthia papillosa*, whereas a relatively high cover of encrusting tunicate species was observed in a single site in Lesvos.

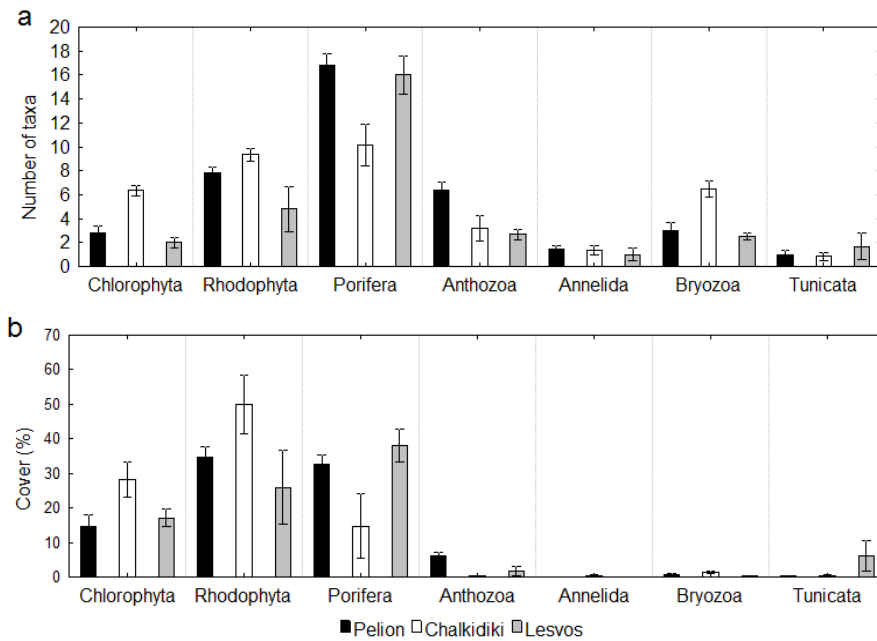


Fig. 2: a) Mean number and b) mean percentage cover of the main taxonomic groups per locality. Whisker span represents standard deviation.

Discussion and conclusions

This study is the first to provide quantitative data on the biodiversity patterns of coralligenous assemblages dominated by *E. cavolini* in the northern Aegean Sea. Results suggest that this facies encompasses a rich diversity of benthic fauna and flora. Although species richness was similar among the distinct localities, the mean number of species and mean cover per taxonomic group displayed some degree of variability. Chalkidiki was characterized by a higher number and cover of algal species, and presented the highest number of bryozoans, while the contribution of sponges was low compared to the remaining localities. On the contrary, number of sponge species was higher in Pelion and Lesvos, and their contribution to the biotic cover was similar to that of algal species. Additionally, the number and cover of anthozoans were highest in Pelion, while tunicates were more diverse in Lesvos.

Overall, community structure – in terms of species richness and biotic cover – was found to be similar to that reported in other areas of the western Mediterranean basin (e.g. Deter *et al.*, 2012; Gatti *et al.*, 2012; Kipson *et al.*, 2011; Teixidó *et al.*, 2013). However, there are also several differences which are mainly related to the composition of erect species. In the investigated sites, structural complexity at the upper layer of the assemblages was primarily promoted by the presence of *E. cavolini*, together with a large number of massive and erect sponges (e.g. *Agelas oroides*, *Axinella* spp., *Ircinia* spp., *Sarcotragus* spp.), while the number and cover of erect bryozoans was low and sporadically pronounced in certain sites. This result is in line with additional observations made outside the *E. cavolini* facies, where sponges remain the dominant structural group of the upper assemblage stratum (MS pers. obs.). Moreover, other octocoral species (e.g. *Paramuricea clavata*, *E. singularis*, and *Corallium rubrum*) are particularly rare, if not absent, in the shallow coralligenous communities of the Aegean Sea (*i.e.* <50 m, Dounas *et al.*, 2009, Salomidi *et al.*, 2009, MS pers. obs.), while *Alcyonium* species are known to be restricted to the deep “coralligène de plateau” (Pérès & Picard, 1958). On the other hand, at the basal layer, a greater number of scleractinians were recorded in the

northern Aegean localities compared to those reported for coralligenous communities in other areas of the Mediterranean.

Tab. 1 List of the main species observed in photoquadrats within the *E. cavolini* coralligenous assemblages.

Algae

Chlorophyta

Codium coralloides (Kützing) P.C.Silva
Cladophora pellucida (Hudson) Kützing
Flabellia petiolata (Turra) Nizamuddin
Halimeda tuna (J.Ellis & Solander)
J.V.Lamouroux
Pseudochlorodesmis furcellata (Zanardini)
Børgesen
Valonia macrophysa Kützing

Rhodophyta

Lithophyllum stictaeforme / cabiochiae cf.
Mesophyllum alternans (Foslie) Cabioch &
M.L.Mendoza,
Neogoniolithon mamillosum (Hauck) Setchell &
L.R.Mason,
Peyssonnelia rosa-marina Boudouresque &
Denizot,
Peyssonnelia rubra / bornetii cf.
Peyssonnelia squamaria (S.G.Gmelin) Decaisne

Porifera

Acanthella acuta Schmidt, 1862
Agelas oroides (Schmidt, 1864)
Aplysilla sulfurea Schulze, 1878
Axinella cannabina (Esper, 1794)
Axinella damicornis (Esper, 1794)
Axinella verrucosa (Esper, 1794)
Chondrosia reniformis Nardo, 1847
Clathrina clathrus (Schmidt, 1864)
Cliona celata Grant, 1826
Cliona schmidti (Ridley, 1881)
Cliona viridis (Schmidt, 1862)
Crambe crambe (Schmidt, 1862)
Dictyonella incisa (Schmidt, 1880)
Dysidea fragilis (Montagu, 1814)
Haliclona (Halichoelona) fulva (Topsent, 1893)
Haliclona (Soestella) mucosa (Griessinger, 1971)
Hexadella racovitzae Topsent, 1896
Ircinia oros (Schmidt, 1864)
Ircinia variabilis (Schmidt, 1862)

Petrosia (Petrosia) ficiformis (Poiret, 1789)
Phorbas tenacior (Topsent, 1925)
Pleraplysilla spinifera (Schulze, 1879)
Sarcotragus foetidus Schmidt, 1862,
Sarcotragus spinosulus Schmidt, 1862
Spirastrella cunctatrix Schmidt, 1868

Cnidaria

Caryophyllia (Caryophyllia) inornata (Duncan,
1878)
Eunicella cavolini (Koch, 1887)
Hoplangia durotrix Gosse, 1860
Leptopsammia pruvoti Lacaze-Duthiers, 1897
Madracis pharensis (Heller, 1868)
Paracyathus pulchellus (Philippi, 1842)
Parazoanthus axinellae (Schmidt, 1862)
Phyllangia americana mouchezii (Lacaze-
Duthiers, 1897)
Polycyathus muelleriae (Abel, 1959)

Annelida

Eupolymnia nebulosa (Montagu, 1818)
Myxicola infundibulum (Montagu, 1808)
Filograna implexa / Salmacina dysteri
Serpula vermicularis Linnaeus, 1767

Bryozoa

Adeonella calveti (Canu & Bassler, 1930)
Beania magellanica (Busk, 1852)
Hornera frondiculata (Lamarck, 1816)
Rhynchozoon neapolitanum Gautier, 1962
Schizomavella auriculata (Hassall, 1842)
Reteporella sp.
Smittina cervicornis (Pallas, 1766)

Tunicata

Aplidium elegans (Giard, 1872)
Clavelina lepadiformis (Müller, 1776)
Cystodytes dellechiaiei (Della Valle, 1877)
Didemnum spp.
Halocynthia papillosa (Linnaeus, 1767)

The results provide valuable information for future monitoring and comparisons at a Mediterranean-scale level, focusing on *E. cavolini* assemblages. Given the great geographic extent and wide bathymetric range of coralligenous communities in the Aegean Sea (Giakoumi *et al.*, 2013, Martin *et al.*, 2014; Pérès & Picard, 1958), further

research will enhance our understanding of the ecology, biodiversity patterns, and conservation status of this largely unexplored habitat.

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