

The understory of gorgonian forests in mesophotic temperate reefs

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S1 Distribution of *Paramuricea clavata*

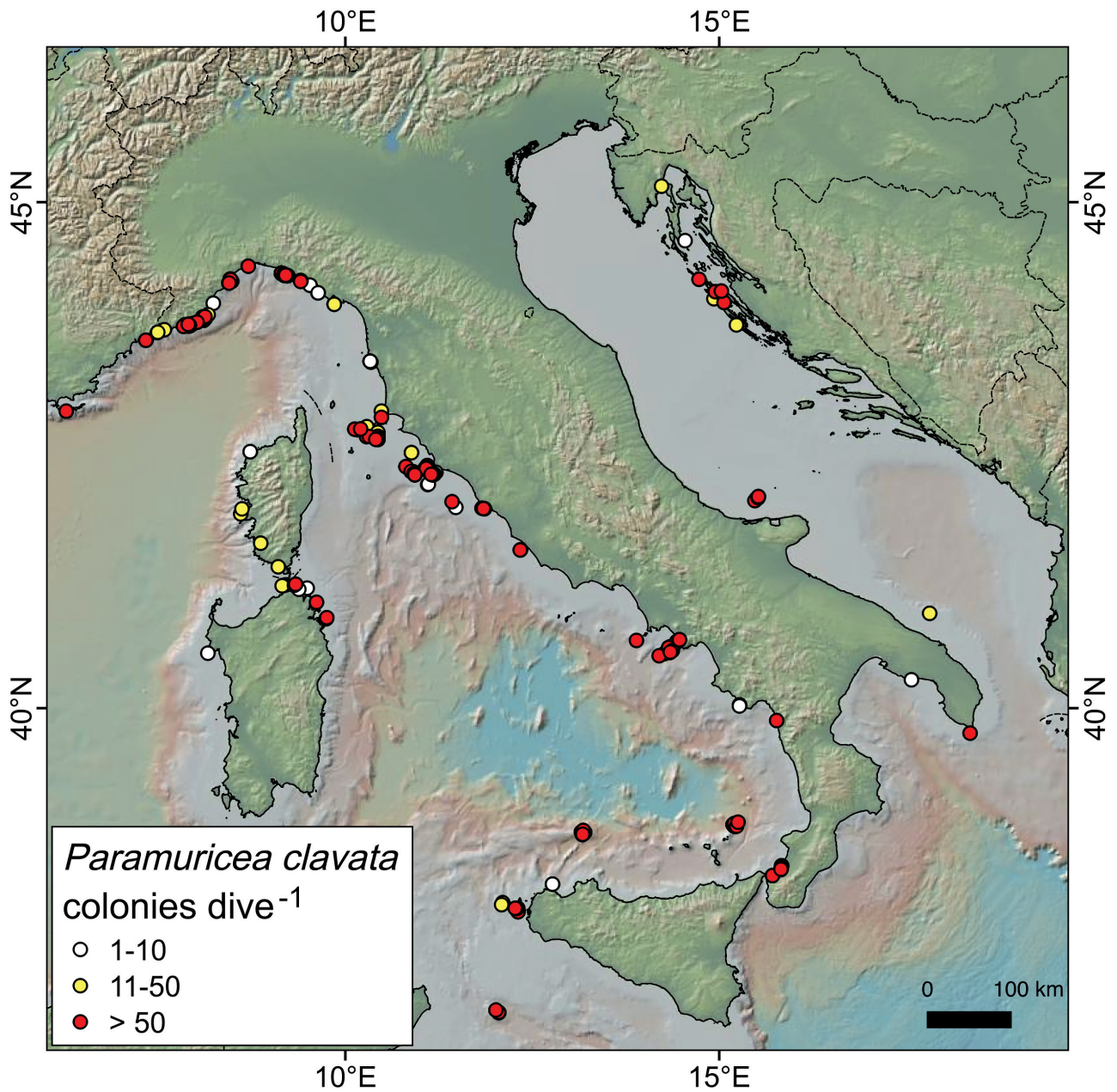


FIGURE S1.1 Reports of *Paramuricea clavata* colonies provided by volunteer divers according to the Reef Check protocol (www.reefcheckmed.org; Cerrano, Milanese, & Ponti, 2017) along Italian, French and Croatian coasts from 2006 to 2016 (n = 698). Abundances are reported in terms of number of colonies sighted per dive by independent observers (base map: Global Multi-Resolution Topography, GMRT (Ryan et al., 2009); Mercator Projection, Datum WGS 84).

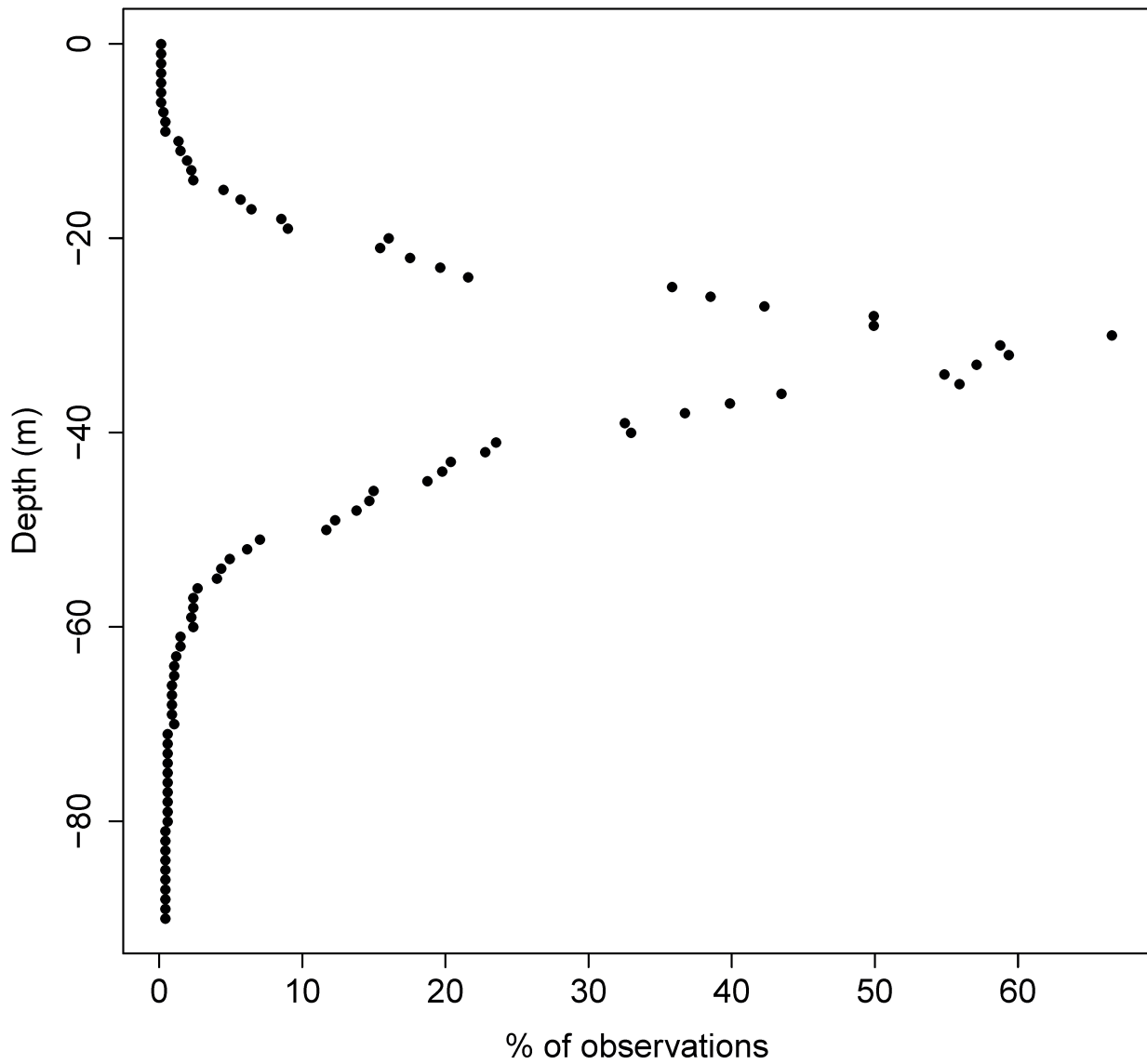


FIGURE S1.2 Bathymetric distribution of *Paramuricea clavata*. Percentage of observations provided by volunteer divers according to the Reef Check protocol (www.reefcheckmed.org; Cerrano, Milanese, & Ponti, 2017) along Italian, French and Croatian coasts from 2006 to 2016 (n = 667).

S2 Geological and environmental features at each study site

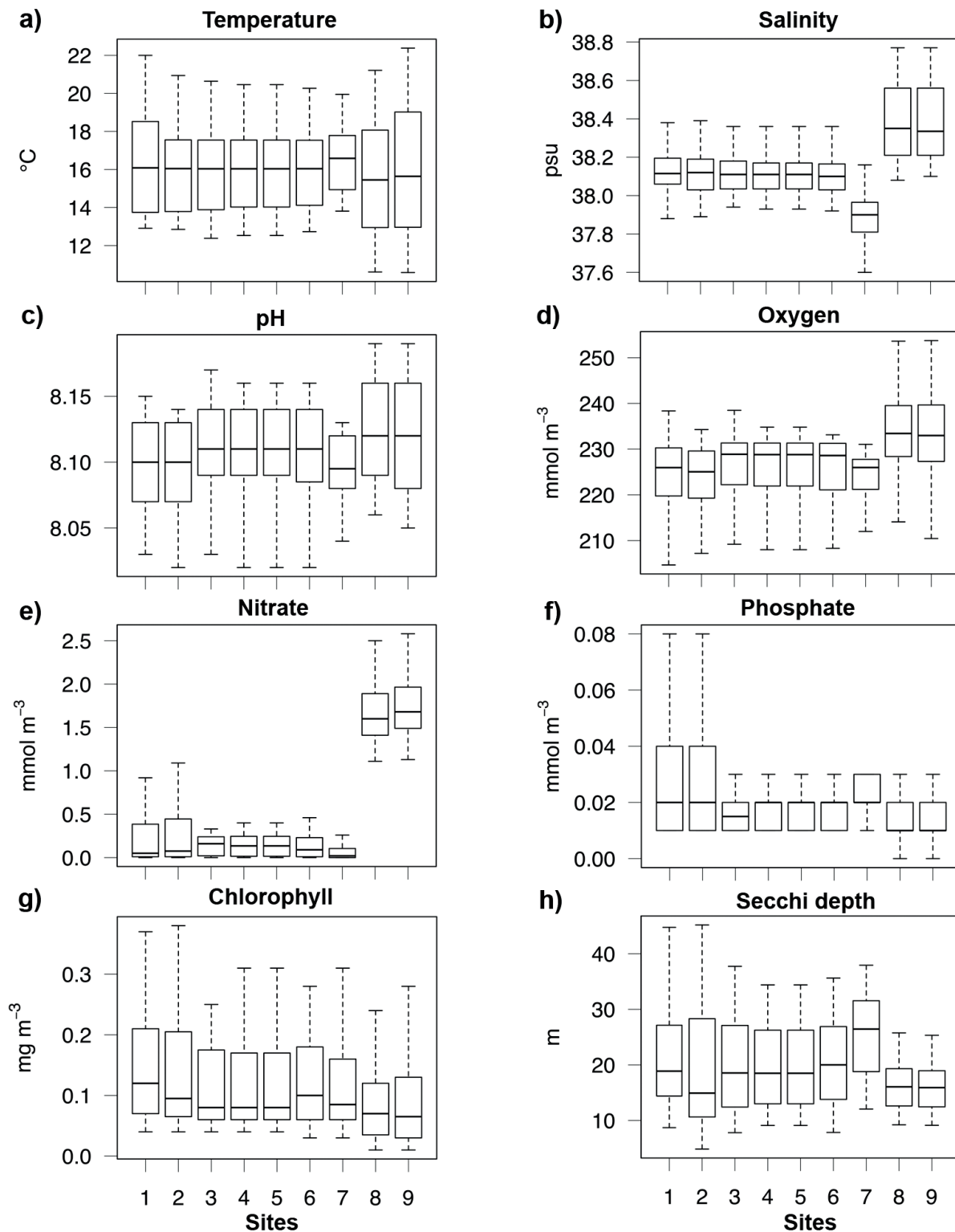


FIGURE S2.1 Boxplot of the monthly mean temperature (a), salinity (b), pH (c), concentration of dissolved Oxygen (d), Nitrate (e), Phosphate (f), and Chlorophyll (g), and water transparency as Secchi depth (h), estimated at each sampling site and depth in the period January 2009 - December 2014 ($n = 72$, except for Secchi depth at Site 1, $n = 67$, and at Site 2 and 8, $n = 71$).

All data were retrieved from the E.U. Copernicus Marine Service Information (<http://marine.copernicus.eu/>). Temperature and salinity were derived from the Mediterranean Sea Physics Reanalysis numerical model (Spatial resolution: 0.06°; Vertical resolution: 72 levels) provided by the MED-INGV-BOLOGNA-IT unit (Fратиanni et al., 2015); oxygen, nutrients and chlorophyll concentration were obtained from the Mediterranean Sea Biogeochemistry Reanalysis numerical model (Spatial resolution: 0.06°; Vertical resolution: 72 levels) provided by the MED-OGS-TRIESTE-IT unit (Teruzzi et al., 2016); water transparency data come from the Global Ocean and Optics GlobColour-OSS2015 satellite observations (Spatial resolution: 4 km; Vertical resolution: surface) provided by the OC-ACRI-NICE-FR unit.

TABLE S2.1 Geological features at the sampling sites.

Site	Geological formation	Period	Source
1	Marl-limestone	Jurassic	Geological Map of France http://infoterre.brgm.fr
2	Sandstone and conglomerates	Palaeogene	Geological Map of Italy http://www.pcn.minambiente.it
3-6	Metamorphic limestones and marls sometimes with shales and radiolarytes	Jurassic	Geological Map of Italy http://www.pcn.minambiente.it
7	Terrigenous-skeletal limestones like “Panchina”	Pleistocene	Geological Map of Italy http://www.pcn.minambiente.it
8-9	Carbonate (limestone, dolomite, and carbonate breccia)	Cretaceous	Pikelj & Juračić, 2013 http://www.hgi-cgs.hr

TABLE S2.2 Sampling site names and locations. Sampling depths, substrate inclinations and orientations are also reported.

No.	Site name	Location	Sea	Country	Latitude	Longitude	Depth	Inclination	Orientation	Sampling date
					North	East				
1	P.te Causinière	Cap Ferrat	Ligurian Sea	FR	43.67603°	7.33505°	32-34	Vertical	135°	16/10/2014
2	Colombara	Portofino	Ligurian Sea	IT	44.31159°	9.17580°	35-36	Vertical	225°	13/06/2014
3	Punta delle Cannelle	Elba Island	Tyrrhenian Sea	IT	42.77617°	10.43467°	36-38	Horizontal	112°	06/11/2015
4	Capo Calvo	Elba Island	Tyrrhenian Sea	IT	42.73465°	10.43412°	36-38	Horizontal	67°	08/11/2015
5	Picchi di Pablo	Elba Island	Tyrrhenian Sea	IT	42.72733°	10.43517°	36-38	Horizontal	67°	07/11/2015
6	Scoglio del Remaiolo	Elba Island	Tyrrhenian Sea	IT	42.70968°	10.43467°	36-38	Horizontal	157°	07/11/2015
7	Punta San Paolo	Ustica Island	Tyrrhenian Sea	IT	38.69627°	13.18653°	40-42	Vertical	135°	27/08/2014
8	Zverinac Južni Rt	Zverinac Island	Adriatic Sea	HR	44.14483°	14.94783°	33-35	Vertical	157°	09/08/2014
9	Rivanjski Kanal	Sestrunj-Rivanj Island	Adriatic Sea	HR	44.15020°	15.02890°	22-23	Vertical	315°	10/08/2015

S3 Allocation of taxa to morpho-functional groups

TABLE S3.1 Allocation to the morpho-functional groups of the identified taxa and their role as builders or borers (n.a. = not assigned).

Taxa	morpho-functional groups	Builders / Borers
Microalgal mat	Microalgal mats	n.a.
Green algal turf	Mixed turfs	n.a.
Mucilaginous aggregates	Mucilaginous aggregates	n.a.
Dictyotales cfr. <i>Dictyopteris lucida</i>	Erect ochrophytes	n.a.
Dictyotales	Erect ochrophytes	n.a.
<i>Padina pavonica</i>	Erect ochrophytes	n.a.
Ectocarpales cfr. <i>Spermatochmus paradoxus</i>	Erect ochrophytes	n.a.
<i>Zanardinia typus</i>	Erect ochrophytes	n.a.
Red algal turf	Mixed turfs	n.a.
<i>Amphiroa rigida</i>	Erect rhodophytes	Builders
<i>Ellisolandia elongata</i>	Erect rhodophytes	Builders
Encrusting Corallinaceae	Encrusting calcareous rhodophytes	Builders
Ceramiales cfr. <i>Chondria capillaris</i>	Erect rhodophytes	n.a.
<i>Osmundaria volubilis</i>	Erect rhodophytes	n.a.
<i>Peyssonnelia</i> spp.	Erect rhodophytes	n.a.
Encrusting Peyssonneliaceae	Encrusting calcareous rhodophytes	Builders
<i>Botryocladia</i> cfr. <i>botryoides</i>	Erect rhodophytes	n.a.
<i>Botryocladia</i> cfr. <i>chiajeana</i>	Erect rhodophytes	n.a.
Gigartinales cfr. <i>Dudresnaya verticillata</i>	Erect rhodophytes	n.a.
<i>Phyllophora crispera</i>	Erect rhodophytes	n.a.
<i>Palmophyllum crassum</i>	n.a.	n.a.
<i>Acetabularia acetabulum</i>	Erect chlorophytes	n.a.
<i>Bryopsis plumosa</i>	Erect chlorophytes	n.a.
<i>Caulerpa cylindracea</i>	Erect chlorophytes	n.a.
<i>Codium bursa</i>	Erect chlorophytes	n.a.
<i>Codium</i> cfr. <i>decortdatum</i>	Erect chlorophytes	n.a.
<i>Codium</i> cfr. <i>effusum</i>	Erect chlorophytes	n.a.
<i>Halimeda tuna</i>	Erect chlorophytes	Builders
<i>Flabellia petiolata</i>	Erect chlorophytes	n.a.
<i>Pseudochlorodesmis furcellata</i>	Erect chlorophytes	n.a.
<i>Valonia macrophysa</i>	Erect chlorophytes	n.a.
<i>Clathrina</i> spp.	Massive and erect sponges	n.a.
<i>Cliona</i> spp.	n.a.	Borers
<i>Polymastia</i> spp.	Massive and erect sponges	n.a.
<i>Tethya</i> spp.	Massive and erect sponges	n.a.

Taxa	morpho-functional groups	Builders / Borers
<i>Chondrosia reniformis</i>	Massive and erect sponges	n.a.
<i>Crella (Grayella) pulvinar</i>	Encrusting sponges	n.a.
<i>Hemimycale</i> spp.	Encrusting sponges	n.a.
<i>Phorbas tenacior</i>	Encrusting sponges	n.a.
<i>Tedania (Tedania) anhelans</i>	Massive and erect sponges	n.a.
<i>Axinella</i> spp.	Massive and erect sponges	n.a.
<i>Axinella cannabina</i>	Massive and erect sponges	n.a.
<i>Dictyonella incisa</i>	Encrusting sponges	n.a.
<i>Agelas oroides</i>	Massive and erect sponges	n.a.
<i>Haliclona</i> cfr. (<i>Halichoclona</i>) <i>fulva</i>	Massive and erect sponges	n.a.
<i>Petrosia (Petrosia) ficiformis</i>	Massive and erect sponges	n.a.
<i>Ircinia</i> spp.	Massive and erect sponges	n.a.
<i>Sarcotragus</i> spp.	Massive and erect sponges	n.a.
<i>Dysidea</i> spp.	Massive and erect sponges	n.a.
<i>Pteraplysilla spinifera</i>	Massive and erect sponges	n.a.
<i>Aplysina</i> spp.	Massive and erect sponges	n.a.
Massive sponge sp. 1 cfr. <i>Clathria (Clathria) compressa</i>	Massive and erect sponges	n.a.
Massive sponge sp. 2	Massive and erect sponges	n.a.
Encrusting sponge sp. 1 cfr. <i>Spirastrella cunctatrix</i>	Encrusting sponges	n.a.
Encrusting sponge sp. 2 cfr. <i>Crambe crambe</i>	Encrusting sponges	n.a.
Encrusting sponge sp. 3	Encrusting sponges	n.a.
Encrusting sponge sp. 4	Encrusting sponges	n.a.
<i>Oscarella lobularis</i>	Massive and erect sponges	n.a.
Hydroids turf	Mixed turfs	n.a.
<i>Pennaria disticha</i>	n.a.	n.a.
<i>Cornularia cornucopiae</i>	Encrusting corals	n.a.
<i>Alcyonium acaule</i>	n.a.	n.a.
<i>Maasella edwardsi</i>	Encrusting corals	n.a.
<i>Corallium rubrum</i>	Tree-like corals	Builders
<i>Eunicella cavolini</i>	Tree-like corals	n.a.
<i>Eunicella singularis</i>	Tree-like corals	n.a.
<i>Cerianthus</i> spp.	n.a.	n.a.
<i>Caryophyllia (Caryophyllia) smithii</i>	Solitary hard corals	Builders
<i>Balanophyllia (Balanophyllia) europaea</i>	Solitary hard corals	Builders
<i>Leptopsammia pruvoti</i>	Solitary hard corals	Builders
<i>Epizoanthus</i> spp.	Encrusting corals	n.a.
<i>Parazoanthus axinellae</i>	Encrusting corals	n.a.
<i>Filograna implexa</i>	Tube forming polychaetes	Builders
Sabellidae	Tube forming polychaetes	n.a.

Taxa	morpho-functional groups	Builders / Borers
Serpulidae	Tube forming polychaetes	Builders
Vermetidae	Vermetids	Builders
<i>Rocellaria dubia</i>	n.a.	Borers
<i>Beania</i> spp.	Encrusting bryozoans	Builders
<i>Adeonella calveti</i>	Erect bryozoans	Builders
<i>Smittina cervicornis</i>	Erect bryozoans	Builders
<i>Pentapora fascialis</i>	Erect bryozoans	Builders
<i>Myriapora truncata</i>	Erect bryozoans	Builders
<i>Reteporella</i> spp.	Erect bryozoans	Builders
Encrusting bryozoan sp. 1 cfr. <i>Schizomavella (Schizomavella) mamillata</i>	Encrusting bryozoans	Builders
Encrusting bryozoan sp. 2 cfr. <i>Schizobrachiella sanguinea</i>	Encrusting bryozoans	Builders
Encrusting bryozoan sp. 3	Encrusting bryozoans	Builders
Erect branched bryozoan cfr. <i>Schizoretepora solanderia</i>	Erect bryozoans	Builders
<i>Pycnoclavella</i> spp.	n.a.	n.a.
<i>Polycitor adriaticus</i>	Massive ascidians	n.a.
<i>Aplidium conicum</i>	Massive ascidians	n.a.
<i>Microcosmus</i> spp.	Massive ascidians	n.a.
<i>Halocynthia papillosa</i>	Massive ascidians	n.a.
Colonial ascidians sp. 1 cfr. Polyclinidae	Massive ascidians	n.a.
Colonial ascidians sp. 2	Massive ascidians	n.a.
Colonial ascidians sp. 3	Massive ascidians	n.a.
Colonial ascidian sp. 4 cfr. <i>Polysyncraton</i> spp.	Encrusting ascidians	n.a.
Colonial ascidians sp. 5	Encrusting ascidians	n.a.

References

- Cerrano, C., Milanese, M., Ponti, M. (2017). Diving for science - science for diving: Volunteer scuba divers support science and conservation in the Mediterranean Sea. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 27, 303–323.
- Fратиани, C., Simoncelli, S., Pinardi, N., Cherchi, A., Grandi, A., Dobricic, S. (2015). Mediterranean Sea physical reanalysis (1955-2015) (Version 1). [Data set]. *Copernicus Monitoring Environment Marine Service (CMEMS)*, DOI: 10.25423/medsea_reanalysis_phy_006_009
- Pikelj, K., Juračić, M. (2013). Eastern Adriatic coast (EAC): Geomorphology and coastal vulnerability of a karstic coast. *Journal of Coastal Research*, DOI: 10.2112/JCOASTRES-D-12-00136.1, 944-957.
- Ryan, W. B. F., Carbotte, S. M., Coplan, J. O., O'Hara, S., Melkonian, A., Arko, R., ... Zemsky, R. (2009). Global Multi-Resolution Topography synthesis. *Geochemistry, Geophysics, Geosystems*, 10, n/a-n/a.
- Teruzzi, A., Cossarini, G., Lazzari, P., Salon, S., Bolzon, G., Crise, A., Solidoro, C. (2016). Mediterranean Sea biogeochemical reanalysis (CMEMS MED REA-Biogeochemistry 1999-2015). *Copernicus Monitoring Environment Marine Service (CMEMS)*, DOI: 10.25423/medsea_reanalysis_bio_006_008