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Bryozoan diversity of Cyprus (eastern Mediterranean Sea): first results from census surveys (2011-2018)

Katerina ACHILLEOS[1], Carlos JIMENEZ[1], Björn BERNING[2] and Antonis PETROU[1]

[1]Enalia Physis Environmental Research Centre, Acropoleos str. 2, Aglantzia 2101, Nicosia, Cyprus
[2]Upper Austrian State Museum, Geoscience Collections, Welser Str. 20, Leonding 4060, Austria

Corresponding author: k.achilleos@enaliaphysis.org.cy

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Abstract

The Mediterranean bryozoan fauna is considered to be well studied compared to other marine areas of the world. However, in the Levantine Basin, bryozoan diversity has not yet been adequately documented. This report presents the first systematic and most comprehensive study of bryozoans sampled in Cyprus during census surveys from 2011 to 2018. The specimens were collected between 9 and ~620 m depth from several habitat types (mainly soft-bottom environments but also hard natural/artificial substrata, ancient shipwrecks, a marine cave, and deep-water coral habitats) around the island by means of bottom trawls, remotely operated vehicles, and scuba diving. The surveys produced a total of 91 species, 26 of which (=28%) are new records for the Levantine Basin, and 10 (=11%) are probably new to science. Our results thus show that the diversity of bryozoans in the eastern Mediterranean Sea is still significantly underestimated.

Keywords: Biodiversity; Bryozoa; Cyprus; Levantine; Mediterranean Sea.

Introduction

The eastern Mediterranean Sea, and especially the Levantine Basin, is an oligotrophic area poor in dissolved nutrients and phytoplankton biomass, with a relatively high salinity (~39 psu) and temperature (annual average, ~20°C), compared to the open ocean (Shaltout & Omstedt, 2014). Moreover, the Levantine Basin is currently under severe pressure due to the continuous rise in seawater temperature, a phenomenon known as the tropicalization of the Mediterranean (Bianchi, 2007; Shaltout & Omstedt, 2014), and because of the increased migration of warm-water species from the Red Sea via the Suez Canal (Ulman *et al*., 2017; Ferrario *et al*., 2018).

Despite the fact that the Mediterranean Sea is one of the most thoroughly investigated areas, representing nearly 9.6% of the global bryozoan diversity, the eastern basin has been poorly studied in the past (Rosso & Di Martino, 2016; Gerovasileiou & Rosso, 2016). However, during the last years several studies have been published describing the bryozoan diversity of the Levantine Basin (Koçak *et al*., 2002; Harmelin *et al*., 2007, 2009; Abdelsalam, 2014; Harmelin, 2014a,b; Sokolover *et al*., 2016; Abdelsalam *et al*., 2017; Guido *et al*., 2017; Berning *et al*., 2019; Rosso *et al.*, 2019). Whilst most of the species are apparently widely distributed throughout the Mediterranean Sea, a large number of taxa are new records to the region, many of which are regarded as non-indigenous that have probably entered the eastern basin through the Suez Canal. Currently, c. 170 bryozoan species have been identified in the Levantine Basin, 29 of which are considered to be non-indigenous (Harmelin *et al*., 2009, 2016; Zenetos *et al*., 2010, 2012; Koçak & Önen, 2014; Harmelin, 2014a; Sokolover *et al*., 2016; Ferrario *et al.,* 2018). The number of identified species must be considered as very conservative, however, as only a few thorough taxonomic studies have been undertaken, and most of the species were never examined using scanning electron microscopy (SEM), which is crucial for species-level identification of bryozoans. Moreover, even in the better-known western Mediterranean Sea, modern taxonomic revisions reveal that a significant number of species are new to science (e.g. Berning & Kuklinski, 2008; Rosso & Novosel, 2010; Reverter-Gil *et al*., 2015; Haugen *et al*., 2020; Rosso *et al.,* 2020).

The first study on the bryozoan fauna of Cyprus focused on the epifaunal community found on *Posidonia oceanica* from three stations along the northern coast of the island (Koçak *et al*., 2002), yet without illustrating or describing the species. In the only other study, Guido *et al*. (2017) reported four taxa from a submarine cave on the northwestern coast of the island. Thus, the bryozoan diversity of Cyprus has never been adequately recorded. The present work constitutes an extensive yet still preliminary report on the bryozoans collected on several biodiversity surveys that were conducted mainly along the southern Cyprus coastline, sampling depths between 9 and ~620 m as well as a range of different natural and artificial substrata. A detailed taxonomic study and an ecological analysis will be published at a later stage.

Material and Methods

This study represents a combination of material collected during different surveys carried out from 2011 to 2018, mainly around the southern coasts of Cyprus in the Levantine Sea (Fig. 1). As bryozoans were not the main target of these surveys, however, there are several limitations concerning the number of bryozoan species recovered, the distribution and density of sampling stations, and the sampled habitats. For instance, rocky substrata,

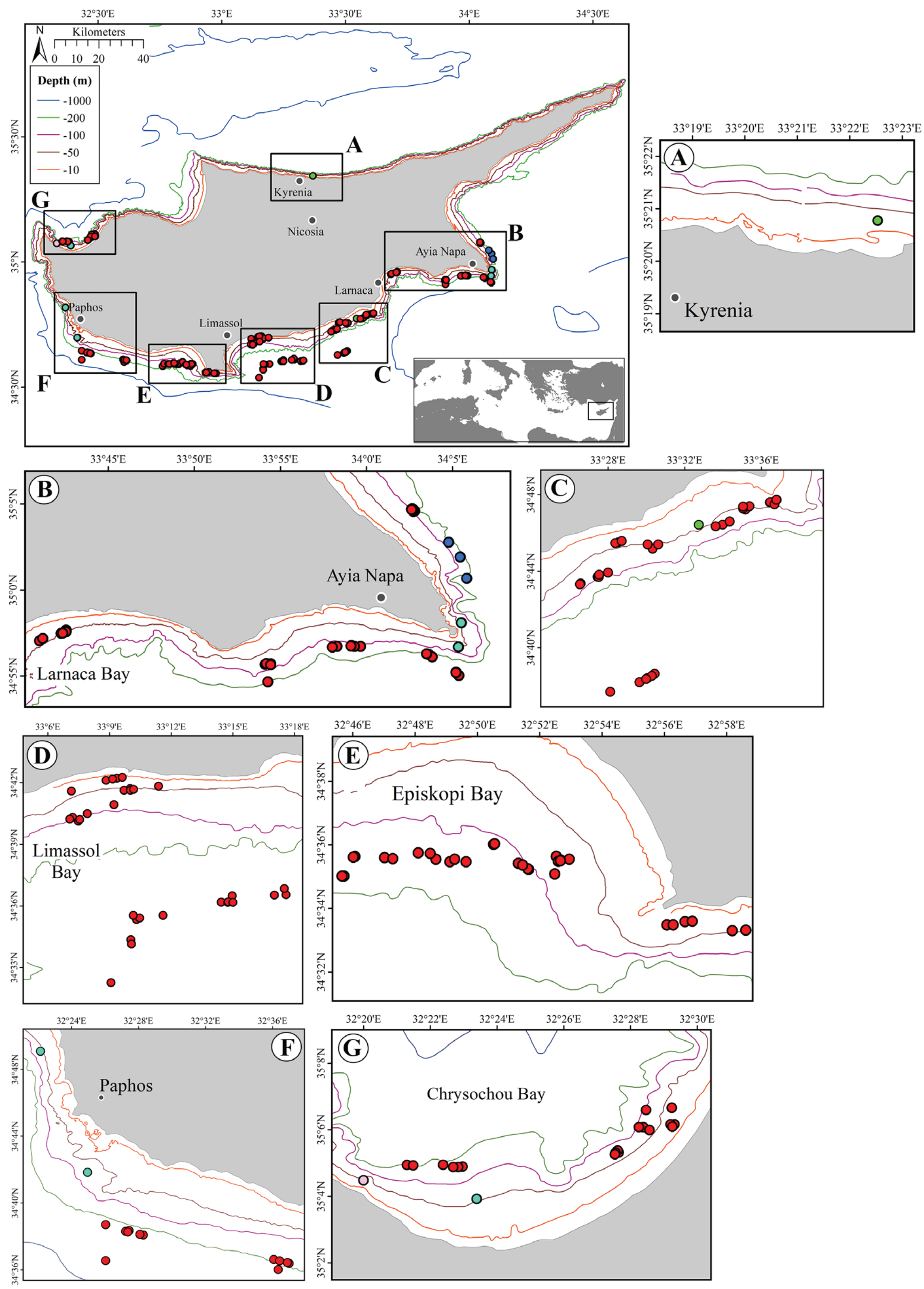

Fig. 1: Overview of the sampling stations along the coasts of Cyprus; Mediterranean Sea in detail. **A**, Kyrenia shipwreck; **B**, MEDITS, CYCLAMEN and PROTOMEDEA stations; **C**, MEDITS stations and Mazotos shipwreck; **D**, MEDITS stations east of Limassol; **E**, MEDITS stations west of Limassol; **F**, MEDITS and PROTOMEDEA stations; **G**, MEDITS and PROTOMEDEA stations as well as Kakoskali marine cave. MEDITS, 2012-2018: red circles; Mazotos and Kyrenia shipwrecks, 2011-2012: green circles; Kakoskali cave, 2012: pink circle; CYCLAMEN, 2015: dark blue circles; PROTOMEDEA, 2016: light blue circles.

which usually host the greatest bryozoan diversity, were not sampled owing to the sampling gear (trawl nets) used on the surveys. Nevertheless, the sampling stations range from 9-620 m depth and cover a range of different natural and artificial substrata as listed below. To homogenize the depth distribution between the different surveys, the predefined depth ranges of the annual "Mediterranean International Bottom Trawl Survey" (MEDITS) will be followed throughout the study.

Surveys including artificial substrata sampled:

1. Two ancient shipwrecks dating back to the 4th Century BCE (Mazotos and Kyrenia shipwrecks).

Surveys including natural substrata sampled:

1. Kakoskali marine cave (hereafter Kakoskali);
2. the "Cyprus Cold-Water Corals Survey" (hereafter CYCLAMEN);
3. two trawling surveys, MEDITS and "Protecting Mediterranean East" (hereafter PROTOMEDEA).

Processing of specimens

Live specimens from the MEDITS, PROTOMEDEA and CYCLAMEN censuses, as well as those from the Mazotos shipwreck, were preserved in ethanol (90%). Specimens from the Kyrenia shipwreck and the Kakoskali cave were stored dry.

The bryozoan colonies were selected and preliminarily identified with an optical stereo-microscope. Specific colonies for imaging with SEM were bleached using diluted sodium hypochlorite, cleaned in an ultrasonic bath, then dried, and photographed using a FEI Inspect S50 SEM at the University of Vienna, and a Tescan Vega-II SEM at the University of Cyprus. Zooidal measurements were taken from these digital images using the image analysis software ImageJ 1.48v. Bryozoans from nine biostalactites (one collected from the wall and the rest found detached on the cave's floor) were only inspected using an optical microscope (Zeiss StereoDiscovery V12, Axiovision Rel. 4.8). All bryozoans were identified to the lowest taxonomic level possible.

The specimens are currently stored at Enalia Physis Environmental Research Centre facilities in Nicosia. Type and voucher specimens will be selected during the forthcoming taxonomic study and will then be permanently stored at the Thalassa Agia Napa Municipal Museum in Cyprus and the Oberösterreichisches Landesmuseum Linz (Austria).

Sampling areas and surveys

Ancient shipwrecks (4th century BCE)

Two ancient shipwrecks from the Late Classical period (325–350 BCE) were sampled for bryozoans.

The Kyrenia shipwreck is an ancient Greek merchant ship. The wreck was discovered in 1967 at 33 m depth off the northern coast of Cyprus (Katzev, 1974) (Fig. 1A). The size of the shipwreck is 14 x 4.5 m, with a cargo of about 400 amphorae (Steffy, 1985). The cargo was found partially or fully exposed on the sandy bottom. The underwater excavation was carried out during 1967-1969, and the amphorae, along with the encrusting organisms, are now stored in the Kyrenia Castle Museum. Bryozoan specimens were collected from 24 amphorae.

The Mazotos shipwreck is an ancient wooden ship located at 44 m depth (Demesticha, 2011), about 1.5 nautical miles off the southern shore of Cyprus (Fig. 1C). The size of the shipwreck itself is 17.5 x 8 m; its cargo consisted of approximately 500 amphorae (lying partially or fully exposed on the seafloor). Sediment from the underwater excavation and from inside the amphorae was collected in May 2011 and 2012. The sediments were washed and sieved (3 mm) to separate bryozoans from other material. Live and dead bryozoan colonies were also collected from the encrusted surface of 13 amphorae.

Kakoskali

Kakoskali cave is located at the islet with the same name off Akamas Peninsula, Paphos (northwestern Cyprus, Fig. 1G) at ~9 m depth and has been studied since 2012 (Guido *et al*., 2017). The cave has unique biostalactites formed mainly by serpulid polychaetes and bryozoans.

CYCLAMEN

The Cyprus Cold-Water Corals Survey was carried out during June 2015 in waters off Protaras (Famagusta, southeastern Cyprus) to map the deep-water coral habitats of the area (Fig. 1B). Video documentation and sampling took place using a Remotely Operated Vehicle (ROV), MAX ROVER, at two stations between 118-477 m depth. Bryozoan specimens attached to five colonies of the coral *Dendrophyllia ramea* were collected together with other benthic fauna (e.g. brachiopods), anthropogenic materials (e.g. fishing lines), and carbonate accretions found in the area. In addition, four other specimens of *D. ramea* accidentally brought up by fishermen in the same area (~150 m) were also included in the study.

MEDITS and PROTOMEDEA surveys

MEDITS is carried out in Cyprus annually during the summer months (June-August). Bryozoans were collected on MEDITS trawling surveys from 2012 until 2018 (Fig. 1B-G). The sampling stations (26 in total) were mainly positioned along the southern coastal area of the island, extending from Famagusta Bay in the southeast to Chrysochou Bay in the northwest. PROTOMEDEA was carried out in Cyprus during June 2016 primarily on the west side of the island (Fig. 1B, F, G). In both surveys, samples were taken from soft bottoms within the following depth ranges: 10-50 m, 51-100 m, 101-200 m, 201-500 m and 501-800 m. The sampling gear used and haul duration was according to MEDITS protocol (Fiorentini *et al*., 1999). Bryozoans were collected from the general haul sample once the trawling net was retrieved.

Results

In total, 91 bryozoan species were identified from all surveys and stations, 26 (=28%) of which are presently considered as new records for the Levantine Basin, and at least 10 (=11%) are new to science (Fig. 2, Table 1).

The class Gymnolaemata is represented by 68 species, three of which belong to the order Ctenostomatida, and 74 to the order Cheilostomatida. The order Cyclostomatida (class Stenolaemata) was represented by 14 species. The most frequently occurring species throughout the surveys were *Scrupocellaria incurvata* (Fig. 2A), *Hippellozoon* aff. *mediterraneum*, *Schizobrachiella sanguinea* and *Alcyonidium cellarioides*. The highest species richness was found at the Mazotos shipwreck (45 species), in deep-water coral habitats (24 species), the Kyrenia shipwreck (19 species), and at two stations off Limassol with patchy occurrences of *P. oceanica* (21 and 23 species, respectively). Samples were taken from as deep as 800 m during the MEDITS cruises, while the deepest station yielding bryozoans was at ~620 m.

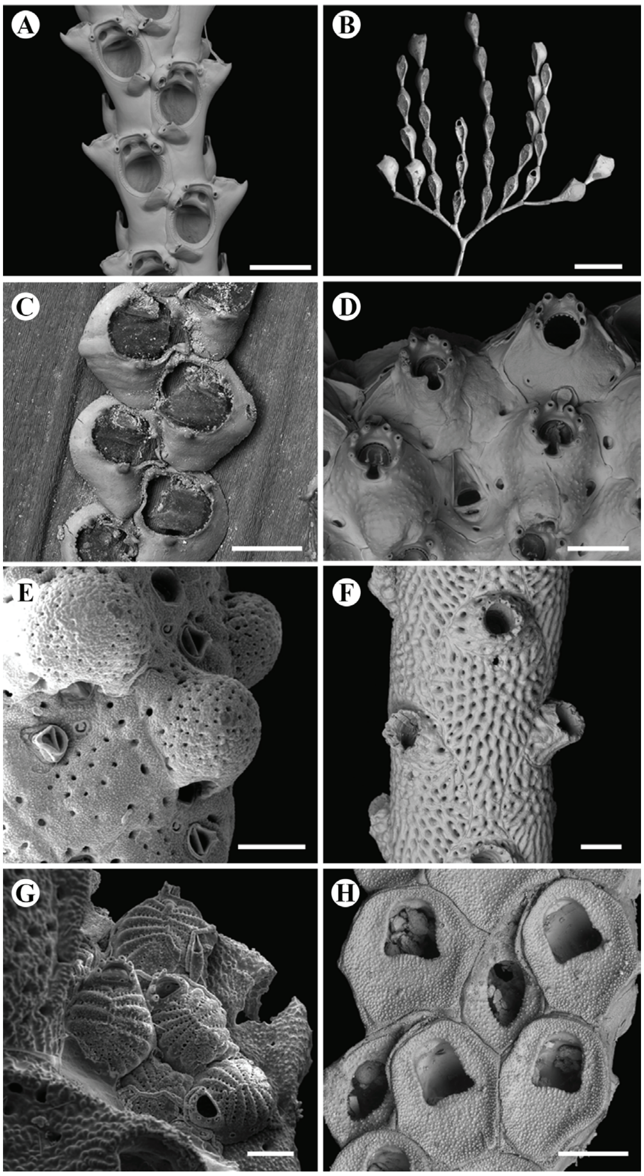

Fig. 2: Bryozoan species found in Cyprus during the surveys 2011-2018. **A**, *Scrupocellaria incurvata* (MEDITS survey). Scale bar = 250 μm; **B**, *Chlidonia pyriformis* (MEDITS survey). Scale bar = 500 μm; **C**, *Electra* aff. *posidoniae* (MEDITS survey). Scale bar = 250 μm; **D**, *Schizotheca* cf. *fissa (MEDITS survey). Scale bar = 150* μm; **E**, *Diporula* aff. *verrucosa* (CYCLAMEN). Scale bar = 200 μm; **F**, *Margaretta cereoides* (Mazotos shipwreck). Scale bar = 250 μm; **G,** *Glabrilaria pedunculata* (Kyrenia shipwreck). Scale bar = 100 μm; **H**, *Onychocella marioni* (Mazotos shipwreck). Scale bar = 250 µm.

The shipwrecks host a unique community compared to the rest of the sampling stations. In total, 12 species identified from the wrecks were not recorded in any of the other stations; one from Kyrenia, and 11 from Mazotos (Table 1). A total of 25 of species were identified from eight MEDITS stations where patches of *P. oceanica* were sampled. Three species were found exclusively on the seagrass: *Chlidonia pyriformis* (Fig. 2B), *Electra* aff. *posidoniae* (Fig. 2C) and *Schizotheca* cf. *fissa* (Fig. 2D). *Diporula* aff. *verrucosa* (Fig. 2E) was found only among samples from the deep-water coral habitat. *Aetea* sp. and *Setosellina* sp. were only found growing in Kakoskali Cave.

The soft bottom environments trawled during the MEDITS cruises yielded 65 species. However, most species were recorded from rock clasts of pebble- and cobble-size, from secondary hard substrata such as bivalve shells and echinoid tests, from ephemeral organic substrata such as algae or tunicates, and from anthropogenic material (modern garbage such as glass and plastic bottles, fragments of ancient amphorae). Only a few colony portions of the species *Jaculina parallelata* and *Margaretta cereoides* (Fig. 2F), which produce cuticular rhizoids and which were not found attached to any substratum, could be considered to be rooted in the sandy or silty bottom.

Furthermore, eight species were found as epibionts on colonies of the deep-water coral *D. ramea* collected off Protaras (eastern coast, 118-477 m depth): *Escharina vulgaris*, *Glabrilaria pedunculata* (Fig. 2G), *Cribrilaria* cf. *hincksi*, *Ellisina gautieri*, *Therenia* cf. *rosei*, *Turbicellepora* cf. *camera*, *Crisia ramosa* and *Beania mediterranea*. However, all these species were found also on other substrata.

Discussion

The total number of 91 bryozoan species recorded from Cyprus in this work is a comparatively low number in relation to other regions of similar areal extent in the Mediterranean Sea (Rosso & Di Martino, 2016). This can partly be explained by the predominance of sampling stations in soft-bottom environments owing to the trawling gear used. As neither rocky outcrops and coralligenous habitats nor subtidal environments shallower than 9 m were sampled, however, this number has to be regarded

Table 1. Checklist of bryozoans from Cyprus identified in the present study. Location/survey: MEDITS (MD), Mazotos (MZ), Kyrenia (KR), Kakoskali Cave (KC), CYCLAMEN (CL), PROTOMEDEA (PRO). Depth range: I: 9-50 m; II: 51-100 m; III: 101-200 m; IV: 201-500 m; V: 501-620 m. New species records for the area are noted with an asterisk (*).

Species	Survey	Depth Range
Ctenostomatida		
Alcyonidium cellarioides Calvet, 1900	MD	I, II, III, IV, V
Amathia cf. *semiconvoluta* Lamouroux, 1824*	MD	II
Walkeria tuberosa Heller, 1867*	MD	I, II, III
Cheilostomatida		
Adeonella cf. *pallasii* (Heller, 1867)	MZ, MD, CL	I, II, III, IV
Aetea aff. *lepadiformis* Waters, 1906	MD	I, II, III
Aetea truncata (Landsborough, 1852)	PRO	II
Aetea sp.	KC	I
Anarthropora cf. *monodon* (Busk, 1860)	MZ	I
Aplousina cf. *capriensis* (Waters, 1898)*	MD	II
Beania cf. *hirtissima* (Heller, 1867)*	MD	II, III
Beania mediterranea Souto, Nascimento, Reverter-Gil & Vieira, 2018	MD, CL	II, III, IV
Buskea aff. *nitida* (Heller, 1867)	MD, CL	II, III, IV
Bugulina sp.	PRO	II
Cabera aff. *boryi* (Audouin, 1826)	MD	III
Callopora sp.	MD	II
Calpensia nobilis Esper, 1796	KR, MZ, MD, CL	I, II, III, IV, V
Cellaria cf. *salicornioides* Lamouroux, 1816	MD, CL	II, III, IV
Celleporina caminata (Waters, 1879)	MZ	I
Celleporina canariensis Arístegui, 1989*	KR, MZ, MD	I, III, V
Celleporina cf. *canariesis* Arístegui, 1989	CL	III, IV
Celleporina sp.	MD	II
Characodoma mamillatum (Seguenza, 1880)	MD	III
Chartella cf. *papyrea* (Pallas, 1766)*	MD	II
Chlidonia pyriformis (Bertoloni, 1810)	MD	II
Chorizopora brongniartii (Audouin, 1826)	MD	I, II
Cleidochasmidra cf. *portisi* (Neviani, 1895)*	KR, MZ, MD, CL	I, II, III, IV
Copidozoum planum (Hincks, 1880)	MD	II, III
Copidozoum tenuirostre (Hincks, 1880)	KR, MZ, MD	I, II
Corbulella maderensis (Waters, 1898)*	CL	III, IV
Cribrilaria cf. *hincksi* (Friedl, 1917)*	MZ, MD, CL	I, II, III
Diporula aff. *verrucosa* (Peach, 1868)	CL	III, IV
Electra aff. *posidoniae* Gautier, 1957	MD	I, II
Ellisina gautieri Fernández Pulpeiro & Reverter Gil, 1993	MD, CL	III, IV, V
Escharina vulgaris (Moll, 1803)	KR, MZ, MD, CL	I, II, III, V
Escharoides coccinea (Abildgaard, 1806)	MZ	I
Exechonella cf. *antillea* (Osburn, 1927)	MZ	I
Glabrilaria pedunculata (Gautier, 1956)	KC, KR, CL, MD	I, III, IV
Hagiosynodos latus (Busk, 1856)*	KR, MZ, MD	I, II, III
Haplopoma graniferum (Johnston, 1847)*	MD	I, II, III
Hippaliosina depressa (Busk, 1854)	KR, MZ, MD, CL	I, III, IV
?*Hippellozoon* aff. *mediterraneum* (Waters, 1894)*	MZ, MD, CL	I, II, III, IV, V
Hippopodina ambita (Hayward, 1974)	CL, MD	III, IV
Hippoporina pertusa (Esper, 1769)	KC, MZ, MD	I, II, III

continued

Table 1 continued

Species	Survey	Depth Range
Jaculina parallelata (Waters, 1895)*	MD	III
?Lagenipora sp.	MZ	I
Margaretta cereoides (Ellis & Solander, 1786)	MZ, MD	I, V
Metroperiella mesogeia Berning, Achilleos & Wisshak, 2019*	CL, MD	III, IV, V
Microporella aff. *coronata* (Audouin & Savigny, 1826)	MZ	I
Mollia patellaria (Moll, 1803)*	KR	I
Monoporella bouchardii (Audouin & Savigny, 1826)	KC, KR, MZ, MD, CL	I, II, IV, III
Onychocella marioni (Jullien, 1882)	KC, KR, MZ, MD	I, IV
Onychocella vibraculifera Neviani, 1895	MD	IV
Parasmittina rouvillei (Calvet, 1902)	MZ	I
Phoceana tubulifera (Heller, 1867)	MZ	I
Plesiocleidochasma mediterraneum Chimenz Gusso & Soule, 2003	KR, MZ, MD	I
Porella sp.*	MD	II
Prenantia inerma (Calvet, 1906)	PRO	II
Reptadeonella cf. *violacea* Johnston, 1847	KR, MZ, MD	I, II, III
Reteporella sp.	PRO	II
Rhynchozoon cf. *pseudodigitatum* Zabala & Maluquer, 1988	MZ, MD	I, II
Schizobrachiella sanguinea (Norman,1868)	KR, MD	I, II, III, IV, V
Schizomavella (Schizomavella) aff. *linearis* (Hassall, 1841)	MD	II
Schizomavella (Schizomavella) mystacea Reverter-Gil, Souto, Novosel & Tilbrook, 2015*	MZ, MD	I, II
Schizomavella (Schizomavella) subsolana Hayward & McKinney, 2002*	MZ, MD	I, II
Schizoporella errata (Waters, 1878)	KR, MZ, MD	I, II
Schizoporella magnifica Hincks, 1886*	MD	III
Schizotheca cf. *fissa* (Busk, 1856)*	MD	II
Scrupocellaria incurvata Waters, 1897*	MD, CL	I, II, III, IV
Setosella cf. *vulnerata* Busk, 1860*	MZ	I
Setosellina sp.	KC	I
Smittina aff. *cervicornis* (Pallas, 1766)*	MZ, MD	I, III
Smittoidea ophidiana (Waters, 1879)*	CL	III, IV
Therenia cf. *rosei* Berning, Tilbrook & Rosso, 2008	KR, MZ, MD	I, III, V
Trematooecia aff. *ligulata* Ayari & Taylor, 2008	MZ	I
Turbicellepora cf. *camera* (Hayward, 1978)*	KR, MZ, CL	I, III, IV
Umbonula ovicellata Hastings, 1944*	MZ	I
Watersipora subtorquata (d'Orbigny, 1852)	MZ, MD	I, III
Cyclostomatida		
Annectocyma major (Johnston, 1847)	MZ, MD	I, II, III
Annectocyma sp.	MZ, MD	I, II, III
Crisia ramosa Harmer, 1891	MD, CL	I, II, III, IV
Disporella sp.	KR, MZ	I
Entalophoroecia deflexa (Couch, 1842)	MZ, MD	I, II, III, V
Eximonea triforis (Heller, 1867)*	MZ, MD	I, II
Frondipora verrucosa (Lamouroux, 1821)	MZ, MD	I, II, III
Hornera frondiculata (Lamarck, 1816)	MZ, MD	I, II, III
Idmidronea sp.	CL	III, IV
Patinella radiata (Audouin, 1826)	MZ, MD	I, II, III
Tervia sp.*	CL	III, IV
Tubulipora sp. 1	MD	II
Tubulipora sp. 2	KC, MZ, MD	I, II
Tubulipora sp. 3	KC, KR, MZ, MD	I, II

as very conservative. The great majority of the species identified in this study were found attached to secondary hard substrata (e.g. the brachiopod *Megerlia truncata*, the coral *D. ramea*, and other shells of bivalves and gastropods, or to anthropogenic material such as plastic, glass, synthetic rubber, shipwreck remains), or to ephemeral substrata such as the seagrass *P. oceanica*, the algae *Caulerpa prolifera* and *Codium bursa*, or the tunicates *Ascidia mentula* and *Microcosmus sulcatus*.

In Kakoskali, eight species were identified, four of which were not recorded by Guido *et al*. (2017): *Hipporina pertusa*, *Onychocella marioni* (Fig. 2H), as well as *Tubulipora* sp. 2 and sp. 3. While the marine cave was the shallowest of all sampling stations at 9 m, the cave environment may represent deep-sea conditions even at this depth (e.g. Harmelin, 1986). The recorded species may, therefore, not readily be regarded as a shallow-water assemblage.

Although the species number recorded in this study is comparatively low when compared with central and western Mediterranean regions, it is comparable with other regions in the Levantine Basin, where the highest diversity (87 spp.) has been so far recorded from Lebanon (Harmelin, 2014b; Harmelin *et al*., 2016). Comparable numbers are also obtained for Israel when combining data reported by d'Hondt (1988) and Sokolover *et al.* (2016). The relatively low number of bryozoan species present in the eastern Mediterranean region, compared with similar habitats in the western basin, reflects the general pattern of a decreasing diversity towards the east (e.g. Coll *et al*., 2010).

The significantly elevated species richness of bryozoans reported from the shipwrecks suggests that the wrecks act as artificial reefs, especially after considering that the area surrounding the Mazotos shipwreck is almost devoid of hard substrata (e.g. rocky outcrops, coralligenous habitats). The difference in the number of species occurring on the shipwrecks (19 from Kyrenia, 45 from Mazotos) is likely a result of the amount of material examined from each shipwreck. Both sediments and amphoras were examined from Mazotos shipwreck, while only the amphoras were examined from the Kyrenia shipwreck.

On the other hand, the relatively high diversity recorded from stations with patchy occurrences of *P. oceanica* or aggregations of detached leaves on the seafloor reinforces once more the ecological importance of seagrass habitats (e.g. Di Martino & Taylor, 2014; Lepoint *et al*., 2014, 2016). The existence of both artificial habitats (shipwrecks as accidental artificial reefs) and *P. oceanica* meadows is vital and crucial for the local biodiversity, especially in areas where ecosystem engineers, and in particular coralligenous habitats are absent, and in which low levels of primary productivity also prevent heterotrophic organisms from forming three-dimensional structures.

The importance of *P. oceanica* to bryozoan diversity was also illustrated by Koçak *et al*. (2002), who recorded a total of 43 species from seagrass meadows from the northern coast of Cyprus. About 47% of these seagrass-associated species were not encountered in the present censuses, which is likely due to sampling restrictions in seagrass meadows and a merely accidental sampling of seagrass plants at their lower depth limit (see below). Moreover, it may be that some of the species present in this work may be synonymous with congeneric species listed by Koçak *et al*. (2002) as these authors identified the bryozoans using only optical microscopy. For instance, the species reported as *Electra posidoniae* by Koçak *et al*. (2002) and as *Electra* aff. *posidoniae* by us are likely to be identical. Both taxa are, as the nominal species, obligate epibionts on seagrass in Cyprus. However, the proximal autozooidal gymnocyst is imperforate in the material we analyzed, which distinguishes it from true *E. posidoniae* from the western Mediterranean Sea that is characterized by a pseudoporous gymnocyst (see Gautier, 1962: fig. 4).

Overall, 161 species have been identified growing on *Posidonia* in the Mediterranean (Di Martino & Taylor, 2014; Lepoint *et al*. 2014, 2016). Again, the 25 species reported here from *Posidonia* is low compared to the rest of the Mediterranean and also Cyprus' northern coast; it is most probably due to the few samples collected from this habitat, which, in addition, were only from the lower bathymetric limit of *Posidonia*. The nature of the surveys on which this study is based (e.g. the MEDITS survey) does not allow trawling in areas with *Posidonia* meadows. The collection of any *Posidonia* fragments or entire plants through MEDITS was thus merely accidental. Additional surveys of bryozoans on seagrass substrata will undoubtedly increase the number of species reported for the southern areas of Cyprus.

According to the results herein, the southern coasts of Cyprus are characterized by an inhomogeneous vertical distribution in species richness. Only about 20% of the species reported here are found below 200 m, with *Onychocella vibraculifera* being the only species to be exclusively found below this depth. The differences observed are mainly due to the limitation of (primary or secondary) hard substrata, since the seafloor below 250 m depth is predominantly characterized by silty sediment, and therefore by a low spatial heterogeneity. These results might also be due to nutrient limitations since the vertical distribution of chlorophyll-*a* decreases with depth while the surface waters are already oligotrophic (Yacobi *et al*., 1995; Ediger & Yilmaz, 1996; Orejas *et al*., 2015).

Diporula aff. *verrucosa* was the only species found to be exclusively associated with deep-sea corals, although it is unclear whether the colonies were attached to the coral skeletons or to another substratum as only fragments were recovered. No bryozoans were found growing on skeletons of solitary deep-water coral species (e.g. *Caryophyllia smithii*) that were collected at several MEDITS stations below 200 m depth.

With the possible exception of *Metroperiella mesogeia*, which may be synonymous with *Metroperiella montferrandii* from the Red Sea (see Berning *et al*., 2019), non-indigenous bryozoan species were not among the taxa that could confidently be identified. This can presumably be ascribed to the fact that not many shallow-water stations were sampled, and, more importantly, that artificial substrata of ports and marinas were not targeted at all during the surveys.

Although the bryozoan fauna of the Mediterranean Sea is regarded as extremely well known owing to some 250 years of research, several species are newly described each year (e.g. Berning & Kuklinski, 2008; Rosso & Novosel, 2010; Reverter-Gil *et al*., 2015; Berning *et al*. 2019; Rosso *et al.,* 2020). The eastern Mediterranean has traditionally been neglected by bryozoologists, and relatively few studies exist in which bryozoans from the Levantine Basin were thoroughly described and SEM images were used for determination (e.g. Harmelin 2014a, b; Harmelin *et al*., 2007, 2009, 2016; Sokolover *et al*., 2016). Unsurprisingly, among the 91 species recorded during this work, 26 have not been previously recorded in the Levantine, and at least 10 cheilostomatid species have to be regarded as distinct from known congenerics (given as "aff." in Table 1). Several other species could only doubtfully be referred to existing taxa (given as "cf."), and may be new to science pending further study. This suggests that many of the species identifications in earlier ecological studies or in checklists, which referred the recorded taxa to established western Mediterranean or Atlantic species, are likely to be erroneous, and that a significant number of bryozoan species in the eastern Mediterranean remain to be described. Therefore, the overall percentage of species endemic to the Levantine Basin is likely to increase.

Finally, it is worth noting that all surveys included herein were not focused on collecting bryozoans. On the contrary, bryozoans were simply a byproduct or bycatch of these surveys, which therefore poses several limitations that were beyond our capability to eliminate or improve. For instance, MEDITS surveys, which form the core of this study owing to their wide temporal and spatial coverage, were conducted to assess the population dynamics of commercial fish species, and were therefore not designed for sampling sessile epibenthos. As such, sampling stations were pre-determined based only on the available trawlable areas (soft bottoms) around the island's continental shelf. Thus, rocky outcrops, coralligenous habitats and ecologically important areas dominated by *P. oceanica* meadows, which are generally known to host a rich bryozoan diversity, were not included in the chosen sampling sites.

Conclusions

This is the most comprehensive study of bryozoans from Cyprus to date: 91 species were identified from depths between 9 to ~620 m around the southern part of the island. Twenty-six species (28%) are new records for the Levantine Sea while 11% can be regarded as new to science. Areas with patchy occurrences of seagrass, as well as shipwrecks and deep-water coral environments proved to be the most species-rich habitats, with one of the shipwrecks (Mazotos) hosting 45 bryozoan species.

Distinctly fewer species were found to colonize waters deeper than 200 m, probably because of the lack of primary and secondary hard substrata. Future study of rocky outcrops (from shallow subtidal to bathyal depths), coralligenous habitats and *P. oceanica* meadows will undoubtedly increase the bryozoan species richness in Cyprus.

Finally, a high percentage of taxa recorded from the Levantine Sea proved to be similar to, but specifically different from, species originally described from the central or western Mediterranean basins. Our study thus indicates once more that ecological and faunistic studies that depend on correct species identification must use SEM, or better a combination of morphology and genetics, when determining bryozoan taxa.

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