Featured Article

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Combining literature review, acoustic mapping and in situ observations: an overview of coralligenous assemblages in Liguria (NW Mediterranean Sea)

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Summary: A review and update of the existing knowledge on the coralligenous assemblages of Liguria (NW Italy) was conducted as an essential step towards management measures for their conservation according to the EU Marine Strategy Framework Directive. By combining a literature review, acoustic mapping and in situ observations on a geographic information systems platform, we were able to assess the distribution and heterogeneity of coralligenous assemblages and the main pressures affecting them. The reliability of the literature was previously estimated using a dependability index. The coralligenous assemblages cover an area of 130.9 ha and range from 10 to 113 m depth. Twelve different biological facies (five of them not included in the EUNIS list) were identified and four main geomorphotypes (plungingcliffs, paleocliffs, rockfalls and shoals) were recognized. Incident light values influenced the distribution of four facies in Portofino promontory. Pressures were found on 33% of the coralligenous assemblages investigated, mainly due to fishing activities, mass mortality events, invasive species and occasional mucilaginous events. Our results showed a high spatial, geomorphological and biological heterogeneity of coralligenous assemblages in Liguria.

Keywords: mapping; literature review; heterogeneity; coralligenous assemblages; NW Mediterranean Sea.

Combinando revisión bibliográfica, mapas acústicos y observaciones in situ: sinopsis de las formaciones coralígenas en Liguria (NO del mar Mediterráneo)

Resumen: Una revisión y actualización del conocimiento existente sobre las formaciones coralígenas en Liguria (NO de Italia) ha sido implementado como paso esencial con vistas a las medidas de gestión para su conservación de acuerdo con la Directiva Marco sobre la Estrategia Marina. Combinando en plataforma SIG revisión bibliográfica, mapas acústicos y observaciones *in situ* hemos sido capaces de determinar la distribución de las formaciones coralígenas, su heterogeneidad y sus principales presiones. La fiabilidad de la bibliografía fue estimada a través del índice de confianza (DI). Las formaciones coralígenas cubren un área de 130.9 ha en un rango de profundidad que va desde los 10 m a los 113 m. 12 facies biológicas diferentes (5 de ellas no incluidas en la lista EUNIS) fueron identificadas y 4 geomorfotipos principales (acantilado actual, paleoacantilado, cúmulo de rocas y bajos) fueron reconocidos. Los valores de luz incidente influenciaron la distribución de 4 facies en el promontorio de Portofino. Fueron encontradas presiones en el 33% de las formaciones coralígenas investigadas, principalmente debidas a actividades de pesca, episodios de muerte masiva, especies invasoras y proliferación de algas mucilaginosas. Nuestros resultados mostraron una elevada heterogeneidad espacial, geomorfológica y biológica de las formaciones coralígenas en Liguria.

Palabras clave: mapeo; revisión bibliográfica; heterogeneidad; formaciones coralígenas; NO del mar Mediterraneo.

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INTRODUCTION

Since Marion (1883) first coined the word "coralligène", coralligenous assemblages have been studied, classified and defined as hard substrata of biogenic origin that are mainly produced by the accumulation of calcareous encrusting algae, light being the main environmental factor affecting their development (Ballesteros 2006). Considered one of the most important and characteristic habitats of the Mediterranean Sea (Laborel 1961, 1987, Laubier 1966), coralligenous assemblages represent the climax biocenosis of the circalittoral zone (Pérès and Picard 1964), where endangered or commercially important fish species are known to live, feed or reproduce (Salomidi et al. 2012). Coralligenous communities are considered of high conservation interest because of their biogeographic uniqueness, their highly varied physical structure, their high species biodiversity, their highly diversified occurrence stratified throughout the different benthic marine zones and their slow growth (Ballesteros 2006, Agnesi et al. 2008, Salomidi et al. 2012).

Trawling has effects on seafloor that resemble those of forest clear-cutting (Watling and Norse 1998). It is the most destructive impact affecting the coralligenous habitat, but it is not the only one. Artisanal fishing, anchoring, diving, waste water discharges, aquaculture facilities, changes in land use, coastal infrastructure construction, urbanization, anomalous high water temperatures, proliferation of mucilage and invasive species are currently affecting the biodiversity and structure of coralligenous assemblages (Baldacconi and Corriero 2009, Ballesteros 2009, Linares et al. 2010).

Although the importance of coralligenous assemblages and the threats affecting them are commonly accepted within the scientific community and among managers, they were not listed among the priority habitats defined by the EU Habitat Directive (92/43/EEC), thus remaining without formal protection. Only one European law (Council Regulation (EC) Nº 1967/2006) prohibits destructive fishing over Mediterranean coralligenous and mäerl communities but it remains ineffective in the current scenario of a lack of relevant geospatial data (UNEP-MAP-RAC/SPA 2008, Salomidi et al. 2012). Although some efforts have been made to increase information on the distribution of this sensitive habitat (Georgiadis et al. 2009, Giakoumi et al. 2013, Martin et al. 2014), knowledge of the geographical and depth distribution of coralligenous assemblages as well as their biodiversity and its relation to their functioning is still needed for their conservation and sustainable use (UNEP-MAP-RAC/SPA 2009, European Commission 2011, Pergent 2011). The current situation is not helped by the fragmented geopolitical scenario characterizing the Mediterranean basin, with weak, uncoordinated, conflicting approaches or non-existent regulatory frameworks, policy mechanisms and enforcement (Fraschetti et al. 2011). Improving the current and future monitoring of marine biodiversity is essential in order to implement the Marine Strategy Framework Directive (MSFD) and to achieve Good Environmental Status (GES). In addition to enhancing regional cooperation, there is a need to further develop innovative and cost-effective monitoring methods and to incorporate state-of-the-art technological developments into current monitoring practices (Patrício et al. 2014).

Habitat mapping is crucial in order to obtain reliable estimates of the total area occupied by each habitat, so as to reach the required conservation targets and to implement appropriate management measures (UNEP-MAP-RAC/SPA 2008, Costello 2009). A bibliographic database plays a major role in the study of habitat distribution and its changes over time. In some Mediterranean regions, information on coralligenous distribution is available in the literature but its reliability must be estimated (Leriche et al. 2001). Acoustic technologies are increasingly being used for monitoring benthic habitats (Zapata-Ramirez et al. 2013), and those used for mapping coralligenous communities normally include side-scan sonars and multibeam sonars (Bonacorsi et al. 2012, Gordini et al. 2012). Acoustic mapping using multibeam echo sounders allows us to infer seafloor topography, and therefore the geomorphologies on which coralligenous assemblages thrive, and the best locations for ground truthing. The European Commission decision on descriptors for the MSFD states that data of geographic information systems (GIS) are a prerequisite for ecosystem-based management of human activities and for developing related spatial tools. Modelling and mapping using GIS provide the basis for informed decision making (Sardá et al. 2012).

In this work we combined a literature review, acoustic mapping and in situ observations to (i) build a map of the distribution of coralligenous assemblages in Liguria (NW Italy) using GIS; (ii) characterize their biology and geomorphology and study the influence of geomorphology and light conditions on biological features; and (iii) consider the main pressures affecting coralligenous assemblages and provide some management recommendations.

MATERIALS AND METHODS

Study area

The Ligurian coast falls into the Ligurian Sea, the northernmost part of the western Mediterranean Sea, with 350 km of arch-shaped coastline from Ventimiglia at the west border with Provence-Alpes-Côte d'Azur (France) to La Spezia at the east border with Tuscany, Italy. Almost two thirds of the coast is composed of cliffs and promontories alternating with sandy to gravelly pocket beaches, especially along the Eastern Riviera. Soft coasts are less developed and are typically found adjacent to small coastal plains along the Western Riviera (Cattaneo-Vietti et al. 2010, Rovere 2011).

Literature review and database creation

We combined a literature review, acoustic mapping and in situ observations to build a data layer of coralligenous presence using the ArcGIS® software by Esri

Table 1. – Scores of the dependability index (up to 5+5 points) from the literature.

Geospatial positioning	Scores
very approximate descriptive spatial information	1
descriptive spatial information with selected terrestrial points and bathymetric data	2
descriptive spatial information and acoustic mapping (multibeam echo sounder)	3
GPS coordinates and acoustic mapping (multibeam echo sounder)	4
files already georeferenced	5
Data acquisition	
fishing material	1
recreational diving before 2000	2
scientific diving before 2000	3
recreational diving after 2000	4
scientific diving after 2000	5

(Environmental Systems Resource Institute), ArcMap 10.2 (www.esri.com). The existing literature was collected from scientific publications, technical reports ("grey literature"), diving and fishing books; we also considered unpublished in situ observations by experts and recreational divers (Cánovas-Molina et al. 2014). In order to estimate the reliability of the literature reviewed, a dependability index (DI) was applied, considering two parameters: geospatial positioning (five points) and method adopted for data acquisition (five points) (Table 1). The DI was not calculated for documents taken from the literature reviews because of the variety of methods used for data acquisition. A score of 1 for at least one of the parameters measured in the DI, was considered the critical value for low dependability and therefore rejection. Where digital spatial information was not available, polygons of presence of coralligenous assemblages were created by extracting spatial information from textual descriptions, helped by acoustic mapping (multibeam echo sounder) provided by Regione Liguria, when available. We carried out ground truthing through SCUBA diving at selected sites (Vado Ligure, Cogoleto, Arenzano and Punta Manara), following expert divers' observations and/or seafloor topography revealed by multibeam echo sounder.

Database analysis

A list of characteristic sessile megabenthos species of coralligenous assemblages, identified from the literature review and in situ observations, was compiled. Facies were identified following the EUNIS Habitat Classification (Davies et al. 2004). The habitat classification developed and managed by the European Topic Centre for Nature Protection and Biodiversity (ETC/NPB in Paris) provides a comprehensive typology for the habitats of Europe and its adjoining seas. EUNIS habitats are arranged in a hierarchy, from level 1 to 4 for marine habitats. Information on the most conspicuous species was used to identify the facies for each site with coralligenous.

Geomorphotypes where coralligenous assemblages in Liguria thrive were identified using multibeam echo sounder, when available, and textual descriptions from the literature gathered. Four geomorphotypes were considered: i) cliffs, vertical or near-vertical walls from a steep rock face, either active (plunging cliffs) or inactive (paleocliffs), ending occasionally in a flat bottom; ii) rockfalls, sets of masses of rocks of different sizes and shapes that lay on a bedding plane that originated from the face collapse of the cliff; and iii) shoals, isolated outcrops surrounded by sand or biodetrital sediments, which originated through past erosional events of the cliff, sea level rise and deposition of sediments.

To study the influence of incident light on coralligenous assemblages, we calculated incident light values on coralligenous assemblages from satellite imagery and long term-Secchi Disc records in Liguria available for the Portofino coastal area (Rapallo, Genoa). Percent light values of surface irradiance at each station in Portofino were calculated using standard methods with the formula $E_z=E_0e^{-kz}$ (Kirk 1994), where E_z is the irradiance at depth z, E_0 is the surface irradiance, K is the vertical attenuation coefficient and z is the depth. K was approximate to K_{dPAR} and obtained using Secchi Disc transparency records (January 2002-December 2012) using the formula K_{dPAR}=1.7/Secchi Depth (m). E_0 was approximated to photosynthetically active radiation and obtained from Goddard Earth Sciences Data and Information Services Centre (GES DISC) Interactive Online Visualization and Analysis Infrastructure, "Giovanni" (January 2002-December 2012). Percent light values of surface irradiance on facies of coralligenous assemblages for each station were calculated as the mean value among incident light values at the shallowest and the deepest distribution. To test the influence of incident light on the distribution of coralligenous facies in Portofino, a one-way ANOVA was applied.

Information on presence of mechanical and biological pressures, as well as signs of mass mortality events due to water temperature increasing, was reported for each site with coralligenous assemblages.

RESULTS

Literature reliability

From 1937 to date, 58 documents described some aspects of the coralligenous habitat in Liguria (Supplementary material Table S1), mainly scientific papers or technical reports written in Italian. The Eastern Riviera and Marine Protected Areas (MPAs), i.e. Portofino (Rapallo, Genoa), Punta Mesco (Cinque Terre, La Spezia), and Isole di Portovenere (La Spezia), were among the most studied localities, accounting for 70% and 58% of the documents respectively. Data were

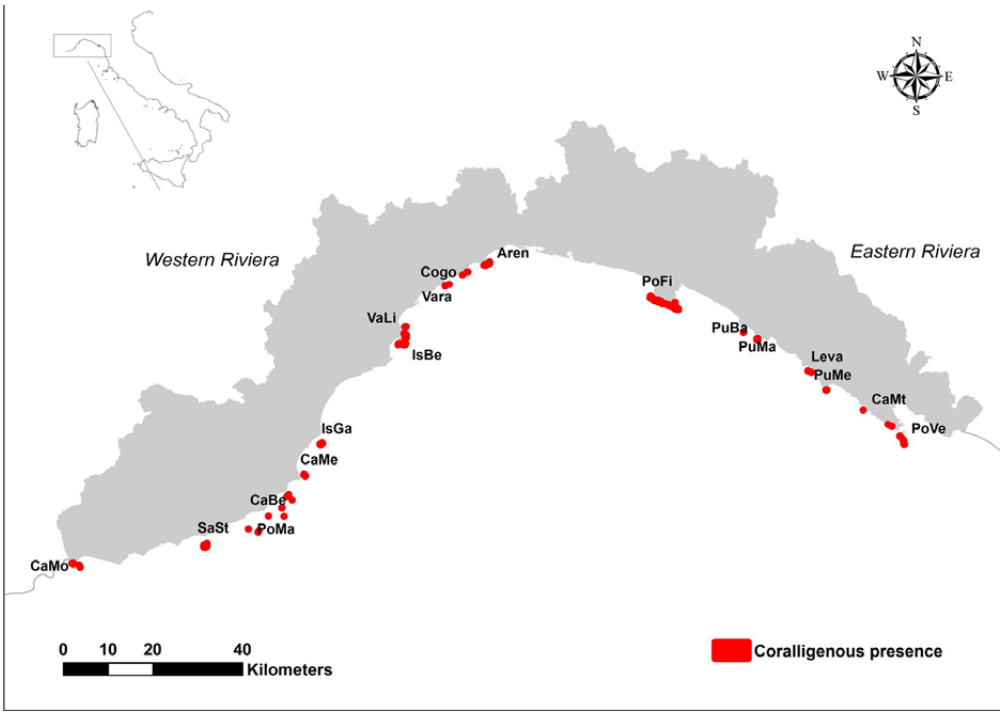

Fig. 1. – Presence of coralligenous assemblages in Liguria. To make small-scale presence visible, boundaries of polygon features have been artificially enhanced. Surface areas covered by these habitats appear much larger than they are in reality. CaMo, Capo Mortola; SaSt, Santo Stefano; PoMa, Porto Maurizio; CaBe, Capo Berta; CaMe, Capo Mele; IsGa, Isola Gallinara; IsBe, Isola Bergeggi; VaLi, Vado Ligure; Vara, Varazze; Cogo, Cogoleto; Aren, Arenzano; PoFi, Portofino; PuMa, Punta Manara; PuBa, Punta Baffe; Leva, Levanto; PuMe, Punta Mesco; CaMt, Capo Montenegro; PoVe, Portovenere.

acquired mainly by means of scientific SCUBA diving during the last two decades. Acoustic mapping was available for 10 localities. Eleven documents showed score 1 for at least one of the parameters of the DI and therefore have low dependability.

Distribution of coralligenous assemblages

A total of 90 sites within 18 localities were found to have coralligenous assemblages with an extent of 130.9 ha (Fig. 1 and Supplementary material Table S2). Seven localities (59.6 ha) were found along the Eastern Ligurian Riviera and 11 localities (71.3 ha) along the Western Riviera, the furthest location being 4 km from the coast at Capo Berta (Imperia) and the closest near the shoreline at Portofino. Regional and National protection laws applied for 48.3 ha (37%) situated in Portofino, Cinque Terre and Portovenere.

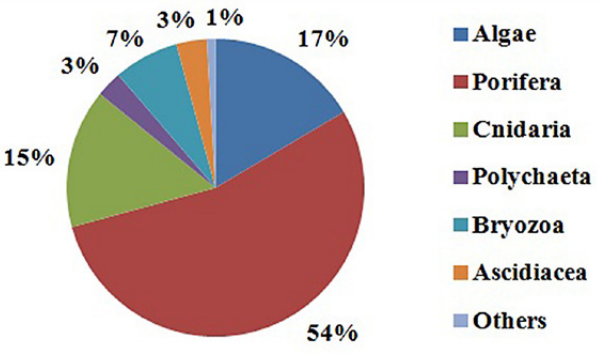

Fig. 2. – Taxonomic composition of coralligenous sessile megabenthos in Liguria.

The shallowest coralligenous assemblages in Liguria were those of Portovenere and Portofino at 10 m depth, the deepest that of Bergeggi at 113 m depth.

Biology, geomorphology and incident light values

A preliminary attempt to estimate the total number of sessile megabenthos taxa in the Ligurian coralligenous habitat is presented in Supplementary material Table S3. Sponges were the dominant group in terms of species richness (Fig. 2). The literature review permitted us to identify 12 facies of coralligenous communities (Table 2).

Table 2. – Population units identified in coralligenous assemblages of Liguria. *massive/erect sponges includes *Spongia lamella, Sarcotragus foetidus, Scalarispongia scalaris, Axinella polypoides, Chondrosia reniformis* and/or *Petrosia ficiformis*.

EUNIS Habitat 2004: A4.26 Mediterranean coralligenous communities moderately exposed to hydrodynamic action
A4.261 Association with *Cystoseira zosteroides*
A4.266 Association with *Mesophyllum lichenoides*
A4.269 Facies with *Eunicella cavolini*
A4.26A Facies with *Eunicella singularis*
A4.26B Facies with *Paramuricea clavata*
A4.26C Facies with *Parazoanthus axinellae*
EUNIS Habitat 2004: A4.32 Mediterranean coralligenous communities sheltered from hydrodynamic action
A4.322 Facies with *Leptogorgia sarmentosa*
Not included in the EUNIS Habitat 2004
Facies with *Eunicella verrucosa*
Facies with *Leptopsammia pruvoti*
Facies with massive/erect sponges*
Facies with *Corallium rubrum*
Facies with *Pentapora fascialis*

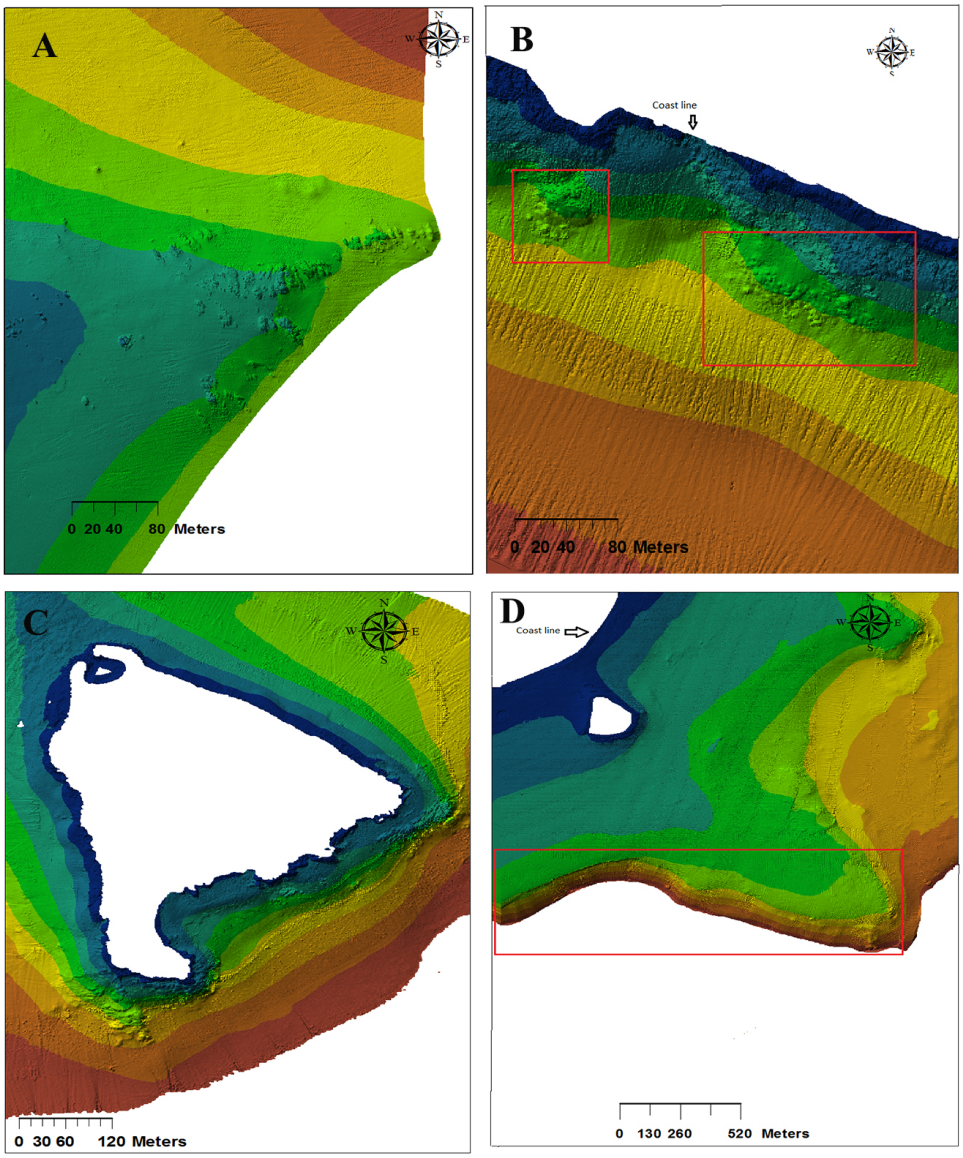

Fig. 3. – Geomorphotypes found in Liguria. A, Shoals of Vado Ligure. B, Rockfalls of Casa del Sindaco, Portofino. C, Plunging cliff of Isola Gallinara. D, Paleocliff of Secca dei Maledetti, Isola di Bergeggi.

Table 3. – Distribution of coralligenous facies on the different geomorphotypes in Liguria (values in hectares). N/A, no data available.

	Plunging cliff	Paleocliff	Rockfalls	Shoals
Corallium rubrum	4.84			
Cystoseira zosteroides				1.30
Eunicella cavolini	3.88	0.71		2.33
Eunicella singularis	0.91			0.58
Eunicella spp.	0.91			3.86
Eunicella verrucosa				1.14
Leptogorgia sarmentosa	6.54			0.21
Leptopsammia pruvoti	0.43			
Massive/erect sponges	2.54			2.69
Mesophyllum lichenoides				0.29
N/A	1.03			0.94
Paramuricea clavata	11.02	29.11	17.86	36.86
Parazoanthus axinellae				0.06
Pentapora fascialis	0.46			0.29
Total	32.56	29.82	17.86	50.55

In Liguria four different coralligenous geomorphotypes were identified (Fig. 3). Shoals were the dominant morphology in Liguria in terms of extent, with 50.6 ha, and were mainly represented in the Western Riviera. Plunging cliffs, paleocliffs and rockfalls covered 32.6, 29.8 and 17.9 ha, respectively (Table 3). Paleocliffs and rockfalls were mainly colonized by facies with *Paramuricea clavata.* In fact, this facies

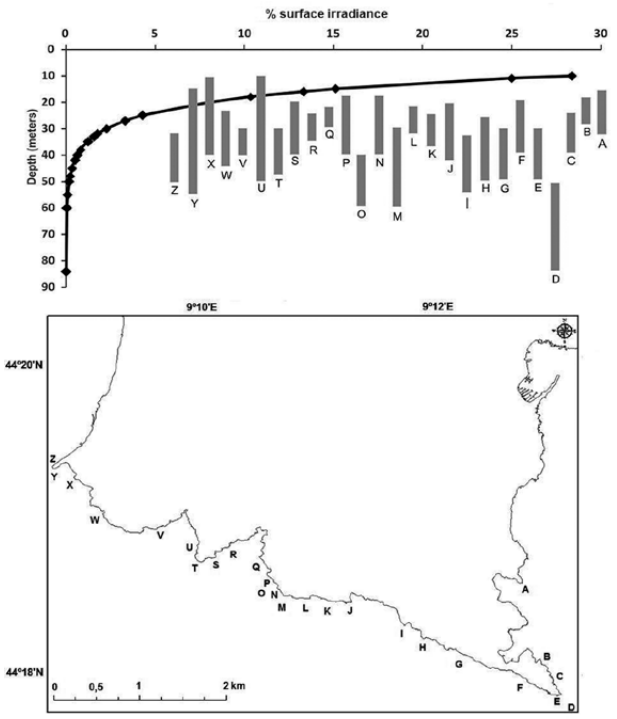

Fig. 4. – Incident light values on coralligenous assemblages of Portofino. A, Punta Cervara; B, Punta Coppo; C, Punta dell'Aurora; D, Dorsale Portofino; E, Punta Faro; F, Chiesa San Giorgio; G, Casa del Sindaco; H, Punta Vessinaro; I, Punta dell'Altare; J, Punta Fregante; K, Testa del Leone; L, Scoglio del Raviolo; M, Secca Gonzatti; N, Punta Carega; O, Scogliera del Dragone; P, Tetto del Dragone; Q, Cristo degli Abissi; R, San Fruttuoso; S, Punta Volpe; T, Punta Torretta; U, Cala dell'Oro Est; V, Cala dell'Oro Ovest; W, Punta Bussago; X, Punta Targuetta; Y, Secca dell'Isuela; Z, Punta Chiappa.

was the most conspicuous, found in all geomorphotypes with the highest extension. Units of assemblages with *Mesophyllum lichenoides, Parazoanthus axinellae, Cystoseira zosteroides* and *Eunicella verrucosa* showed a more constrained distribution, being found only on shoals.

In Portofino, incident light values on coralligenous communities varied from 0.003% to 28.37% of surface irradiance (Fig. 4). Eight facies of coralligenous assemblages thrived in Portofino promontory at different % values of surface irradiance (Fig. 5). A one-way ANOVA on incident light values showed significant differences between the facies with *Paramuricea clavata, Eunicella cavolini, Corallium rubrum* and *Leptogorgia sarmentosa* ($p<0.01$, $F=6.13$, $df=3$). Facies with *Eunicella cavolini* showed the highest distribution range of incident light values. On the other hand, *Corallium rubrum, Paramuricea clavata* and *Leptogorgia sarmentosa* thrived on lower and narrower ranges of light conditions.

Main pressures

Pressures reported in the literature were mainly due to fishing activities, such as the presence of abandoned gears such as nets, traps and "palamiti" (a type of longliner). Other pressures were anchors, plastic bags, invasive species such as the macroalgae *Caulerpa cylindracea* and *Womersleyella setacea,* occasional mucilaginous events, and mass mortality events linked to climate warming. In Liguria, evidence of one or more such pressures was found in 30 of 90 sites.

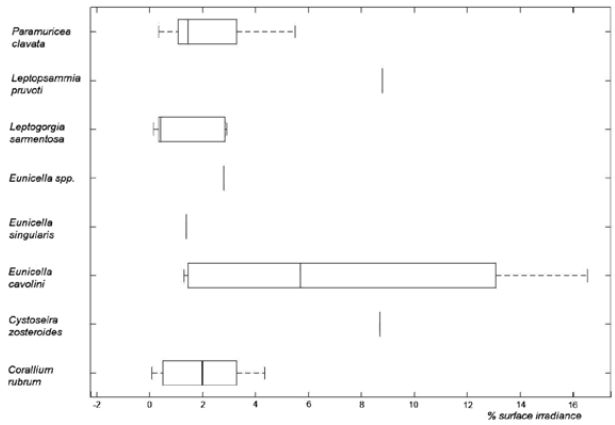

Fig. 5. – Incident light values for the different facies thriving at Portofino promontory.

DISCUSSION

Database of coralligenous assemblages

A total of 47 documents describing aspects of coralligenous habitats in Liguria were considered reliable after applying the DI for literature, and were therefore used to assess the distribution, biology, geomorphology and pressures. As digital spatial information and GPS positioning were scarce in the literature review, combining it with acoustic mapping and in situ observations helped improve accurate positioning on a GIS platform. Literature dealing with coralligenous assemblages in Liguria is more detailed for the Eastern Riviera, accounting for 70% of the documents, where their distribution is mainly associated with cliffs. The Western Riviera has been poorly studied and rarely characterized due to its particular distribution on isolated rocky outcrops of little extent found patchily along the coast.

Distributional, biological and geological aspects

Coralligenous habitats can be defined as highly heterogeneous systems, where the environmental variables together with distribution and abundances of taxa can differ greatly on both a geographical and a local (tens of metres) scale (Ferdeghini et al. 2000, Balata et al. 2005, Virgilio et al. 2006). The coralligenous assemblages in Liguria therefore show high spatial, morphological and biological variability (Fig. 6).

The shallowest distribution of coralligenous communities in Liguria was found in Portovenere, where they developed from 10 to 30 m depth associated with low light irradiance. Sediment load coming from the Magra River, located about 10 km away, explains the high turbidity in the water, with Secchi Disc values of 6.2±1.6 m (Bassano et al. 2000). Twelve facies were identified in the Ligurian coralligenous assemblages.

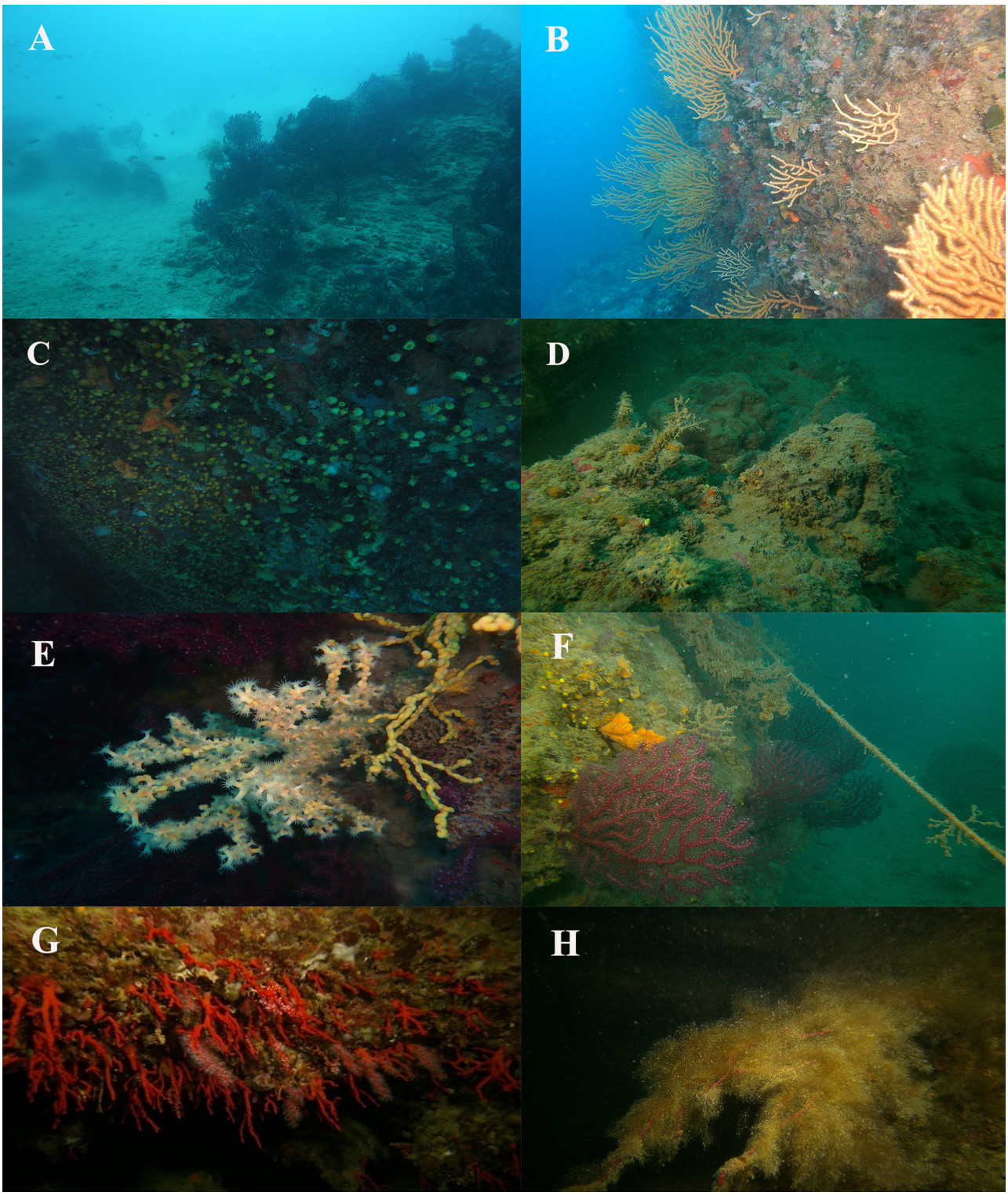

Fig. 6. – Coralligenous assemblages in Liguria. A, facies with *Paramuricea clavata* thriving on shoal geomorphotype (Corallo Nero, Vado Ligure) at 32 m depth. B, facies with *Eunicella cavolini* on cliff geomorphotype (Cala dell'Oro, Portofino) at 14 m depth. C, Facies with *Leptopsammia pruvoti* (Punta Cervara, Portofino) at 18 m depth. D, facies with massive/erect sponges (Punta Manara) at 36 m depth. E, *Savalia savaglia* colony (Punta Manara) at 39 m depth. F, presence of lost fishing gears (Punta Manara) at 35 m depth. G, Facies with *Corallium rubrum* (Punta dell'Altare, Portofino) at 38 m depth. H, presence of mucilaginous event (Punta dell'Altare, Portofino) at 38 m depth.

Eunicella verrucosa and massive/erect sponges could be assigned to EUNIS Habitat 2004 classification as A4.32 Mediterranean coralligenous communities sheltered from hydrodynamic action and *Corallium rubrum, Leptopsammia pruvoti* and *Pentapora fascialis* to A4.26 Mediterranean coralligenous communities moderately exposed to hydrodynamic action. An update of the EUNIS list is needed in order to consider the real biological heterogeneity of coralligenous communities (Bianchi et al. 2010).

In the marine environment, light is a key environmental variable coupling physics to biogeochemistry and ecology. According to Ballesteros (1992), coralligenous communities develop between 0.05% and 3% of the surface irradiance. "Dorsale Portofino" reaches light values below 0.05% (0.003-0.14%) where coralligenous assemblages grow on shoals between 52 and 84 m depth and are dominated by suspension feeders: gorgonians, antipatharians and sponges with few calcareous concretions. Light values greater than 3% correspond to coralligenous communities above 27 m depth with a high frequency of so-called "precoralligenous" species (Bianchi et al. 2004), such as *Cladocora caespitosa, Codium bursa, Flabellia petiolata, Halimeda tuna* and *Sarcotragus fasciculatus* as components of coralligenous communities with high light tolerance.

In coralligenous assemblages two main geomorphologies have been described (Pérès and Picard 1964, Ballesteros 2006): i) banks, which can fall into the *coralligène de plateau* definition and consist of flat frameworks with a variable thickness (0.5 to 4 m) built on horizontal substrate; and ii) rims, which can fall into the *coralligène de l'horizon inférieur de la roche littorale* definition and consist of structures developed along vertical cliffs with a thickness range of 0.2 to 2 m. Some problems arise in trying to classify coralligenous formations into these two categories due to the high variability of the build-ups in terms of geometry, dimension, areal distribution and settled substrate (Bracchi et al. 2014). In Liguria, the high variability of origin, extension, slope and shape of geomorphologies led us to identify, as did Laborel (1961), four different geomorphotypes: cliffs (paleocliffs and plunging cliffs), shoals, and rockfalls.

Main pressures

Pressures were found at 33% of the sites, mainly due to professional and recreational fishing activities, mass mortality events, presence of invasive species and mucilaginous events. In Portofino, a major cause of mortality in *Paramuricea clavata* is damage by fishing lines, followed by the attachment of numerous epibionts (Bavestrello et al. 1997). Coralligenous habitats have been invaded by alien species such as *Caulerpa cylindracea* (Piazzi et al. 2007) and/or *Womersleyella setacea* (Gatti et al. 2015), with consequent loss of structure and biodiversity of the original assemblages. In the late summer of 1999, when a sudden increase in sea water temperature in the Ligurian Sea occurred down to 50 m depth, an extensive mortality of gorgonians and other epibenthic organisms was observed in Liguria: the proportion of affected gorgonians ranged from 60% to 100%, suggesting that millions of sea fans died (Cerrano et al. 2000).

Management recommendations

We highly recommend including coralligenous habitats in the EU Habitats Directive (92/43/EEC) as a priority natural habitat type. In addition, MPAs must be established in order to protect representative coralligenous assemblages by applying the protection and management measures recommended by Articles 6 and 7 of the SPA protocol (Ballesteros 2009). In Liguria, 48.3 ha (37%) of coralligenous habitats are inside national or regional MPAs. Among the 82.6 ha of coralligenous assemblages without a specific conservation plan, the assemblages of Bergeggi and the deep (>70 m) assemblages of Portofino lie outside the limits of the MPAs of "Isola di Bergeggi" and "Portofino", respectively. Therefore, we recommend the extension of the two MPAs in order to include them.

To enforce the MSFD and achieve GES, we suggest the implementation of a common monitoring programme for coralligenous habitats of Liguria. This monitoring programme should fulfil the following requirements:

- It should take into account their high geographic and biological heterogeneity and therefore be applied also in the poorly studied shoals of the Western Riviera.
- It should be able to assess ecological status and pressures and their linkage. Ecological status assessment should consider coralligenous structure (e.g. species richness and percentage cover), as well as functioning (e.g. connectivity and population dynamics).
- It should include new methods and technologies. The use of photo-video mosaicing can provide information on both landscape level (metre-scale) maps and high-resolution (sub-millimetre) images of individual colonial organisms (Reid et al. 2010). If further validated, the photo mosaic techniques and 3D reconstructions would provide a cost-effective tool for assessing ecological status and monitoring changes due to natural or anthropogenic disturbance in these environments (Zapata-Ramirez et al. 2013).

Combining a literature review (scientific publications, unpublished documents and books), acoustic mapping and in situ observations (ground truthing and personal communications) on a GIS platform resulted in an efficient, powerful tool for the assessment of the distribution and heterogeneity of coralligenous communities and the pressures affecting them. This methodology could give information on the real extent and diversity of these assemblages to help governments and stakeholders implement appropriate management measures to guarantee sustainable development of coastal areas.

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Table S1. – Literature review on coralligenous assemblages in Liguria. Scarce, scarce biological information or just focused on one species. DI (GP+DA), dependability index of literature (Geospatial Positioning + Data Acquisition).*Score=1 for at least one of the parameters considered in the DI.

Table S2. – Ligurian localities with coralligenous and main characteristics. N/A, No data available. * Facies not included in the EUNIS Habitat 2004 classification for Mediterranean coralligenous communities.

Table S3. – List of sessile megabenthos taxa reported by different authors for the Ligurian coralligenous community.

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Combining literature review, acoustic mapping and in situ observations: an overview of coralligenous assemblages in Liguria (NW Mediterranean Sea)

Almudena Cánovas Molina, Monica Montefalcone, Paolo Vassallo, Carla Morri, Carlo Nike Bianchi, Giorgio Bavestrello

Supplementary material

Table S1. – Literature review on coralligenous assemblages in Liguria. Scarce, scarce biological information or just focused on one species. DI (GP+DA), dependability index of literature (Geospatial Positioning + Data Acquisition).*Score=1 for at least one of the parameters considered in the DI.

Year	Author	Type of document	Language	Biological information	Spatial information	Method of data acquisition	DI(GP+DA)
1937	Tortonese E. and Faraggiana R.	Scientific paper	Italian	scarce	very approximate	fishing material	2=1*+1*
1958	Tortonese E.	Scientific paper	Italian	qualitative	terrestrial points and bathymetric data	scientific diving	6=3+3
1961	Rossi L.	Congress contribution	French	qualitative	terrestrial points and bathymetric data	scientific diving	6=3+3
1961	Tortonese E.	Scientific paper	Italian	qualitative	terrestrial points and bathymetric data	scientific diving	6=3+3
1965	Rossi L.	Scientific paper	Italian	qualitative	terrestrial points and bathymetric data	scientific diving	6=3+3
1965	Rossi L.	Scientific paper	Italian	Quantitative	terrestrial points and bathymetric data	scientific diving	6=3+3
1965	Santi G.	Book	Italian	scarce	terrestrial points and bathymetric data	fishing material	3=2+1*
1967	Fusco N.	Book	Italian	scarce	terrestrial points and bathymetric data	fishing material	3=2+1*
1968	Fusco N.	Book	Italian	scarce	terrestrial points and bathymetric data	fishing material	3=2+1*
1972	Fusco N.	Book	Italian	scarce	terrestrial points and bathymetric data	fishing material	3=2+1*
1973	Melegari G.	Book	Italian	scarce	terrestrial points and bathymetric data	recreational diving	5=3+2
1976	Pansini M. et al.	Technical report	Italian	qualitative	very approximate	scientific diving	4=1*+3
1979	Balduzzi A. et al.	Book	Italian	qualitative	very approximate	scientific diving	4=1*+3
1986	Bavestrello G. et al.	Scientific paper	Italian	qualitative	very approximate	scientific diving	4=1*+3
1986	Morri C. et al.	Scientific paper	Italian	qualitative	very approximate	scientific diving	4=1*+3
1989	Peirano A. et al.	Scientific paper	Italian	Quantitative	terrestrial points and bathymetric data	scientific diving	6=3+3
1992	Balduzzi A. et al	Congress contribution	Italian	qualitative	terrestrial points and bathymetric data	scientific diving	6=3+3
1992	Peirano A. et al.	Scientific paper	Italian	Quantitative	terrestrial points and bathymetric data	scientific diving	6=3+3
1993	Tommei A.	Book	Italian	scarce	terrestrial points and bathymetric data	recreational diving	5=3+2
1994	Bavestrello G. et al.	Scientific paper	English	scarce	terrestrial points and bathymetric data	scientific diving	6=3+3
1994	Bianchi C.N. et al.	Technical report	Italian	qualitative	terrestrial points and bathymetric data	scientific diving	6=3+3
1997	Bavestrello G. et al.	Scientific paper	English	scarce	terrestrial points and bathymetric data	scientific diving	6=3+3
1997	Cocito S. et al.	Scientific paper	English	Quantitative	terrestrial points and bathymetric data	scientific diving	6=3+3
1997	Salvati E.	Thesis	Italian	Quantitative	terrestrial points and bathymetric data	scientific diving	6=3+3
1998	Cocito S. et al.	Scientific paper	English	scarce	terrestrial points and bathymetric data	scientific diving	6=3+3
1999	Relini M et al.	Technical report	Italian	qualitative	terrestrial points and bathymetric data	scientific diving	5=2+3
2000	Cerrano C. et al.	Scientific paper	English	quantitative	terrestrial points and bathymetric data	scientific diving	6=3+3
2000	Leali-Rizzi T. and Penco A.	Book	Italian	scarce	terrestrial points and bathymetric data	recreational diving	5=3+2
2000	Morri C.	Technical report	Italian	qualitative	terrestrial points and bathymetric data	scientific diving	6=3+3
2000	Peirano A. et al.	Scientific paper	English	qualitative	terrestrial points and bathymetric data	scientific diving	6=3+3
2001	Cerrano C. et al.	Book	English	scarce	very approximate	scientific diving	6=1*+5
2001	Leali-Rizzi T. and Penco A.	Book	Italian	scarce	terrestrial points and bathymetric data	recreational diving	6=2+4
2002	Bianchi C.N. et al.	Technical report	Italian	qualitative	terrestrial points and bathymetric data	scientific diving	8=3+5
2002	Cocito S. et al.	Scientific paper	English	quantitative	GPS points	scientific diving	9=4+5
2003	Galliadi A. et al.	Book	Italian	scarce	terrestrial points and bathymetric data	recreational diving	7=3+4
2003	Massajoli M. and Barsotti G.	Book	Italian	scarce	terrestrial points and bathymetric data	recreational diving	7=3+4
2003	Sara G. et al.	Thesis	Italian	quantitative	GPS points	scientific diving	9=4+5
2003	Sara G. et al.	Scientific paper	Italian	quantitative	terrestrial points and bathymetric data	scientific diving	8=3+5
2004	Cattaneo-Vietti R.	Technical report	Italian	quantitative	GPS points	scientific diving	9=4+5
2005	Cerrano C. et al.	Scientific paper	English	scarce	terrestrial points and bathymetric data	scientific diving	8=3+5

2006	Bianchi C:N. et al.	Technical report	Italian	scarce	Files already georeferenced	Recreational diving	9=5+4
2006	Rovere A. et al.	Scientific paper	Italian	qualitative	very approximate	scientific diving	6=1*+5
2006	Rovere A. and Parravicini V.	Technical report	Italian	qualitative	GPS points	scientific diving	9=4+5
2007	Parravicini V. et al.	Scientific paper	Italian	qualitative	terrestrial points and bathymetric data	recreational diving	7=3+4
2007	Previati M. et al.	Scientific paper	Italian	scarce	GPS points	scientific diving	9=4+5
2008	Vota P.	Thesis	Italian	qualitative	terrestrial points and bathymetric data	scientific diving	8=3+5
2009	Cerrano C. et al.	Technical report	Italian	quantitative	terrestrial points and bathymetric data	scientific diving	7=2+5
2009	Previati M. et al.	Scientific paper	Italian	quantitative	terrestrial points and bathymetric data	scientific diving	8=3+5
2009	Scinto A. et al.	Scientific paper	English	quantitative	terrestrial points and bathymetric data	scientific diving	8=3+5
2010	Bianchi C.N. et al.	Technical report	Italian	qualitative	GPS points	scientific diving	9=4+5
2010	Montefalcone M. et al.	Technical report	Italian	qualitative	files already georeferenced	scientific diving	10=5+5
2011	Previati M.	Book	Italian	quantitative	terrestrial points and bathymetric data	scientific diving	8=3+5
2011	Previati M. et al.	Scientific paper	Italian	quantitative	GPS points	scientific diving	9=4+5
2012	Cupido R. et al.	Scientific paper	English	scarce	GPS points	scientific diving	9=4+5
2012	ENEA	Technical report	Italian	quantitative	terrestrial points and bathymetric data	scientific diving	8=3+5
2012	Gatti G. et al.	Scientific paper	English	qualitative	files already georeferenced	scientific diving	10=5+5
2012	Previati M. et al.	Technical report	Italian	quantitative	GPS points	scientific diving	9=4+5
2013	Bertolino M. et al.	Scientific paper	English	qualitative	terrestrial points and bathymetric data	scientific diving	8=3+5

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Table S2. – Ligurian localities with coralligenous and main characteristics. N/A, No data available. * Facies not included in the EUNIS Habitat 2004 classification for Mediterranean coralligenous communities.

Locality	Site	Depth (m)	Geomorphotype	Facies	Pressures	Ha
Capo Mortola	Canyon (Pertuso)	18-35	paleocliff	*Paramuricea clavata*	*Caulerpa cylindracea*	0.46
	Desolation	20-33	paleocliff	*Paramuricea clavata*	N/A	0.31
	San Giuseppe	15-25	paleocliff	*Eunicella cavolini*	*Caulerpa cylindracea*	0.71
	Monaco	14-39	paleocliff	*Paramuricea clavata*	N/A	2.02
	Pignatum	35-43	paleocliff	*Paramuricea clavata*	N/A	0.20
	Aragostine	28-35	shoals	*Paramuricea clavata*	N/A	0.19
	Fontana	24-36	shoals	*Paramuricea clavata*	N/A	0.62
Santo Stefano	Santo Stefano	25-40	shoals	*Paramuricea clavata*	Fishing gears	21.81
Porto Maurizio	Gorgonie	34-40	shoals	*Paramuricea clavata*	Fishing gears, anchors	0.38
	Nebbia	49-54	shoals	*Paramuricea clavata*	N/A	0.29
	Maldive	50-56	shoals	*Paramuricea clavata*	N/A	0.20
Capo Berta	Scogli dell'Ariete	50-56	shoals	Massive/erect sponges*	N/A	0.29
	Diano 40	38-44	shoals	*Eunicella* spp.	N/A	0.13
	Diano 56	54-56	shoals	*Eunicella singularis*	N/A	0.16
	Carri armati	52-60	shoals	*Paramuricea clavata*	N/A	0.28
	Il muraglione	30-35	shoals	*Mesophyllum lichenoides*	*Caulerpa cylindracea*	0.29
	Il Pilone	32-37	shoals	*Eunicella verrucosa**	N/A	0.23
	Le Stelle	34-38	shoals	Massive/erect sponges*	N/A	0.28
Capo Mele	Il Giardino	29-36	shoals	*Eunicella* spp.	N/A	3.73
	Scoglio di Capo Mele	34-40	shoals	*Paramuricea clavata*	N/A	3.43
Isola Gallinara	Punta Falconara	25-45	plunging cliff	Massive/erect sponges* *Leptogorgia sarmentosa*	Anchors, mass mortality event	2.34
	Punta Sciusciaü	25-45	plunging cliff	Massive/erect sponges*, *Leptogorgia sarmentosa*	Anchors, mass mortality event	1.37
Isola di Bergeggi	Secca dei maledetti	50-113	paleocliff	*Paramuricea clavata*	N/A	20.21
	Secca della travacca	50-78	paleocliff	*Paramuricea clavata*	N/A	4.24
	Secca del banano	60-80	shoals	*Paramuricea clavata*	N/A	3.26
	Scoglietti di Bergeggi	26-35	shoals	Massive/erect sponges*	N/A	0.64
Vado Ligure	Corallo nero	30-36	shoals	*Paramuricea clavata*	N/A	0.05
	C3	31-38	shoals	*Paramuricea clavata*	Fishing gears, plastic bags	0.01
	C2	20-28	shoals	*Parazoanthus axinellae*	Fishing gears	0.03
	C4	21-23	shoals	*Cystoseira zosteroides*	Fishing gears	0.02
	C5	17-18	shoals	*Leptogorgia sarmentosa*	Anchors	0.01
	C1	22-30	shoals	*Parazoanthus axinellae*	N/A	0.03
Varazze	Secca dei Cerianthus	29-36	shoals	N/A	N/A	0.36
	Secca a Varazze	45-46	shoals	*Eunicella verrucosa**	N/A	0.50
	Secca dei Forzieri	32-33	shoals	Massive/erect sponges*	N/A	0.63
Cogoleto	Punto41,42	29-38	shoals	N/A	N/A	0.24
	Secche San Giaccomo	28-35	shoals	*Paramuricea clavata*	Fishing gears	0.16
Arenzano	Secca 2 balconi	43-48	shoals	*Paramuricea clavata*	N/A	0.12
	Secche ad Arenzano	30-33	shoals	Massive/erect sponges*	Fishing gears	0.11
	Punta Martino - Marina Grande	38-42	shoals	*Paramuricea clavata*	N/A	0.23
	Punta Martino - Marina Grande	30-32	shoals	Massive/erect sponges*	N/A	0.68
Portofino	Punta Chiappa	33-50	plunging cliff	*Paramuricea clavata,* *Leptogorgia sarmentosa*	N/A	1.74
	Secca dell'Isuela	15-55	shoals	*Cystoseira zosteroides,* *Eunicella cavolini,* *Paramuricea clavata*	N/A	3.55
	Punta Targhetta	11-40	plunging cliff	*Eunicella cavolini* *Corallium rubrum**	N/A	2.19
	Punta Bussago	25-45	plunging cliff	*Paramuricea clavata*	N/A	3.02
	Cala dell'Oro O	30-40	plunging cliff	*Eunicella cavolini*	N/A	1.07
	Cala dell'Oro E	10-50	plunging cliff	*Eunicella cavolini,* *Paramuricea clavata*	N/A	3.01
	Punta Torretta	10-48	plunging cliff	*Eunicella cavolini,* *Paramuricea clavata*	Mass mortality event	1.77
	Punta Volpe	20-40	plunging cliff	*Paramuricea clavata*	N/A	0.58
	San Fruttuoso	25-35	plunging cliff	*Corallium rubrum**	N/A	0.43
	Cristo degli Abissi	23-30	plunging cliff	*Corallium rubrum**	N/A	0.31
	Scogliera del dragone	40-60	shoals	*Paramuricea clavata*	N/A	1.39
	Tetto del Dragone	18-40	plunging cliff	*Paramuricea clavata*	N/A	1.21
	Secca Gonzatti	30-60	shoals	*Paramuricea clavata*	N/A	0.92
	Punta Carega	18-40	plunging cliff	*Eunicella cavolini* *Paramuricea clavata*	N/A	0.51
	Scoglio del Raviolo	23-33	rockfalls	*Paramuricea clavata*	N/A	0.13
	Testa del Leone	25-38	rockfalls	*Paramuricea clavata*	N/A	1.18
	Punta Fregante	20-42	plunging cliff	*Eunicella cavolini* *Eunicella singularis* *Leptogorgia sarmentosa*	N/A	0.79

Portofino	Punta dell'Altare	32-55	plunging cliff	*Eunicella cavolini, Corallium rubrum*, Paramuricea clavata, Leptogorgia sarmentosa*	Mucilaginous event	1.73
	Punta Vessinaro	27-50	plunging cliff	*Eunicella* spp *Paramuricea clavata Leptogorgia sarmentosa*	N/A	1.96
	Casa del Sindaco	30-50	rockfalls	*Paramuricea clavata*	Fishing gears	4.22
	Chiesa San Giorgio	20-40	rockfalls	*Paramuricea clavata*	N/A	2.52
	Punta Faro	30-50	plunging cliff	*Paramuricea clavata*	Fishing gears, mass mortality event	1.41
	Dorsale Portofino	52-84	shoals	*Corallium rubrum**	N/A	1.65
	Punta Faro (Secca)	60-100	shoals	*Eunicella cavolini*	Fishing gears, anchors	1.15
	Punta dell'Aurora	25-40	plunging cliff	*Paramuricea clavata*	Mass mortality event	0.90
	Punta Aurora-Punta Coppo	20-30	plunging cliff	N/A	N/A	1.03
	Punta Cervara	16-33	plunging cliff	*Leptopsammia pruvoti*, Leptogorgia sarmentosa*	N/A	0.85
Punta Manara	Immersione II	21-30	shoals	*Paramuricea clavata*	Fishing gears	0.13
	Immersione III	27-34	shoals	*Paramuricea clavata*	Fishing gears	0.12
	Immersione I	29-35	shoals	*Paramuricea clavata*	Fishing gears	0.03
	Immersione IV	35-36	shoals	Massive/erect sponges*	N/A	0.04
	Punta Manara	24-33	shoals	Massive/erect sponges*, *Leptogorgia sarmentosa*	N/A	0.05
Punta Baffe	Punta Baffe	20-40	rockfalls	*Paramuricea clavata*	N/A	9.81
Levanto	Secca della Pevea	15-22	shoals	N/A	N/A	0.34
	Secca della Francesca	20-28	shoals	*Leptogorgia sarmentosa*	N/A	0.17
	Secca di San Pietro	20-35	shoals	*Cystoseira zosteroides, Paramuricea clavata*	N/A	0.20
Punta Mesco	Punta Mesco	17-44	paleocliff	*Paramuricea clavata*	*Caulerpa cylindracea Womersleyella setacea* Mass mortality event	1.60
	Canalone	20-30	paleocliff	*Paramuricea clavata*	*Womersleyella setacea* Mass mortality event	0.04
	Contraforte	20-30	paleocliff	*Paramuricea clavata*	*Womersleyella setacea* Mass mortality event	0.03
Capo	Capo Montenegro	18-33	plunging cliff	*Leptogorgia sarmentosa*	N/A	0.27
Montenegro	Le Rosse	11-13	plunging cliff	*Leptogorgia sarmentosa*	N/A	0.23
Portovenere	Le Nere	13-14	plunging cliff	*Leptogorgia sarmentosa*	N/A	0.20
	Punta Pittone	12-24	plunging cliff	Massive/erect sponges* *Leptogorgia sarmentosa*	N/A	0.98
	Secca di Dante	12-28	shoals	*Eunicella verrucosa* Eunicella singularis*	N/A	0.84
	Punta Bianca	12-27	plunging cliff	*Pentapora fascialis* Paramuricea clavata*	Mass mortality event	0.92
	Cala del Bunker	12-30	plunging cliff	*Leptogorgia sarmentosa Eunicella singularis*	Mass mortality event	1.30
	Tinetto west wall	12-28	plunging cliff	Massive/erect sponges* *Paramuricea clavata*	Mass mortality event	0.27
	Secca Tinetto and Tinetto south wall	10-25	plunging cliff	Massive/erect sponges*, *Paramuricea clavata, Leptogorgia sarmentosa*	Mass mortality event	0.17
	Secca Tinetto	10-30	shoals	*Pentapora fascialis* Paramuricea clavata*	Mass mortality event	0.59

Table S3. – List of sessile megabenthos taxa reported by different authors for the Ligurian coralligenous community.

Taxonomic groups

Foraminifera
Miniacina miniacea (Palas, 1766)

Algae
Amphiroa J.V.Lamouroux, 1812
Cladophora prolifera (Roth) Kützing, 1843
Codium bursa (Olivi) C.Agardh, 1817
Codium vermilara (Olivi) Delle Chiaje, 1829
Contarinia squamariae (Meneghini) Denizot, 1968
Cystoseira zosteroides C.Agardh, 1820
Dictyopteris polypodioides (A.P.De Candolle) J.V.Lamouroux, 1809
Dictyota dichotoma (Hudson) J.V.Lamouroux, 1809
Ectocarpus Lyngbye, 1819
Flabellia petiolata (Turra) Nizamuddin, 1987
Halimeda tuna (J.Ellis and Solander) J.V.Lamouroux, 1816
Kallymenia requienii (J.Agardh) J.Agardh, 1842
Lithophyllum incrustans R.A.Philippi, 1837
Lithophyllum (Philippi, 1837)
Lythophyllum stictaeformis (Areschoug) Hauck, 1877
Mesophyllum alternans (Foslie) Cabioch and M.L.Mendoza, 1998
Mesophyllum expansum (Philippi) Cabioch and M.L.Mendoza, 2003
Mesophyllum lichenoides (J.Ellis) Me.Lemoine, 1928
Mesophyllum (Me.Lemoine, 1928)
Neogoniolithon brassica-florida (Harvey) Setchell and L.R.Mason, 1943
Nereia filiformis (J.Agardh) Zanardini, 1846
Osmundaria volubilis (Linnaeus) R.E.Norris, 1991
Padina pavonica (Linnaeus) Thivy, 1960
Palmophyllum crassum (Naccari) Rabenhorst, 1868
Peyssonnelia rubra (Greville) J.Agardh, 1851
Peyssonnelia squamaria (S.G.Gmelin) Decaisne, 1842
Peyssonnelia (Decaisne, 1841)
Phorbas tenacior (Topsent, 1925)
Phyllophora crispa (Hudson) P.S.Dixon, 1964
Rytiphlaea tinctoria (Clemente) C.Agardh, 1824
Sargassum C.Agardh, 1820
Sphaerococcus coronopifolius Stackhouse, 1797
Sporochnus pedunculatus (Hudson) C.Agardh, 1820
Tricleocarpa fragilis (Linnaeus) Huisman and R.A.Townsend, 1993
Zanardinia typus (Nardo) P.C.Silva, 2000

Porifera
Aaptos aaptos (Schmidt, 1864)
Acanthella acuta (Schmidt, 1862)
Agelas oroides (Schmidt, 1864)
Antho (Antho) involvens (Schmidt, 1864)
Aplysina aerophoba Nardo, 1833
Aplysina cavernicola (Vacelet, 1959)
Axinella cannabina (Esper, 1794)
Axinella damicornis (Esper, 1794)
Axinella polypoides (Schmidt, 1862)
Axinella vaceleti (Pansini, 1984)
Axinella verrucosa (Esper, 1794)
Borojevia cerebrum (Haeckel, 1872)
Bubaris carcisis Vacelet, 1969
Bubaris vermiculata (Bowerbank, 1866)
Calyx nicaeensis (Risso, 1826)
Chondrilla nucula Schmidt, 1862
Chondrosia reniformis (Nardo, 1847)
Clathria (Microciona) armata (Bowerbank, 1866)
Clathria (Microciona) atrasanguinea (Bowerbank, 1862)
Clathria (Microciona) gradalis Topsent, 1925
Clathria (Microciona) haplotoxa (Topsent, 1928)
Clathria (Microciona) toxistyla (Sarà, 1959)
Clathria (Microciona) toxivaria (Sarà, 1959)
Clathrina (Gray, 1867)
Clathrina clathrus (Schmidt, 1864)
Cliona celata Grant, 1826
Cliona janitrix Topsent, 1932
Cliona schmidtii (Ridley, 1881)
Cliona viridis (Schmidt, 1862)
Crambe crambe (Schmidt, 1862)
Crella (Crella) elegans (Schmidt, 1862)
Crella (Crella) mollior Topsent, 1925
Crella (Grayella) pulvinar (Schmidt, 1868)
Delectona de Laubenfels, 1936
Dendroxea lenis (Topsent, 1892)
Hymerhabdia typica Topsent, 1892
Ircinia (Nardo, 1833)
Ircinia selaginea (Lamarck, 1814)
Ircinia variabilis (Schmidt, 1862)
Jaspis johnstonii (Schmidt, 1862)
Leucosolenia variabilis (Haeckel, 1870)
Lissodendoryx (Lissodendoryx) isodictyalis (Carter, 1882)
Mycale (Aegogropila) tunicata (Schmidt, 1862)
Oscarella lobularis (Schmidt, 1862)
Penares euastrum (Schmidt, 1868)
Petrosia (Petrosia) clavata (Esper, 1794)
Petrosia (Petrosia) ficiformis (Poiret, 1789)
Phakellia Bowerbank, 1862
Phorbas fictitius Bowerbank, 1866
Phorbas mercator (Schmidt, 1868)
Phorbas tenacior (Topsent, 1925)
Plakortis simplex Schulze, 1880
Pleraplysilla minchini Topsent, 1905
Pleraplysilla spinifera (Schulze, 1879)
Plocamionida ambigua (Bowerbank, 1866)
Poecillastra compressa (Bowerbank, 1866)
Polymastia Bowerbank, 1864
Pseudosuberites sulphureus (Bowerbank, 1866)
Raspaciona aculeata (Johnston, 1842)
Sarcotragus fasciculatus (Pallas, 1766)
Sarcotragus foetidus Schmidt, 1862
Sarcotragus spinosulus (Schmidt, 1862)
Scalarispongia scalaris (Schmidt, 1862)
Siphonodictyon insidiosum (Johnson, 1899)
Spirastrella cunctatrix Schmidt, 1868
Spiroxya heteroclita Topsent, 1896
Spongia (Spongia) lamella (Schulze, 1879)
Spongia (Spongia) officinalis Linnaeus, 1759
Spongia (Spongia) virgultosa (Schmidt, 1868)
Spongia Linnaeus, 1759
Suberites carnosus (Johnston, 1842)
Suberites domuncula (Olivi, 1792)
Tedania (Tedania) anhelans (Lieberkühn, 1859)
Terpios gelatinosa (Bowerbank, 1866)
Timea stellata (Bowerbank, 1866)
Timea unistellata (Topsent, 1892)
Triptolemma simplex (Sarà, 1959)

Cnidaria
Actinia cari Delle Chiaje, 1822
Aglaophenia pluma (Linnaeus, 1758)
Aiptasia mutabilis (Gravenhorst, 1831)
Alcyonium acaule Marion, 1878
Alcyonium coralloides (Pallas, 1766)
Alcyonium palmatum Pallas, 1766
Alicia mirabilis Johnson, 1861
Balanophyllia (Balanophyllia) europaea (Risso, 1826)
Caryophyllia (Caryophyllia) smithii Stokes and Broderip, 1828
Cerianthus membranaceus (Spallanzani, 1784)
Cladocora caespitosa (Linnaeus, 1767)
Corallium rubrum (Linnaeus, 1758)
Eudendrium racemosum (Cavolini, 1785)
Eunicella cavolini (Koch, 1887)
Eunicella singularis (Esper, 1791)
Eunicella verrucosa (Pallas, 1766)
Eunicella Verrill, 1869
Leptogorgia sarmentosa (Esper, 1789)
Leptopsammia pruvoti (Lacaze-Duthiers, 1897)
Lytocarpia myriophyllum (Linnaeus, 1758)
Madracis pharensis (Heller, 1868)
Obelia dichotoma (Linnaeus, 1758)
Paramuricea clavata (Risso, 1826)
Paramuricea macrospina (Koch, 1882)
Parazoanthus axinellae (Schmidt, 1862)
Pennaria disticha (Goldfuss, 1820)
Pennaria Goldfuss, 1820
Pennatula rubra (Ellis, 1761)
Phyllangia americana mouchezii (Lacaze-Duthiers, 1897)
Polycyathus muellerae (Abel, 1959)
Savalia savaglia (Bertoloni, 1819)

Dercitus (Stoeba) plicatus (Schmidt, 1868)
Dictyonella incisa (Schmidt, 1880)
Dictyonella marsilii (Topsent, 1893)
Dictyonella obtusa (Schmidt, 1862)
Dictyonella pelligera (Schmidt, 1862)
Diplastrella bistellata (Schmidt, 1862)
Dysidea (Johnston, 1842)
Dysidea avara (Schmidt, 1862)
Dysidea fragilis (Montagu, 1814)
Erylus discophorus (Schmidt, 1862)
Eurypon cinctum Sarà, 1960
Eurypon clavatum (Bowerbank, 1866)
Eurypon coronula (Bowerbank, 1874)
Eurypon denisae Vacelet, 1969
Eurypon gracile Bertolino, Calcinai and Pansini, 2013
Eurypon major Sarà and Siribelli, 1960
Eurypon topsenti Pulitzer-Finali, 1983
Eurypon vesciculare Sarà and Siribelli, 1960
Forcepia (Leptolabis) brunnea (Topsent, 1904)
Geodia conchilega Schmidt, 1862
Geodia cydonium (Jameson, 1811)
Halichondria (Halichondria) convolvens Sarà, 1960
Haliclona (Gellius) angulata (Bowerbank, 1866)
Haliclona (Gellius) marismedi (Pulitzer-Finali, 1978)
Haliclona (Halichoclona) fulva (Topsent, 1893)
Haliclona (Halichoclona) parietalis (Topsent, 1893)
Haliclona (Reniera) citrina (Topsent, 1892)
Haliclona (Reniera) cratera (Schmidt, 1862)
Haliclona (Reniera) mediterranea (Griessinger, 1971)
Haliclona (Rhizoniera) rosea (Bowerbank, 1866)
Haliclona (Soestella) mucosa (Griessinger, 1971)
Halicnemia geniculata Sarà, 1958
Halicnemia patera Bowerbank, 1864
Halisarca dujardinii (Johnston, 1842)
Hemimycale columella (Bowerbank, 1874)
Hippospongia communis (Lamarck, 1814)
Hymedesmia (Stylopus) coriacea (Fristedt, 1866)
Hymerhabdia oxytrunca Topsent, 1904

Polychaeta
Filograna (Berkeley, 1835)
Protula tubularia (Montagu, 1803)
Sabella spallanzanii (Gmelin, 1791)
Salmacina dysteri (Huxley, 1855)
Serpula vermicularis Linnaeus, 1767
Serpulidae Rafinesque, 1815

Bivalvia
Pinna nobilis Linnaeus, 1758

Bryozoa
Cellaria fistulosa (Linnaeus, 1758)
Cradoscrupocellaria reptans (Linnaeus, 1758)
Myriapora truncata (Pallas, 1766)
Pentapora fascialis (Pallas, 1766)
Pentapora foliacea (Ellis and Solander, 1786)
Reteporella beaniana (King, 1846)
Reteporella grimaldii (Jullien, 1903)
Reteporella (Busk, 1884)
Rhynchozoon Hincks, 1895
Schizomavella linearis (Hassall, 1841)
Schizoporella errata (Waters, 1878)
Schizoporella (Hincks, 1877)
Scrupocellaria scrupea Busk, 1852
Smittina cervicornis (Pallas, 1766)
Turbicellepora avicularis (Hincks, 1860)

Ascidiacea
Aplidium conicum (Olivi, 1792)
Ciona edwardsi (Roule, 1884)
Clavelina lepadiformis (Müller, 1776)
Diplosoma spongiforme (Giard, 1872)
Halocynthia papillosa (Linnaeus, 1767)
Microcosmus vulgaris Heller, 1877
Phallusia fumigata (Grube, 1864)