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Benthic invertebrates associated with subfossil cold-water coral frames and hardgrounds in the Albanian deep waters (Adriatic Sea)

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Abstract: The fauna collected associated with subfossil *Lophelia pertusa* and *Dendrophyllia cornigera* coral samples and hardgrounds from Albanian waters between 190–230 m is discussed. Eighty-three benthic species are recorded: 2 Foraminifera, 22 Porifera, 6 Cnidaria, 25 Mollusca, 14 Annelida, 1 Arthropoda, 12 Bryozoa, and 1 Echinodermata. Seventy-four species are new records for the poorly investigated Albanian deep waters.

Key words: Cold-water corals, biodiversity, Mediterranean basin, Adriatic Sea, Albania, *Lophelia pertusa*, *Dendrophyllia cornigera*, deep-water benthos

1. Introduction

The habitat-forming ability of corals has fascinated generations of marine biologists and this role has been formalized through the concept of 'ecological engineering' (Jones et al., 1994; Wright and Jones, 2006). Cold-water coral (CWC) bioconstructions providing structural habitats promote a high level of diversity during their lifetimes and after (e.g., Jensen and Frederiksen, 1992; Freiwald and Wilson, 1998; Mortensen and Fossa, 2006). CWCs such as the frame-builder scleractinian corals *Lophelia pertusa* and *Madrepora oculata* have been documented from various parts of the Mediterranean basin (Taviani et al., 2017, with references therein). As for the Atlantic Ocean, *L. pertusa* and *M. oculata* may form three-dimensional structures in the Mediterranean, which provide a substrate for various sessile benthic invertebrates, thus increasing the environmental biodiversity of CWC habitats, including their thanatofacies (Carlier et al., 2009; Freiwald et al., 2009; Bongiorni et al., 2010; Mastrototaro et al., 2010; Rosso et al., 2010; Vertino et al., 2010; D'Onghia et al. 2015; Bargain et al., 2017; Taviani et al., 2017). The subfossil coral frames have been documented to act as taphonomic traps, at times including representatives both of the CWC-associated fauna and skeletal remains from adjacent habitats (Remia and Taviani, 2005; Angeletti and Taviani, 2011; Taviani et al., 2011b). The most important live CWC sites in the southeastern Adriatic are the Bari Canyon, the Gondola Slide, the Dauno Seamount, and off Tricase (Freiwald et al., 2009; Taviani et al., 2011a, 2016; Angeletti et al., 2014). In the eastern side of this basin, CWC growth appears sporadic and localized, and records often refer to subfossil material (Angeletti et al., 2014, 2015; Nasto, 2017). This asymmetrical CWC distribution in the southern Adriatic has been hypothesized to be governed by hydrologic processes, including North Adriatic Dense Water cascading (Taviani et al., 2016). Although the Adriatic Albanian margin is indented by a number of small canyons, evidence of living megabenthic sessile fauna in such environments is almost lacking. This is true for CWCs, which are documented to date only as subfossil records of *L. pertusa* and *Desmophyllum dianthus* found in the Albanian part of the Otranto channel (Angeletti et al., 2014).

The occurrence of dead (subfossil) CWC frames in Albanian deep waters has been known to fishermen for a while. This serendipitous information generated curiosity

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in the scientific community, which led to the organization of a first exploratory investigation of anecdotally reported CWC sites. Two surveys dedicated to getting more in-depth information on CWC distribution were therefore conducted onboard commercial fishing boats. Two areas of the southern Albanian coast between 190 and 210 m were trawled off Vlora Bay in 2015 and 2016 (stations AL15SE1 and AL16SE2 are illustrated Figure 1 and Table 1). Our research resulted in the recovery of two large subfossil *Lophelia* colonies and hardground slabs and fragments fouled by serpulids, sponges, bivalves, bryozoans, and solitary scleractinian corals. This paper provides new information about the benthic fauna associated with these subfossil coral frameworks and cooccurring hardgrounds. Such material comprises both live and dead representatives, here considered cumulatively. It should be noted, however, that the latter may well include late Pleistocene subfossils, including CWCs, whose presence in the deep southern Adriatic Sea was ascertained long ago (Colantoni et al., 1975; McCulloch et al., 2010). Finally, this study also offers a contribution to the current renewed interest for the marine taxonomy of the Mediterranean Sea (Cirino et al., 2016; Boero et al., 2017; Keppell et al., 2017), and to helping to establish a better governance of CWC habitats in light of current anthropic and climatic threats (Fosså et al., 2002; Orejas et al., 2009; Fabri et al., 2012; Maier et al., 2012; McCulloch et al., 2012; Rodolfo-Metalpa et al., 2015; D'Onghia et al., 2017).

A further sampling site was located at the southern Albanian margin off Saranda (AL16SA1) and close to the Greek island of Corfu (Figure 1; Table 1), characterized by the predominance of coral rubble of *Dendrophyllia cornigera* (yellow coral) and hardgrounds. Fragments of *D. cornigera* appear patinated by oxides, bioeroded, and partly covered by sediment. Subfossil coral remains are fouled by serpulids, sponges, and solitary scleractinians like *Caryophyllia calveri* and, subordinately, *D. dianthus* and *Stenocyathus vermiformis*.

2. Materials and methods

All living taxa were picked from the substrate and fixed in 95% ethanol. For species identification of sponges, slides of dissociated spicules were prepared and observed with an optical microscope (Leica DM500) and, when needed, examined by scanning electron microscope (SEM, model Hitachi TM3000), as for some bryozoans. Taxa have been identified to the possible lowest taxonomic level. Nomenclature follows WoRMS (World Register of Marine

Figure 1. a) Map of the southern Adriatic Sea showing the two sampling areas discussed in the text; b) location of stations AL15SE1 and AL16SE2; c) location of station AL16SA1.

Table 1. Main station characteristics and material typology.

Stations	Material	Latitude, N	Longitude, E	Depth (m)
AL15SE1	*L. pertusa*, hardgrounds	40°48′26″	18°59′24″	190
AL16SE2	*L. pertusa*	40°50′730″	18°59′970″	210
AL16SA1	*D. cornigera*, *L. glaberrima*, hardgrounds	39°55′938″	19°48′248″	208

Species: available online at http://www.marinespecies.org) and Rosso and Di Martino (2016) for bryozoans. The subfossil *Lophelia* colonies are stored in the zoological collection of the University "Ismail Qemali" Vlora, Albania; sponges, cnidarians, and mollusks are hosted in the Department of Biology, University of Bari, Italy; and bryozoan and serpulid samples are located in the Paleontological Museum of the University of Catania, Italy, under the collective codes 'Rosso bryozoans collections Albania, Pl-H' and 'Sanfilippo serpulid collections Albania, Pl-H', respectively.

3. Results and discussion

A total of 83 benthic species were identified (Table 2), predominantly Porifera, Mollusca, and Annelida, with 22, 25, and 14 species, respectively.

3.1. Porifera

A total of 22 sponge taxa (4 at genus level, 18 at species level), all belonging to the class Demospongiae, were identified. Among them, 16 species were recorded from stations AL15SE1 and AL16SE2, and 6 taxa (*Jaspis incrustans*, *Pachastrella monilifera*, *Poecillastra compressa*, *Leiodermatium lynceus*, *Hamacantha* sp., *Sceptrella insignis*) also occurred at station AL16SA1. The order Tetractinellida, with 5 families and 7 species, represents ca. 31% of the sponges, while the other 10 orders (Polymastiida, Tethyida, Poecilosclerida, Axinellida, Desmacellida, Merliida, Bubarida, Agelasida, Haplosclerida, Verongiida) include a few taxa each.

With a few exceptions (*P. compressa*, *P. monilifera*, and *L. lynceus*), sponges mainly occurred as small thin incrustations on the exposed surfaces and branches of subfossil coral colonies. Heavy bioerosion observed on *L. pertusa* and *D. cornigera* likely points to the presence of boring sponges, a common case on dead coral substrates (Beuck et al., 2010), but extraction of sponge tissue and/or spicules for species identification proved unfeasible.

Most sponges have a North Atlantic distribution and were previously reported from a few Mediterranean sites (Pansini and Longo, 2003; Van Soest et al., 2018). All such taxa were already recorded from CWC grounds at Santa Maria di Leuca (SML) and the Bari Canyon (11 for Bari Canyon and 14 for SML: Longo et al., 2005; Mastrototaro et al., 2010; Bo et al. 2011; D'Onghia et al., 2015). The range of *Antho signata* and *Geodia nodastrella* (identified at SML as first Mediterranean records: Longo et al., 2005; Mastrototaro et al., 2010) is expanded to the Albanian waters. This holds true also for the lithistid *Siphonidium ramosum* (Figure 2), originally described from Florida seamounts (Van Soest et al., 2018) and equally displaying a patchy Mediterranean distribution (Longo et al., 2005; Mastrototaro et al., 2010).

Analogously, the finding of the lithistid sponge *Siphonidium ramosum* (Figure 2), first described from Florida seamounts (Van Soest et al., 2018), is interesting because its distribution is presently restricted to a few areas in the Mediterranean Sea (Topsent, 1925; Longo et al., 2005; Mastrototaro et al., 2010).

3.2. Cnidaria

The fauna encrusting subfossil colonies of *L. pertusa* include *C. cyathus* (Figure 3) and *Caryophyllia calveri*, the latter being a first record for the Adriatic Sea. On the basal part of these *L. pertusa* colonies, solitary polyps of *Stenocyathus vermiformis* (Figure 3) formed a canopy of dead and living individuals. Dead specimens of *C. cyathus* and *C. calveri* were used as a substrate by juveniles belonging to the same species, as also observed for the Eratosthenes Seamount (Galil and Zibrowius, 1998).

The presence of the bamboo coral *Isidella elongata* (Figure 3) was ascertained on muddy bottoms at both sites. Furthermore, a number of *Stephaniscyphistoma* specimens were noticed, the benthic stage of bathypelagic medusae of the genus *Nausithoe* (Scyphozoa: family Coronatae), in analogy with other coral banks (Jarms et al., 2003; Mastrototaro et al., 2010). *C. cyathus* was also observed to colonize *D. cornigera* rubble at station AL16SA1. Two living colonies of *Leiopathes glaberrima* were also recovered during our survey. It is worth mentioning that the presence of *L. glaberrima* in this sector of the Mediterranean was documented offshore Saranda associated with *D. dianthus* (CNR oceanographic cruise CoCoMap 2014: unpublished data). Solitary corals such as *D. dianthus*, *S. vermiformis*, and *C. calveri* often settle on subfossil coral substrate.

3.3. Mollusca

A total of 25 benthic species was identified pertaining to Gastropoda (13 species) and Bivalvia (12 species). Shells of the holoplanktic thecosomatous pteropod *Cavolinia gibbosa*, shed from the water column, also occurred. As a whole, the fauna is characterized by typical epibathyal mollusks of the Mediterranean Sea (Oliverio, 2008; Negri and Corselli, 2016). Station AL15SE provided the highest number of species, all already previously reported for the deep Adriatic Sea (Taviani, 1978; Panetta et al., 2013; Negri and Corselli, 2016). The large majority of the mollusk fauna is represented by taxa dwelling on mobile bottoms such as the infaunal mud-dwelling bivalves *Yoldiella philippiana* and *Abra longicallus* (Figure 4). The mollusk fauna mainly consisted of empty shells typical of muddy bottoms. Only a few species (including living representatives) were identified associated with *Lophelia* subfossil colonies and hardgrounds. Some shells are cemented or encased into the subfossil coral frames, a case reported from other CWC situations in the Mediterranean Sea (Remia and Taviani 2005; Taviani et al., 2005; Angeletti and Taviani, 2014). No mollusks strictly associated with CWCs habitats,

Table 2. Taxa associated with subfossil *L. pertusa* and *D. cornigera* colonies and hardgrounds (* = first record for the Albanian fauna).

Phylum	Order	Family	Species
Foraminifera	Rotaliida	Homotrematidae	*Miniacina miniacea* (Pallas, 1766)*
	Miliolida	Nubeculariidae	*Cornuspiramia* sp.*
Porifera	Tetractinellida	Ancorinidae	*Jaspis incrustans* (Topsent, 1890)*
		Geodiidae	*Geodia nodastrella* Carter, 1876*
		Pachastrellidae	*Pachastrella* sp.*
			Pachastrella monilifera Schmidt, 1868*
		Vulcanellidae	*Poecillastra compressa* (Bowerbank, 1866)*
			Vulcanella gracilis (Sollas, 1888)*
		Siphonidiidae	*Siphonidium ramosum* (Schmidt, 1870)*
	Polymastiida	Polymastiidae	*Polymastia* sp.*
	Tethyida	Timeidae	*Timea* sp.*
	Poecilosclerida	Microcionidae	*Antho signata* (Topsent, 1904)*
		Hymedesmiidae	*Hymedesmia mutabilis* (Topsent, 1904)*
		Latrunculiidae	*Sceptrella insignis* (Topsent, 1890)*
	Desmacellida	Desmacellidae	*Desmacella inornata* (Bowerbank, 1866)*
	Merliida	Hamacanthidae	*Hamacantha johnsoni* (Bowerbank, 1864)*
		Hamacanthidae	*Hamacantha papillata* Vosmaer, 1885*
			Hamacantha sp.*
	Axinellida	Raspailiidae	*Eurypon clavatum* (Bowerbank, 1866)*
		Axinellidae	*Phakellia robusta* Bowerbank, 1866*
	Bubarida	Bubaridae	*Bubaris vermiculata* (Bowerbank, 1866)*
	Agelasida	Hymerhabdiidae	*Hymerhabdia typica* Topsent, 1892*
	Haplosclerida	Chalinidae	*Haliclona flagellifera* (Ridley & Dendy, 1886)*
	Verongiida	Ianthellidae	*Hexadella dedritifera* Topsent, 1913*
Cnidarian	Coronatae	Nausithoidae	*Nausithoe* spp.*
	Alcyonacea	Isididae	*Isidella elongata* (Esper, 1788)*
	Antipatharia	Leiopathidae	*Leiopathes glaberrima* (Esper, 1788)*
	Scleractinia	Caryophylliidae	*Caryophyllia calveri* Duncan, 1873*
			Caryophyllia cyathus (Ellis & Solander, 1786)*
			Desmophyllum dianthus (Esper, 1794) **(subfossil)***
			Lophelia pertusa (Linnaeus, 1758) **(subfossil)***
		Guyniidae	*Stenocyathus vermiformis* (Pourtalès, 1868)*
		Dendrophylliidae	*Dendrophyllia cornigera* (Lamarck, 1816) **(subfossil)***
Mollusca	Vetigastropoda	Fissurellidae	*Emarginula adriatica* O. G. Costa, 1830*
		Trochidae	*Clelandella miliaris* (Brocchi, 1814)*
		Eucyclinae	*Putzeysia wiseri* (Calcara, 1842)*
	Neotaenioglossa	Rissoidae	*Alvania cimicoides* (Forbes, 1844)
		Ranellidae	*Ranella olearia* (Linnaeus, 1758)
	Ptenoglossa	Muricidae	*Orania fusulus* (Brocchi, 1814)*
			Pagodula echinata (Kiener, 1840)*
		Nassariidae	*Nassarius lima* (Dillwyn, 1817)

Table 2. (Continued).

		Fasciolariidae	*Fusinus rostratus* (Olivi, 1792)
		Conidae	*Bela nuperrima* (Tiberi, 1855)
	Heterostropha	Odostomiidae	*Chrysallida stefanisi* (Jeffreys, 1869)*
		Pyramidellidae	*Eulimella bogii* Van Aartsen, 1995*
	Cephalaspidea	Acteonidae	*Callostracon tyrrhenicum* (Smriglio & Mariottini, 1996)
	Solemyoida	Yoldiidae	*Yoldiella philippiana* (Nyst, 1845)*
	Arcoida	Arcidae	*Asperarca nodulosa* (O. F. Müller, 1776)*
			Bathyarca philippiana (Nyst, 1848)*
	Pterioida	Propeamussiidae	*Parvamussium fenestratum* (Forbes, 1844)*
		Pectinidae	*Pseudamussium peslutrae* (Linnaeus, 1771)*
			Karnekampia sulcata (Müller, 1776)*
		Spondylidae	*Spondylus gussoni* O. G. Costa, 1830*
	Veneroida	Chamidae	*Pseudochama gryphina* (Lamarck, 1819)*
		Semelidae	*Abra longicallus* (Scacchi, 1835)
		Kellielliidae	*Kelliella miliaris* (Philippi, 1844)*
		Veneridae	*Timoclea ovata* (Pennant, 1777)
	Pholadomyoida	Cuspidariidae	*Tropidomya abbreviata* (Forbes, 1843)*
Annelida	Sabellida	Serpulidae	*Filogranula gracilis* Langerhans, 1884*
			Filogranula stellata (Southward, 1963)*
			Filogranula annulata (O.G. Costa, 1861)*
			Filograna sp. 1*
			Filograna sp. 2*
			Hyalopomatus madreporae Sanfilippo, 2009*
			Hyalopomatus sp.*
			Janita fimbriata (Delle Chiaje, 1822)*
			Metavermilia multicristata (Philippi, 1844)*
			Placostegus tridentatus (Fabricius, 1779)*
			Protis sp. *
			Serpula cf. *vermicularis* Linnaeus 1767*
			Vermiliopsis monodiscus Zibrowius, 1968*
			Serpulidae sp. 1
Bryozoa	Cyclostomatida	Tubuliporidae	*Idmidronea* sp.*
		Crisiidae	*Crisia tenella longinodata* Rosso, 1998*
	Cheilostomatida	Calloporidae	*Ramphonotus* sp.*
			Copidozoum exiguum (Barroso, 1920)*
		Cribrilinidae	*Puellina pedunculata* (Gautier, 1956)*
		Romancheinidae	*Neolagenipora eximia* (Hincks, 1860)*
		Smittinidae	*Smittina* cf. *crystallina* (Norman, 1867)*
		Escharinidae	*Herentia hyndmanni* (Johnston, 1847)*
		Celleporidae	*Turbicellepora coronopus* (Wood, 1844)*
Arthropoda	Decapoda	Leucosiidae	*Ebalia nux* A. Milne-Edwards, 1883*
Echinodermata	Cidaroida	Cidaridae	*Cidaris cidaris* (Linnaeus, 1758)*

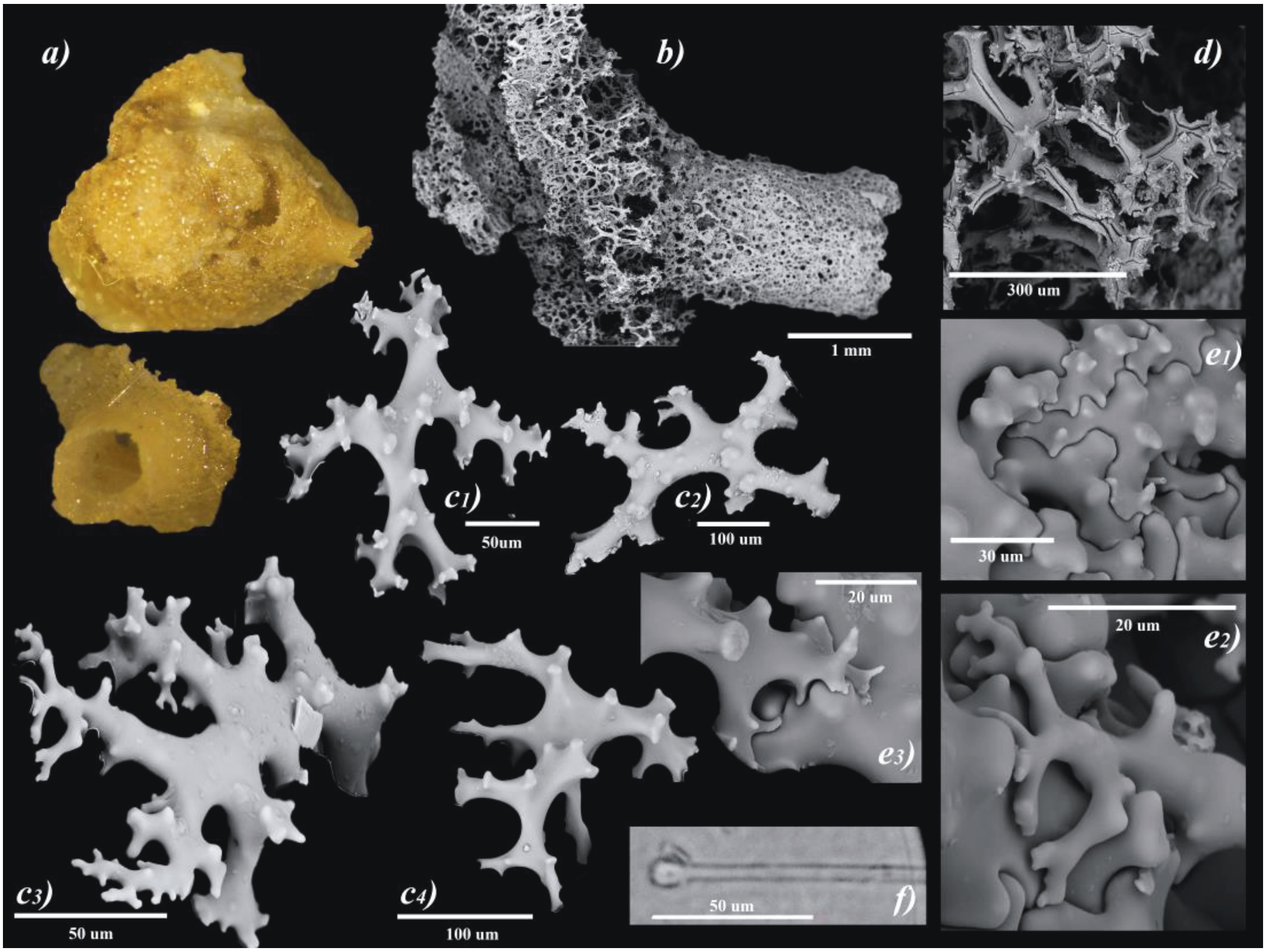

Figure 2. *Siphonidium ramosum* (Schmidt, 1870): a) specimen collected at AL15SE1; b) skeleton formed by extremely compacted rhizoclones; c_1, c_2, c_3, c_4) rhizoclone desmas; d) general view of the framework of spiny rhizoclone desmas; e_1, e_2, e_3) detail of contacts between adjacent desmas; f) heads of exotylostyles.

such as corallivorous or ectoparasite gastropods (Taviani and Colantoni, 1979; Taviani and Sabelli, 1982; Taviani et al., 2009), or large bivalves (López Correa et al., 2005; Gofas et al., 2007), have been observed in our samples. The arcid bivalves *Asperarca nodulosa* and *Bathyarca philippiana* were commonly found byssated on hard substrates. The presence of gastropods, such as *Emarginula adriatica*, *Clelandella miliaris*, *Putzeysia wiseri*, and *Alvania cimicoides*, and bivalves, *A. nodulosa*, *Bathyarca philippiana*, *Karnekampia sulcata*, and *Spondylus gussoni*, is consistent with, although not exclusive to, CWC habitats s.l. (Guidastri et al., 1983; Tursi et al., 2004; Remia and Taviani, 2005; Toscano and Raspini, 2005; Mastrototaro et al., 2010; Rosso et al., 2010; Trincardi et al., 2010; Taviani et al., 2011b; Negri and Corselli, 2016).

3.4. Annelida

The annelid stock identified at stations AL15SE1 and AL16SE2 consists of 14 species at station AL15SE1 and 11 species at AL16SE2. *Metavermilia multicristata*, *Filogranula gracilis*, and *Filograna* sp. 1 are the dominant species in both stations and also included living specimens. The species occurring at both stations are *Filogranula gracilis*, *F. stellata*, *F. annulata*, *Hyalopomatus madreporae*, *Metavermilia multicristata*, *Janita fimbriata* (Figure 5), *Placostegus tridentatus*, *Serpula* cfr. *vermicularis*, and *Vermiliopsis monodiscus*. Two morphotypes that may prove to be separate species in the genus *Filograna* (*Filograna* sp. 1 and *Filograna* sp. 2: Table 2) occur at both stations. Most taxa are widely distributed in the Mediterranean Sea and eastern Atlantic Ocean (Castelli et al., 2008; Sanfilippo, 2009; Mastrototaro et al., 2010; D'Onghia et al., 2015).

Dense aggregates of *Filograna* encrust the surface of coral colonies (stat. AL15SE1). Similar *Filograna* tube aggregates have been previously recorded from the Bari Canyon (D'Onghia et al., 2015). The Mediterranean endemic serpulids *Vermiliopsis monodiscus* and

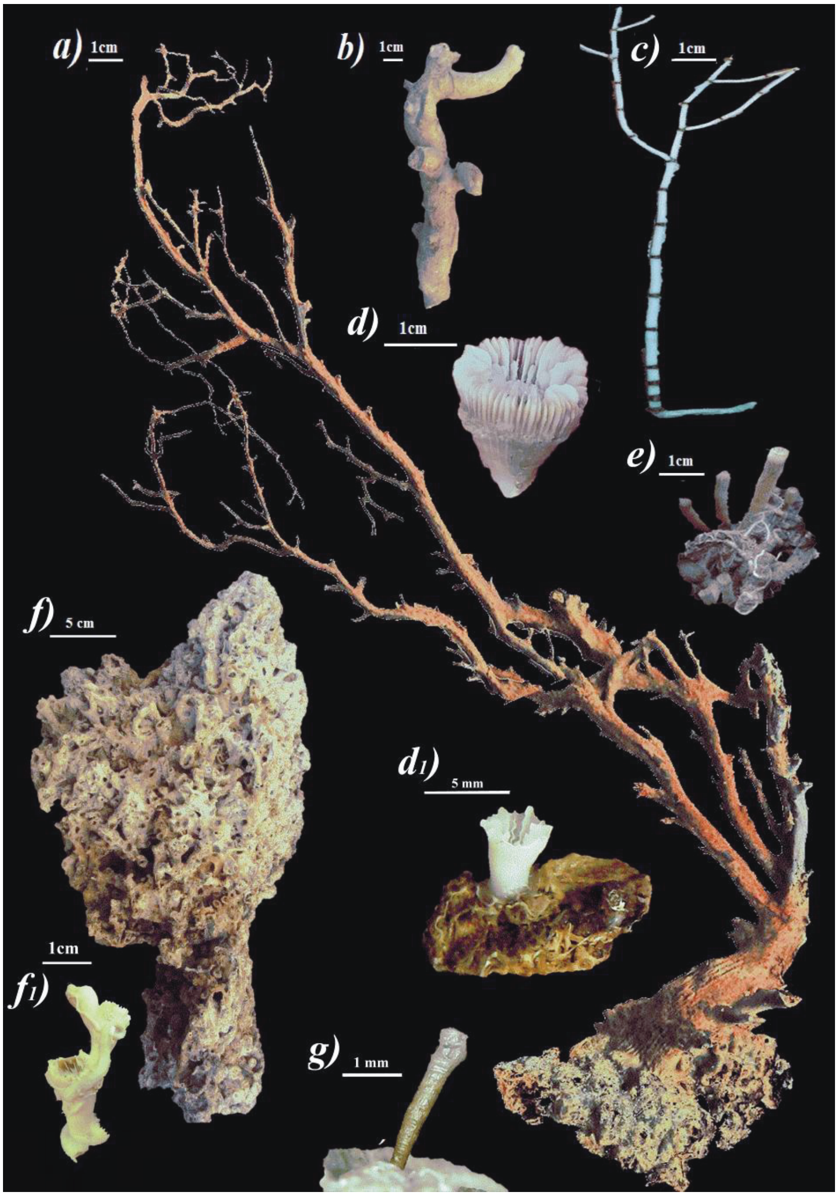

Figure 3. Cnidaria recorded from the study area: a) *Leiopathes glaberrima* (AL16SA1); b) *Dendrophyllia cornigera* (AL16SA1); c) *Isidella elongata* (AL16SE2); d, d_1) *Caryophyllia calveri* (AL15SE1); e) *Stenocyathus vermiformis* (AL16SE2); f, f_1) *Lophelia pertusa* (AL15SE1); g) *Nausithoe* sp. (AL15SE1)

Hyalopomatus madreporae (Figure 5) have both been reported from the SML and the Bari Canyon CWC provinces (Sanfilippo, 2009; Mastrototaro et al., 2010; D'Onghia et al., 2015).

In summary, the censed sessile annelid macrofauna as a whole is typical of deep-circalittoral, bathyal habitats. It also shares common traits with the Apulian CWC sites and deep-sea Mediterranean hardgrounds (Zibrowius and Taviani, 2005; Mastrototaro et al., 2010; Taviani et al., 2011b; Sanfilippo et al., 2013; D'Onghia et al., 2015).

3.5. Bryozoa

A total of 9 bryozoans have been identified on subfossil *Lophelia* colonies, most of which were determined at species level. Cyclostomes are represented by 2 taxa only (*Idmidronea* sp. 1: Figure 6, and *Crisia tenella longinodata*), whereas cheilostomes prevail with 7 species. Only 4 species occurred alive, namely *C. tenella longinodata*, *Idmidronea* sp. 1, *Neolagenipora eximia*, and *Herentia hyndmanni*. *Copidozoum exiguum*, *Smittina* cf. *cristallina*, and *Puellina pedunculata* were present with

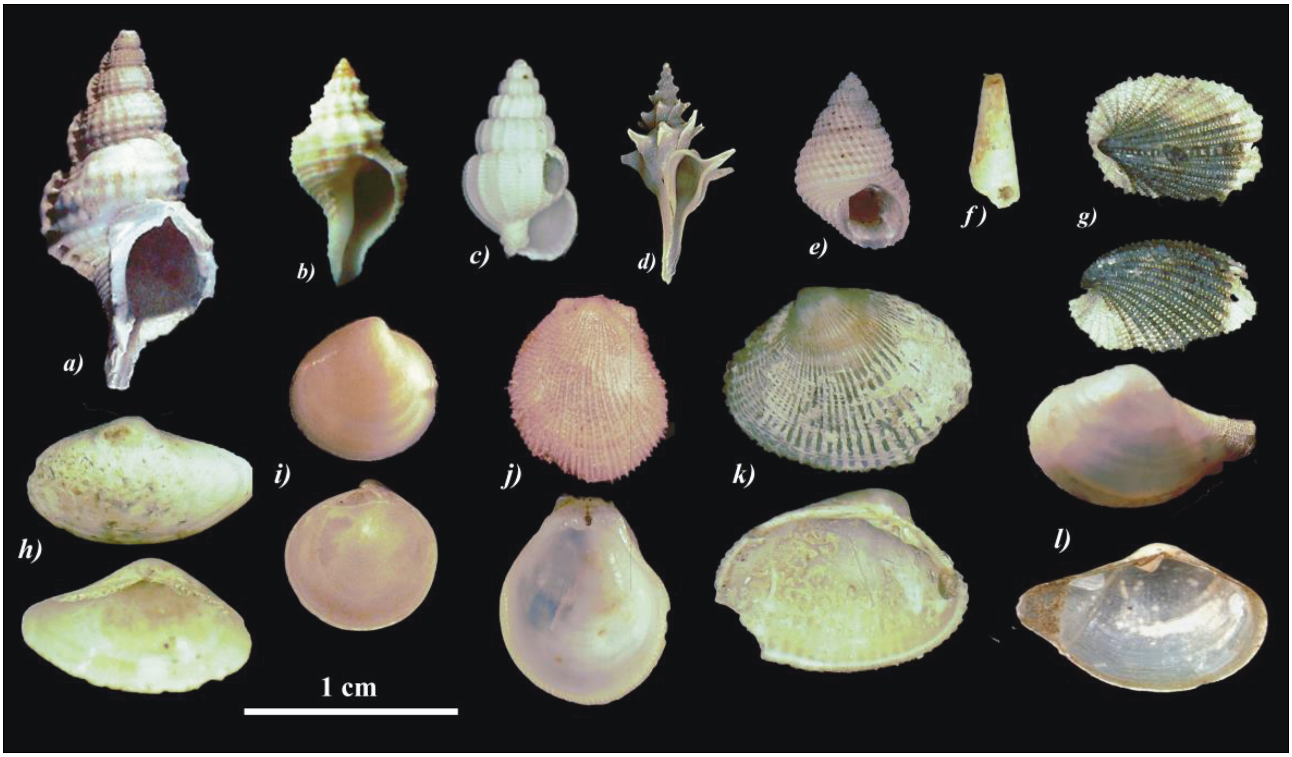

Figure 4. Mollusks associated with the *Lophelia pertusa* and *Dendrophyllia cornigera* subfossil colonies collected at AL15SE1 and AL16SE2, and AL16SA1: a) *Ranella olearia*; b) *Orania fusulus*; c) *Nassarius lima*; d) *Pagodula echinata*; e) *Putzeysia wiseri*; f) *Eulimella bogii*; g) *Emarginula adriatica*; h) *Yoldiella philippiana*; i) *Kelliella miliaris;* j) *Spondylus gussoni*; k) *Timoclea ovata*; l) *Tropidomya abbreviata.*

dead but fresh-looking colonies. The remaining species (*Ramphonotus* sp. and *Turbicellepora coronopus*), as well as fragments of additional species exclusively recorded from sediments, are only represented by old-looking specimens. These latter, namely *Diplosolen obelium*, *Adeonella pallasi*, and *Reptadeonella violacea*, were omitted from Table 2. All taxa are documented by very few colonies, with predominant encrusting morphotypes, including small unilaminar colonies and especially spots, i.e. colonies consisting of few zooids. Erect colonies are sporadic, small-sized and poorly branched. Nearly all species were previously known as colonizers of hard substrates, including live and dead coral skeletons (Zabala et al., 1993; Mastrototaro et al., 2010; D'Onghia et al., 2015; Rosso and Di Martino, 2016), but none specifically adapted to or exclusive to coral substrate. Most species were previously reported from the SML and the Bari Canyon (BC) coral provinces (Mastrototaro et al., 2010; D'Onghia et al., 2015). Both cyclostomes occurring in the Albanian waters with living colonies were first recognized as fossils from southern Italy (Rosso and Di Geronimo, 1998; Rosso, 2005), but were subsequently discovered alive in the SML and BC coral provinces (Mastrototaro et al., 2010; D'Onghia et al., 2015). Conversely, *Puellina pedunculata*, *Smittina* cf. *crystallina*, and *Herentia hyndmanni* were also reported from canyons along the Catalonia slope (Zabala et al., 1993), besides the Apulian offshore (Mastrototaro et al., 2010; D'Onghia et al., 2015). *Neolagenipora eximia* (Figure 6) is a first live record for the area. This species was already known from the northwestern Mediterranean Sea (Harmelin, 1976; Zabala et al., 1993; Madurell et al., 2013). Based upon its mainly northern Atlantic distribution and its occurrence as a Pleistocene fossil in southern Italy (Rosso, 2005), *N. eximia* was considered a relic element in the Mediterranean Sea (Di Geronimo et al., 1996; Rosso and Di Geronimo, 1998). The present finding considerably expands the Mediterranean distribution of a species once considered as nearly disappeared in this basin.

3.6. Conclusions

The present study provides a first account of the macro- and megafauna deep-sea biodiversity associated with CWC and hardground habitats in the Adriatic Albanian waters. A total of 83 species were identified, including 74 species that are new records for the Albanian fauna, remarkably improving the knowledge of the deep-sea benthos of the southeastern Adriatic Sea.

The considerable number of species associated with subfossil *Lophelia* colonies and *Dendrophyllia*

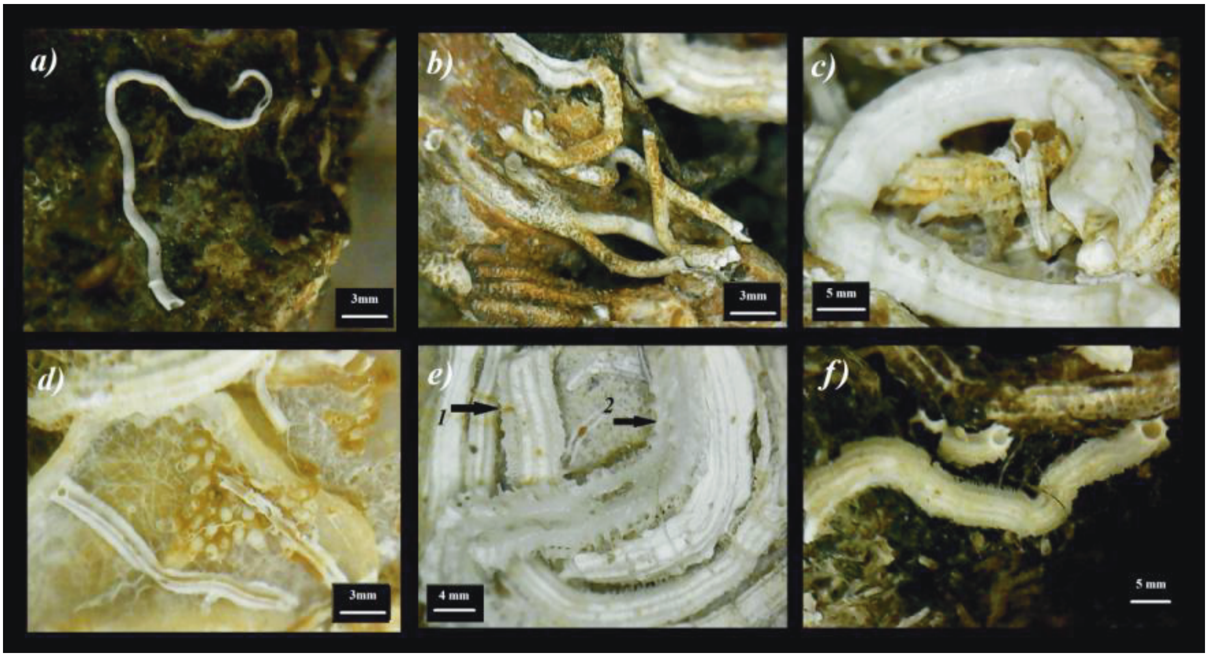

Figure 5. Annelids associated with *Lophelia* subfossil colonies from stations AL15SE1 and AL16SE2: a) *Hyalopomatus madreporae*, b, c) Serpulidae sp. 1, d) *Filogranula gracilis*, e) 1: *Metavermilia multicristata*, 2: *Janita fimbriata*, f) *Metavermilia multicristata*.

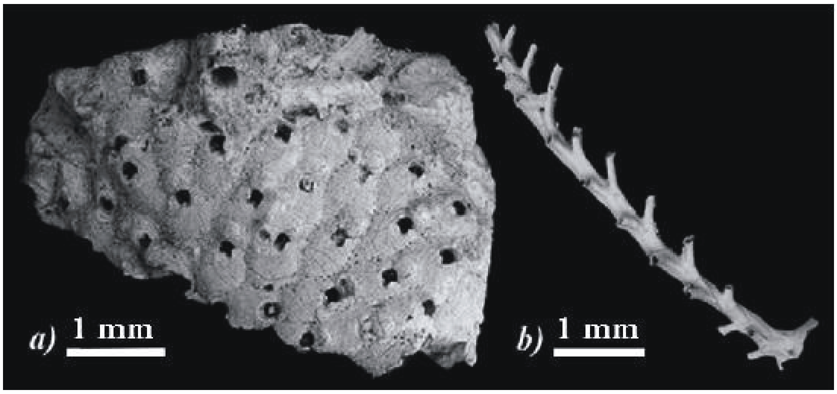

Figure 6. SEM images of bryozoans: a) *Neolagenipora eximia*, stat. AL15SE1; b) *Idmidronea* sp. 1., stat. AL15SE1.

rubble provides further confirmation that dead coral frameworks are highly significant in terms of associated species diversity (Freiwald and Wilson, 1998; Roberts et al., 2009). Dead frames are typically characterized by attached suspension-feeding fauna, including numerous sponges, actinians, and other cnidarian species, and smaller epifauna including bryozoans and serpulids. Sediment trapped in the coral framework offers niches to infaunal species, such as polychaetes and mollusks. The predominance of suspension feeders seems to be linked to the trophic energy system in these situations.

The occurrence of subfossil *L. pertusa* is documented for the first time in Albanian waters and such a finding indicates that ecological conditions were suitable for their development in the past.

Promisingly, our results thus disclosed a considerable diversity of deep-water benthos associated with dead CWC and hardground substrates in Albanian waters. This information derives from commercial fishery operations and this calls for future scientific action to fully evaluate the CWCs' precise location, extent, and biodiversity in this sector of the Adriatic Sea.

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