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A brachiopod biotope associated with rocky bottoms at the shelf-break in the central Mediterranean Sea: geo-biological traits and conservation aspects

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Abstract

1) In the Recent, brachiopods only seldom occur in benthic communities. A biotope dominated by *Megerlia truncata* was identified in 2013 by Remotely Operated Vehicle (ROV) exploration of the south-easternmost Adriatic margin.
2) Emerging rocky substrates next to the shelf-break at ca. 120 m appear intensely exploited by this eurybathic rhynchonelliformean brachiopod attaining a population of >300 individuals/m^2.
3) Calcareous red algae are almost ubiquitous at this site and preferentially encrust sectors of the substrate where brachiopods are minimal.
4) This *Megerlia* biotope is a novel finding for this part of the Mediterranean Sea, similar to a situation previously observed in the Western Basin, off the Mediterranean French coast.
5) It is proposed that this remarkable brachiopod biotope and the adjacent Rhodolith bed are considered important for conservation management.

Keywords: Brachiopoda, *Megerlia truncata*, Mediterranean Sea, ROV, habitat mapping, natural heritage, conservation

Introduction

Brachiopods have been an important component of the benthic marine realm since the Cambrian (Santagata, 2015; Carlson, 2016). They achieved an astonishing diversity and abundance in the Paleozoic and, Mesozoic, with some 30,000 described species. A net decline took place in the Cenozoic, with ca. 400 species known in the modern ocean (Emig, Bitner, & Álvarez, 2013). At present, rhynchonelliformean brachiopods are prevalently throughout temperate to polar regions (e.g., Foster, 1974; Campbell & Fleming, 1981; Tunnicliffe & Wilson, 1988; Hiller, 1991; Lee, 1991; Roux & Bremec, 1996; Baird, Lee & Lamare, 2013; Emig, 2017; Gordillo, Muñoz, Bayer & Malvé, 2018), and, more rarely, at tropical latitudes (Laurin, 1997; Kowalewski, Simões, Carroll, & Rodland, 2002; Simões, Kowalewski, Mello, Rodland, & Carroll, 2004). These filter-feeders settle on mobile to hard substrates from subtidal to abyssal depths (Emig et al., 2013). Today, as for the past, their occurrence is controlled by oceanographic factors, above all current strength, nutrient availability and oxygen content (Fürsich, & Hurst, 1974; Tunnicliffe & Wilson, 1988; Kowalewski et al., 2002; Gordillo, Muñoz, Bayer, & Malvé, 2018). Overall, brachiopods play a minor role in modern benthic communities but there are a few examples where they achieve high abundances, like fjords of the

Canadian Pacific (Tunnicliffe & Wilson, 1988), Chilean Patagonia (Baumgarten, Laudien, Jantzen, Häussermann, & Försterra, 2014) and New Zealand (Bowen, 1968), or the California shelf-break (Pennington, Tamburri, & Barry, 1999). *Post-mortem* subtidal brachiopod shell accumulations are also only seldom recorded (Simões & Kowalewski, 2003; Simões, Rodrigues, de Moraes Leme, & Pires-Domingues, 2007).

The temperate Mediterranean Sea is home to a relatively diverse brachiopod fauna that includes up to 13-14 species (Logan, 1979; Logan, Bianchi, Morri, & Zibrowius, 2004, Emig, 2014). Many such taxa are distributed at shallow depths, often in cryptic habitats (SPA/RAC–UN Environment/MAP, OCEANA, 2017), and six (*Novocrania anomala*, *Gryphus vitreus*, *Terebratulina retusa*, *Megathiris detruncata, Platidia anomioides, Megerlia truncata*) live deeper being either eurybathic (circalittoral-bathyal) or exclusively bathyal. The eurybathic *Gryphus vitreus* (= *Terebratula vitrea*) may form dense populations on mobile silty to coarser sediment on the outer continental shelf and upper slope (Pérès & Picard, 1964; Emig, 1989; Madurell et al., 2012; Aguilar et al., 2015; SPA/RAC–UN Environment/MAP, OCEANA, 2017), or colonize hard substrates (Fourt, Goujard, Perez, & Chevaldonné, 2017). Large subfossil accumulations of *G.vitreus* of Pleistocene age are sometimes found (Emig, 2018, 34-35). Many equivalent fossil situations with terebratulid assemblages are documented in the Neogene to Pleistocene record of the Mediterranean basin (e.g., Gaetani & Saccà, 1983). *Terebratulina retusa* is often recorded from hard substrates at considerable depths (Taviani et al., 2017) and also frequently occurs in the Mediterranean fossil record. The inarticulate brachiopod *Novocrania anomala* can be found in considerable numbers attached to dead biogenic frames, hardgrounds or bedrock, but documentation of this in fossil record is not known (Barrier et al., 1996).

A rather common eurybathic rhynchonelliformean brachiopod in the Mediterranean Sea is *Megerlia truncata* (Linnaeus, 1767). Its geographic range extends to the eastern Atlantic Ocean and occurs at depths between 5-800 m (Logan, 1979; Brunton, 1988; Anadón, 1994; Logan, Bianchi, Morri, Zibrowius, & Bitar, 2002; Logan et al., 2004; Çinar, 2014; Emig, 2014, 2018; Gerovasileiou & Bailly, 2016; Álvarez, Emig, & Tréguier, 2017). In the Recent, *M. truncata* is generally associated with coarse detritic substrates, hardgrounds and bedrock, and with cold-water coral frames from the circalittoral to the bathyal zones (Madurell et al., 2012; Fourtet al., 2017; Emig, 2014, 2018), their dead shells being abundant in submarine deposits (Remia & Taviani, 2005; Taddei Ruggiero, Buono & Raia, 2006). Although it may be common locally, it is not known to play a dominant role in benthic communities, with the exception of the assemblage found at ca. 105 m at Banc d'Esquine, off the Mediterranean French coast (Fourt et al., 2017). Finally, there aresituations where some of the taxa mentioned above (*G. vitreus, T. retusa, M. truncata, M. detruncata* and *N. anomala*) share the same hard substrates at depth (Fourt et al., 2017).

Here we report the first discovery of a distinct brachiopod biotope dominated by *Megerlia truncata* (Linnaeus, 1767) in the central Mediterranean Sea, offshore the Albanian-Greek shelf at the boundary between the Adriatic and Ionian seas. To the best of our knowledge, a comparable biotope has been previously identified only in the Western Mediterranean at similar depth and type of substrate (Fourt et al., 2017). This new finding is discussed in terms of biological characteristics, oceanographic and geo-sedimentary conditions, actuo-paleontological potential and conservation issues.

Material and Methods

The study-area is located in the Bay of Saranda at ca. 20 km from the Albanian coast at ca. 130 m depth (Figure 1). The site was surveyed during the COCOMAP13 oceanographic cruise R/V Urania (May 2013). Bathymetric data, Remotely Operated Vehicle (ROV) images, bottom samples, and hydrological casts were collected. Swath bathymetry was acquired using a hull-mounted Kongsberg Simrad EM302, with a nominal frequency of 30 kHz, swath coverage of ca. 4x greater than water depth and 512 beams per second acquired with Reson PDS2000 software. All data were plotted in the Transverse Mercator – UTM34N-WGS84 Coordinate System. A morphobathymetric map (Figure 1b), with a cell size of 1x1 m, was obtained using CARIS SIS and HIPS software. Physical properties of the seawater were sourced from the World Ocean Atlas 2013 version 2 (WOA13v2) dataset (Locarnini et al., 2013), which provided long-term averaged (1955-2013) temperature and salinity values of 14.43 °C and 38.60, respectively.

The ROV dive (COC13-28) was performed using a Pollux III (Global Electric Italiana) equipped with a low resolution CCD video camera for navigation and a high resolution video camera (SonyHDR-HC7) with an image frame of 2304x1296 dpi; three laser beams positioned 20 cm from each other provided the scale bar on the videos (metadata are reported in Table 1). The ROV was equipped with an underwater acoustic tracking system which provides position and depth every 1s. Taxonomic identifications were made using high resolution still image analysis, while low resolution images were analysed for habitat mapping along the ROV track (Figure 1c-d). Low-resolution still frames were automatically extracted every 10s, all images were georeferenced using Adelie and ESRI ArcGIS software. Macro- (>0.5 mm) and mega-benthic organisms (>2 cm) were identified to the lowest taxonomic rank (Table 2); taxa that could not be identified from images to species-level, such as sponges, were identified only as morphospecies or morphological categories (e.g., Bell & Barnes, 2001; Santín et al., 2019). Taxonomic names conform to the World Register of Marine Species database (WoRMS Editorial Board, 2019). A large volume (60 l) modified Van Veen grab was used to collect sediments from this site (sample COC13-29) which are stored at the ISMAR-CNR Repository in Bologna.

A 3D model (Figure 3b) was reconstructed using Agisoft Photoscan Professional Edition V. 1.2.5. A set of georeferenced high-definition images from ROV videos was selected to reconstruct both the brachiopod- and sponge-dominated rocky outcrops. Firstly, pictures were aligned at high accuracy to create a dense-point cloud. Meshes were then constructed with a high polygon count and a texture layer of the outcrops was created using a mosaic blending mode and superimposed on the meshes.

Results

The outer shelf of the Albanian-Greek continental margin, where the site is located, is characterized by a complex geomorphologic setting that includes rocky highs, blocks and concretions surrounded by vast stretches of coarse biogenic-detrital sediment enriched in rhodoliths (Figure 1). It extends over an area of ca. 10 km^2 and is characterized by a structural high reaching a maximum elevation of ca. 100 m (from 201 to 107 m) and oriented northwest-southeast. The top of this tectonially-driven structure is dominated by small-scale (only few metres) geomorphic reliefs and backscatter (i.e., reflectivity) image analysis shows high reflectivity that indicates the presence of a hard (rocky and/or pebbly) substrate (Figure 1).

The survey covered a total length of 1322 m between 108-130 m, and explored the area with the maximum reflectivity value (Figure 1, Table 1). Two main biotopes were identified and mapped along the ROV track: (1) a Brachiopod-dominated biotope (Bb) settled on hard substrates for a total length of 417 m covering an area of 1251 m^2; (2) a Rhodolith bed (Rb) distributed over a generally flat surface (Figure 1c). The Brachiopod biotope is characterized by two main facies, one dominated by brachiopods, and another where brachiopods and encrusting/erect sponges co-occur (for a length of 279 m). A third facies was observed on top of the blocks, characterized by small patches of *Filograna/Salmacina* complex with *Axinella vaceleti* and *A. verrucosa* (linear extension of 14 m).

Brachiopods colonized mostly steep hard substrates (along the ROV track, for a length of 138 m). *Megerlia truncata* was the species that typified this biotope (Figures 2a, c-e; 3a-c), which attained a mean density of 176±128 individuals/m^2 and maximum density of >300 individuals/m^2 (Figure 3b). Brachiopods were preferentially distributed on rocks facing towards to the coast, from West to Southwest, while Rb faced both sides (Figure 1d). The Bb is bathed by the Eastern Adriatic Current (EAC) that flows northward (e.g., Cushman-Roisin, Gačić, Poulain & Artegiani, 2013; de Ruggiero et al., 2018), however, as shown by the Adriatic Forecasting System model (http://oceanlab.cmcc.it/afs/), the main water mass at 100 m depth in the Bay of Saranda flows southward. In general, *M. truncata* dominates over sessile and encrusting macrofauna (e.g., sponges), however, encrusting red algae seldom develop on living *Magerlia truncata* shells (ca. 10% of the imaged brachiopods) and represents the main epibiosis affecting brachiopod shells (Figures 3c; S1b). There was no evidence of other macroinvertebrates (e.g., bryozoans) was recorded on the surface of the living brachiopods. *Rhabderemia* sp. and *Hexadella pruvoti* are the most common sponges recorded together with crustose coralline algae (CCA) on hard substrates (Figure 2c-e). Cnidarians, such as the sea anemones cf. *Hormathia coronata* and the solitary coral *Caryophyllia calveri* are relatively common, and among annelids *Protula* sp. and *Serpula vermicularis* are the dominant species (Figure S1b-d). The red lance urchin *Stylocidaris affinis* and the hatpin urchin *Centrostephanus longispinus* are vagile organisms that commonly occur also with abundant juvenile specimens (<3 cm in diameter) of *C. longispinus* in the explored area (Figures 2a; S1b). Demersal fish fauna is represented mainly by *Phycis phycis* and by the rare parrot seaperch *Callanthias ruber* that shelter under substrate cavities and ledges (Figure S2a, d; Table 2). All identified *M. truncata* specimens were alive, often feeding (Figure S1b-d); no dead shells where found excepted for those recorded loose on the sedimentary cover at the base of hard substrates (Figures 3c-g; S1a).

The Rhodolith bed extends for 668 metres, with a live coralline-algae coverage estimated at ca. 3 km^2 using backscatter mapping (Figure 1c). No detailed analysis of the living algal component is possible based only on the ROV images, and floras have been generally indicated as CCA. The surveyed area represents one of the deepest living Mediterranean rhodolith beds (Aguilar, Pastor, de la Torriente & García, 2009; Basso, Babbini, Ramos-Esplá & Salomidi, 2017), and the 2005-2009 averaged value of Photosynthetically Active Radiation (PAR) on the seafloor, extracted from EUSeaMap 2016 dataset (European Marine Observation Data Network (EMODnet) Seabed Habitats project, http://www.emodnet-seabedhabitats.eu/) indicate a value of 0.0014 that corresponds to the lowest possible occurrence of red CCA (Runcie, Gurgel & Mcdermid, 2008 with references therein). In general, rhodoliths take the form of small boxworks (< 2 cm) which define the bed thickness (Bracchi et al., 2019). Biodiversity of the Rb is characterized by few dominant taxa (Table 2), mostly erect sponges, such as the fan-shaped cf. *Poecillastra compressa* and the erect *Aplysina cavernicola* (Figure 2e). Vagile fauna is dominated by *Stylocidaris affinis*, while demersal fishes of some commercial value are *Pagellus erythrinus* and *Pagrus pagrus*. The lobster *Palinurus elephas* reprents an invertebrate recorded in the IUCN Red List as Vulnerable (IUCN, 2019).

Finally, in the northernmost surveyed area (Figures 1b), the encrusting sponge *Dendroxea* cf. *lenis* covers a wide portion of the substrate that prevents the settlement of other organisms, including brachiopods.

Discussion

General traits. Dense aggregations of pedunculate brachiopods on hard substrates, such as vertical walls or large boulders, have been rarely reported in the literature. Examples are from the Bay of Fundy in the Canadian Atlantic where *Terebratulina septentrionalis* reaches an average density of 471 individuals/m^2 (Logan & Noble, 1971), the Chilean fjordland where *Magellania venosa* may attain a density of 200 individuals/m^2 (Baumgartenet al., 2014) and in Canadian fjords of British Columbia where brachiopods (such as the Rhynchonelliformea *Laqueus californianus* and *Terebratulina unguicula*) reach a maximum of 945 individuals/m^2, with an average density of 190 individuals/m^2 (Tunnicliffe & Wilson, 1988).

The only other occurrence of *M. truncata* aggregations on rocky substrates at similar depths is that on the French coast mentioned above (Fourt et al., 2017). No data are reported for the French site but the density is comparable to the central Mediterranean site. The high abundance of this almost mono-specific aggregation of *M. truncata* on the shelf-break seems to be a function of the following conditions. Firstly, the peculiar geomorphology of a shelf typified by mobile sediments (and inhabited by a related infauna and mobile epifauna), but complicated by the local occurrence of rocky blocks that offer a substrate for sessile fauna. Secondly, the relatively high colonization potential of a pedunculate brachiopod that displays a eurytopic distribution in terms of depth (5-600 m) and substrate (coarse-particulate to hard); a key factor promoting this may be the recruitment of *Mergerlia* larvae from different suitable habitats nearby. Thirdly, favourable oceanographic conditions that can sustain a dense population of filter feeders, with bottom currents capable of transporting food particles and winnowing the substrate; this oceanographic condition is guaranteed by the NE-flowing current that flushes the shelf-break here, and is bound by the Adriatic Surface Water and the deeper Levantine Intermediate Water deeper (Cushman-Roisinet al., 2013; de Ruggiero et al., 2018 with reference therein).

Conservation aspects

Brachiopod-dominated assemblages are commonplace in the geological record, and to a lesser degree in the Recent. Regarding the Mediterranean Basin, one fossil site of Pliocene age is characterized by a distinct terebratulid paleocommunity, which has been anecdotally proposed for protection (Pavia & Zunino, 2008). Modern brachiopod communities of the Mediterranean Sea are not identified for conservation, which is guaranteed if they occur in ecologically-valuable areas. This is the case of Banc de l'Esquine off the French Riviera, which is located within the Calanques National Park. The uniqueness of the Brachiopod biotope dominated by *M. truncata* located at the Albanian-Greek shelf-break calls for taking formal conservation action, also given that it co-occur with a deep-water rhodolith bed (e.g., Salomidi et al., 2012; Basso, Babbini, Kaleb, Bracchi, & Falace, 2016, Bracchi et al., 2019). The ecological value is further strengthened by the presence here of invertebrates (Table 2 and Figure 2a) listed in the 'Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean' of the Barcelona Convention, such as the erect sponge *Aplysina cavernicola*, the lobster *Palinurus elephas*, and the hatpin urchin *Centrostephanus longispinus* (Annex IV of Habitat Directive, Appendix II of Bern Convention and Annex II of the protocol of the Barcelona Convention). ROV images document the existence of juvenile specimens of *C. longispinus*, what makes the site highly interesting in terms of larval recruitment and, possibly, nursery grounds. Besides the presence of these important taxa, the complex morphology of the site produces cryptic microtopographic situations, ideal for various other sessile and mobile invertebrates, but also for demersal fish (Table 2). At the time of our ROV survey (springtime 2013), there was no evidence of noticeable impacts (e.g., excessive litter or trawl and longline fishing). Anthropogenic-driven stressors, such as global warming and ocean acidification could potentially compromise the Good Environmental Status of this biotope in the future. Especially important might be global warming, which could modify the water mass sustaining the brachiopod community by affecting nutrient content, current strength and flows path. The effects of ocean acidification on brachiopod calcite are less likely to hinder the shell calcification process (Ye et al., 2018; Cross, Peck & Harper, 2018). Thus, we do not foresee major concerns over the short-midterm for the continued survival of the Bb. As a precautionary approach, however, we suggest that protective measures are needed to prevent future disturbances to the biotope (dumping, infrastructure, fishery), such as the implementation of marine protected area. Alternatively, this site should be considered as a Site of Community Importance (SCI), in agreement with the EU Directive 92/43/CEE. The justification is to consider this Bb as a subtype of 'reef' in the Habitat Directive. We propose a region that encompasses the most valuable ecological components of this sector of the shelf, centered on the Bb and surrounding Rhodolith bed, with a reasonably-wide buffer area (Figure 4), of 10 km^2 and 17 km^2, respectively.

Conclusions

1. A biotope dominated by the pedunculate brachiopod *Megerlia truncata* has been identified in the Albanian-Greek offshore, Mediterranean Sea; a comparable biotope was previously only known for the Western Mediterranean, off the French coast.
2. This biotope is located at the shelf-break at ca 120 m, where hard substrates emerge from the mobile sediment represented by a rhodolith bed.
3. The combined Brachiopod biotope and Rhodolith bed host taxa of recognized conservation value. The site is home to a variety of sessile and mobile invertebrates and demersal fish.
4. Conservation-wise, we suggest that this rare biotope and adjacent rhodolith bed deserve protection status and the best area to implement a MPA is proposed.

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Figure captions

Figure 1. Location and morphobathymetric maps of the investigated area. Habitats along the ROV path are also shown on the backscatter and aspect maps.

Figure 2. Main characteristics of biotopes in the area. a) Brachiopod biotope, bar = 20 cm; b) Rhodolith bed, with *Poecillastra compressa*, bar = 20 cm; c) detail of the Brachiopod biotope, note substrate occupancy by brachiopods and crustose coralline algae (CCA), bar = 10 cm; d) detail of the Brachiopod biotope showing a predominance of *Hexadella pruvoti* (yellow sponge) and CCA over *Megerlia truncata*, bar = 10 cm; e) co-dominance of CCA, *Megerlia truncata* and sponges, bar = 10 cm; f) *Filograna*/*Salmacina* complex with the sponges *Axinella vaceleti* and *A. verrucosa*, bar = 20 cm.

Figure 3. a) Dense *Megerlia truncata* aggregations (> 350 individuals/0.36 m^2), bar = 10 cm; b) 3-D image of a block covered by brachiopods; c-d) photograph of brachiopod biotope and related artistic cartoon highlighting living and dead *Megerlia truncata*, bar = 10 cm; e-g) station COC13-29, sediment collected by grab from the Rhodolith bed: e) gravel-size/coarse sand fraction (> 1 cm), Rhodalgal facies showing the absolute prevalence of rhodolith nodules over other biogenic components, bar = 3 cm; f) Foramol facies of sand fraction (> 1 mm), S = serpulid, By = bryozoan, Bi = bivalve, G = gastropod (juvenile of *Bolma rugosa*), bar = 1 mm; g) fine fraction > 63 µm, brachiopod (B), bryozoan (By), foraminifer (F), bar = 0.5 mm.

Figure 4. Core and buffer areas deserving adequate protection to protect the Brachiopod biotope and adjacent Rhodolith bed.

Tables

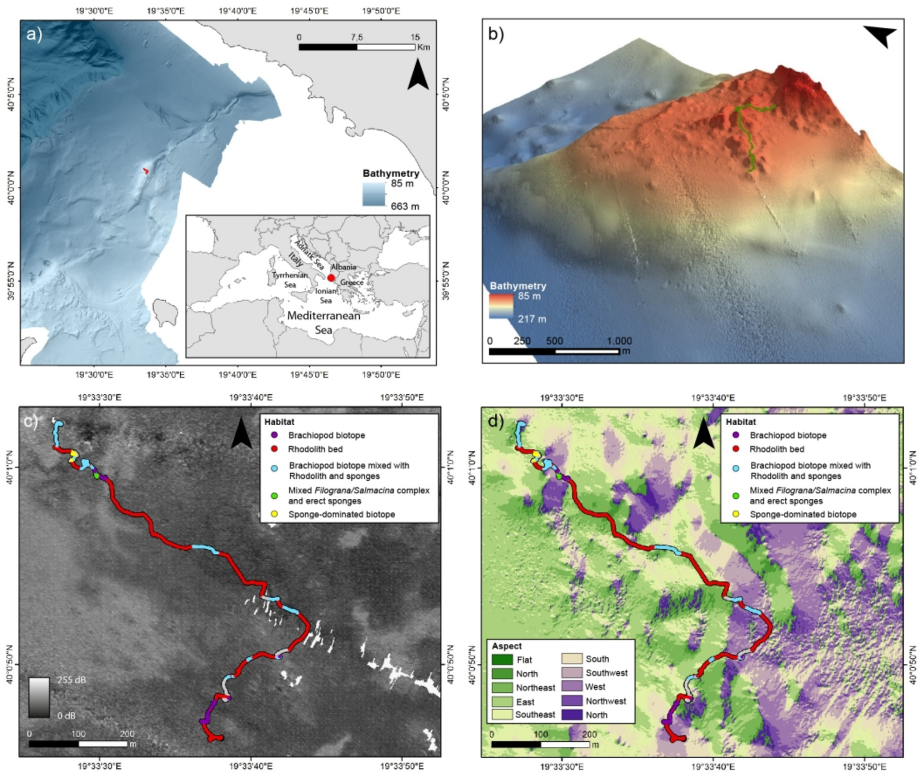
Table 1. ROV metadata.

Cruise	Station	Date	Start lat N [deg/min]	Start long E [deg/min]	Start depth [m]	End lat N [deg/min]	End long E [deg/min]	End depth [m]
COCOMAP13	coc13_28_rov	30/05/2013	40.0128	19.5605	106	40.0173	19.5576	113

Table 2. Living macrorganisms observed or sampled in the explored area. B indicates organisms that pertain to the newly described Brachiopod biotope while R to the surrounding Rhodolith bed. Asterisks indicate the legal instruments under which the species are protected: *Bern Convention, Appendix II, III (Convention on the Conservation of European Wildlife and Natural Habitats); **CITES, Appendix II (Convention on International Trade in Endangered Species of Wild Fauna and Flora); ***ASPIM Annex II, III; ****Habitat Directive, Annex II, IV, V.

	Phylum	Class	Taxon	Habitat
1	Rhodophyta	Florideophyceae	Crustose Coralline Algae (CCA)	Rb, B
2	Foraminifera	Monothalamea	*Pelosina* sp.	Rb
3		Globothalamea	*Miniacina miniacea* (Pallas, 1766)	B
	Porifera	Demospongiae	sp. 1	Rb
			sp. 2	B
			sp. 3	B
			sp. 4	Rb
			sp. 5	B
			sp. 6	Rb, B
4			Tetractinellida spp.	B
5			cf. *Poecillastra compressa* (Bowerbank, 1866)	Rb, B
			cf. *Suberites syringella* (Schmidt, 1868)	B
6			*Penares helleri* (Schmidt, 1864)	B
7			cf. *Rhabderemia* sp.	B
8			*Hamacantha* cf. *falcula* (Bowerbank, 1874)	B
9			*Mycale* sp.	Rb
10			cf. *Raspaciona aculeata* (Johnston, 1842)	B
11			*Axinella vaceleti* Pansini, 1984	B
12			*Axinella verrucosa* (Esper, 1794)	B
13			*Dendroxea* cf. *lenis* (Topsent, 1892)	B
14			*Haliclona* sp.	B
15			*Aplysina cavernicola* (Vacelet, 1959)*	Rb/B
17			*Hexadella pruvoti* Topsent, 1896	B
23	Cnidaria		Hydrozoa spp.	B
24		Anthozoa	*Alcyonium palmatum* Pallas, 1766	B
25			Cerianthidae sp.	B
26			cf. *Hormathia coronata* (Gosse, 1858)	B
27			Actiniaria sp. 1	B

28			*Caryophyllia calveri* Duncan, 1873**	B
29	Mollusca	Gastropoda	cf. *Jujubinus exasperatus* (Pennant, 1777)	B
30		Cephalopoda	*Sepia officinalis* Linnaeus, 1758	Rb
31	Annelida	Polychaeta	*Bonellia viridis* Rolando, 1822	Rb/B
32			Sabellidae spp.	Rb/B
33			*Serpula vermicularis* Linnaeus, 1767	B
34			*Protula tubularia* (Montagu, 1803)	B
35			*Filograna*/*Salmacina* complex	B
36			Serpulidae spp.	Rb/B
37	Arthropoda	Malacostraca	*Plesionika narval* (Fabricius, 1787)	Rb/B
38			*Palinurus elephas* (Fabricius, 1787)*, ***	Rb
39	Brachiopoda	Rhynchonellata	*Megerlia truncata* (Linnaeus, 1767)	B
40	Echinodermata	Echinoidea	*Stylocidaris affinis* (Philippi, 1845)	Rb/B
41			*Centrostephanus longispinus* (Philippi, 1845)*, ***,****	B
42	Echinodermata	Asteroidea	*Peltaster placenta* (Müller & Troschel, 1842)	B
43			cf. *Hacelia attenuata* (Gray, 1840)	B
44	Chordata	Tunicata	cf. *Clavelina lepadiformis* (Müller, 1776)	B
45		Actinopterygii	*Macroramphosus scolopax* (Linnaeus, 1758)	Rb
46			*Callanthias ruber* (Rafinesque, 1810)	B
47			*Facciolella oxyrhyncha* (Bellotti, 1883)	B
48			*Ariosoma balearicum* (Delaroche, 1809)	Rb
49			*Chlorophthalmus agassizi* Bonaparte, 1840	Rb
50			cf. *Molva macrophthalma* (Rafinesque, 1810)	Rb
51			*Phycis phycis* (Linnaeus, 1766)	B
52			*Pagellus erythrinus* (Linnaeus, 1758)	Rb
53			*Pagrus pagrus* (Linnaeus, 1758)	B
54			*Spondyliosoma cantharus* (Linnaeus, 1758)	Rb
55			*Spicara smaris* (Linnaeus, 1758)	Rb/B
56			*Spicara* sp.	B



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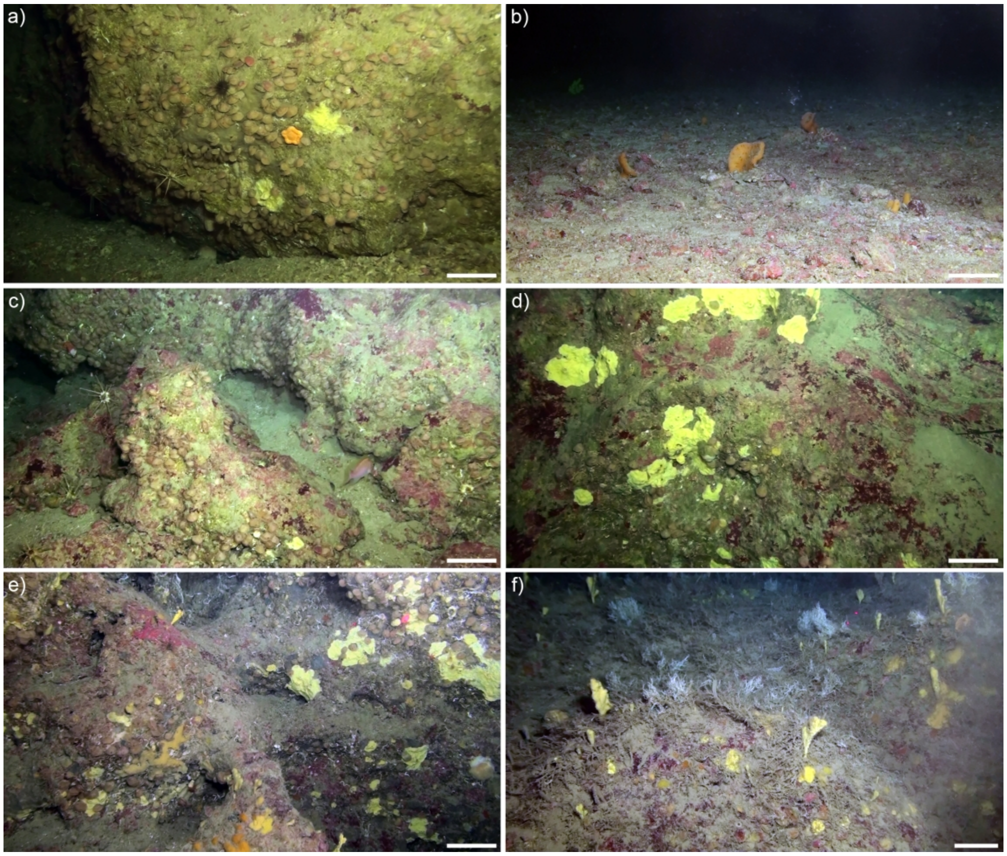

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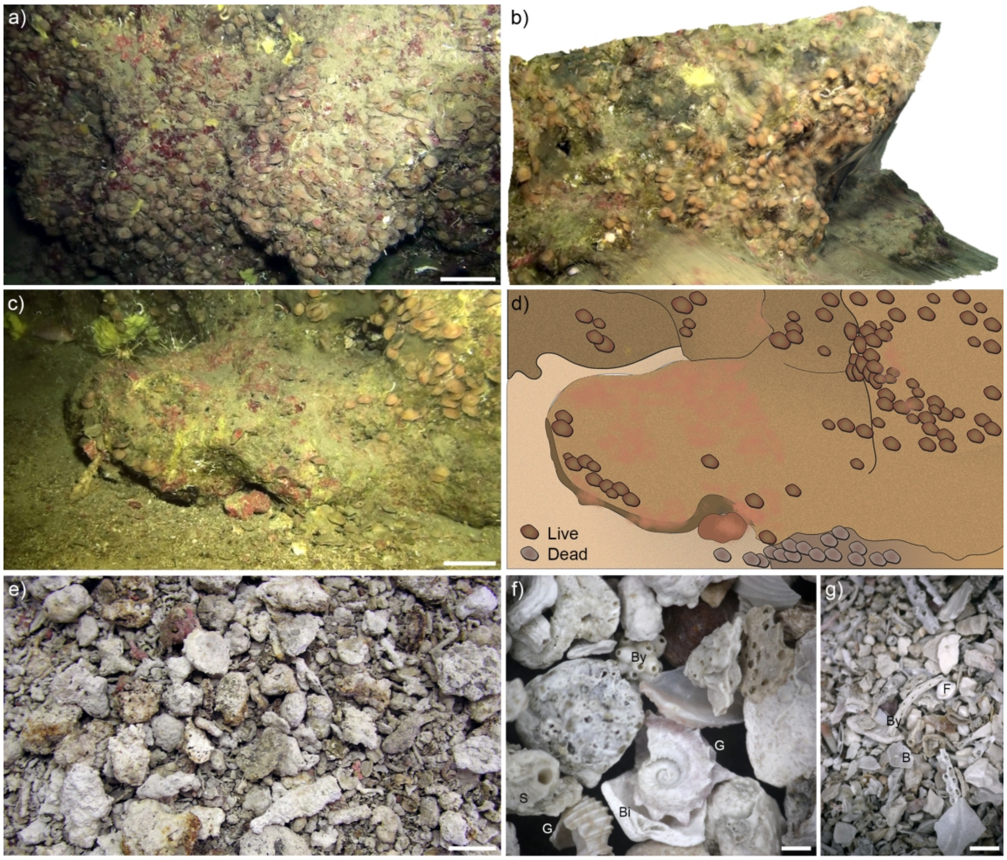

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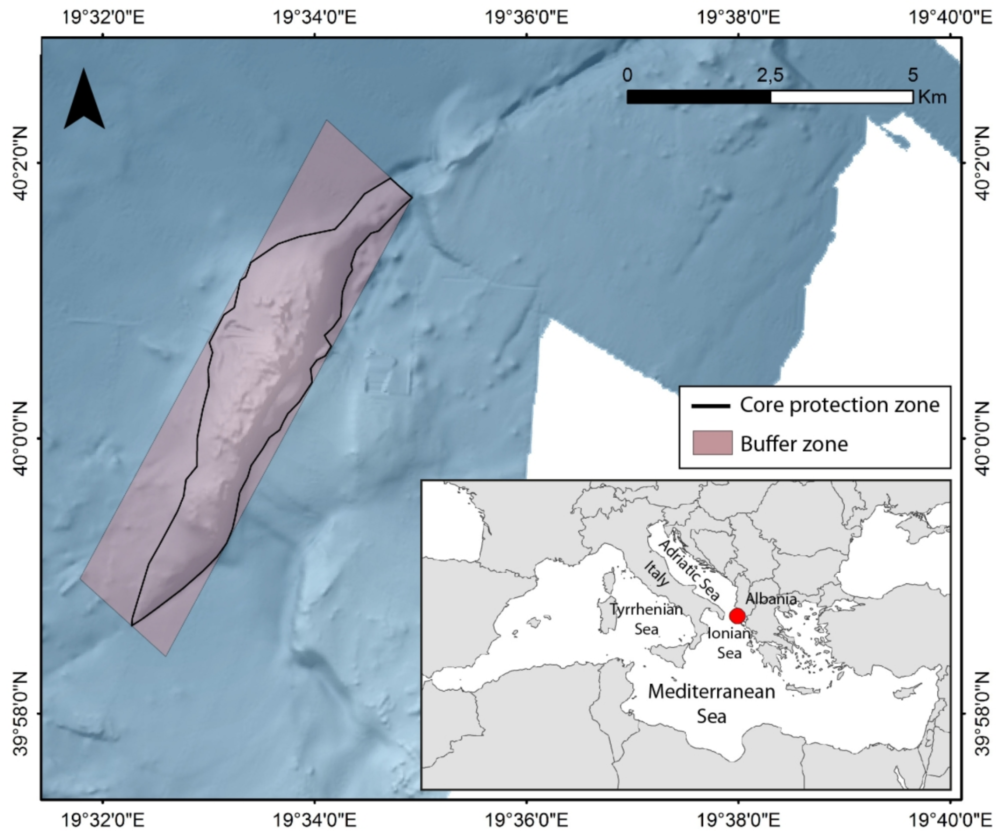

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170x143mm (300 x 300 DPI)