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RESEARCH ARTICLE

Bioeroding sponge species (Porifera) in the Aegean Sea (Eastern Mediterranean)

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Abstract

In the present study, a total of 11 bioeroding sponge species belonging to 4 families were found on rocky substrata in Ildırı Bay (eastern Mediterranean), five of which (*Dotona pulchella mediterranea*, *Volzia albicans*, *Delectona madreporica*, *Siphonodictyon infestum* and *Thoosa mollis*) are new records for the eastern Mediterranean fauna. The most abundant and frequent species in the area were *Chondrosia reniformis*, *Spirastrella cuntatrix* and *Cliona celata*. The morphological and distributional features of the species that are new to the Turkish marine fauna are presented. In addition, a checklist of the bioeroding sponge species reported from the Mediterranean coasts to date is provided.

Keywords: Bioerosion, boring sponges, biodiversity, Mediterranean, Aegean Sea, Turkey

Introduction

Bioerosion is the degradation of substrates as a consequence of the drilling and abrasive activities of various marine organisms inhabiting calcareous substrates (Neumann 1966). In the marine ecosystem, various organisms have synergic effects in eroding rocks that enable the introduction of $CaCO_3$ into the marine environment, which can be later utilized by other organisms (Ruetzler 1975). With a general expression, sponge bioerosion is a result of tissue expansion of the endolithic sponges into rocky formations (Schoenberg 2003). Bioeroding sponges are able to transform all kinds of calcareous substrates into free calcareous particles and mineral elements dissolved in water by chemical and mechanical processes (Schoenberg 2002). Apart from calcareous substrata, *Chondrosia reniformis* is known to erode quartz formations and later incorporate the etched particles into its body tissue (Bavestrello *et al.* 1995; 2003). It is still enigmatic what percent of the substrate dissolution results from these chemical and mechanical processes. Ruetzler and Rieger (1973) postulated that only 2-3% of the abraded surface dissolves chemically, while the

rest dissolves mechanically. The amount of the calcium carbonate removed from the substrate due to the annual bioerosion occurring on the coral reefs was estimated to be 50 - 90% (Reis and Leão 2000). The excavating sponges not only cause erosion on the calcareous rocks but also have great impacts on the breakwaters and other concrete structures (Scott *et al.* 1988).

Rosell and Uriz (2002) published the first comprehensive list of the bioeroding sponges in the western Mediterranean. In the eastern Mediterranean, there is no study specifically dealing with these species. However, Voultsiadou (2005) previously reported 13 boring sponges in the Aegean Sea. Prior to the present study, a total of nine bioeroding sponge species have been reported from the coasts of Turkey, which belonged to Spirastrellidae (*Diplastrella bistellata* and *Spirastrella cunctatrix*), Clionidae (*Cliona celata*, *C. vermifera*, *C. viridis*, *C. schmidti* and *Cliothoosa hancocki*), Thoosidae (*Alectona millari*) and Chondrillidae (*Chondrosia reniformis*) (see the checklist given by Evcen and Çınar 2012; Topaloğlu and Evcen 2014).

The aims of this study are to determine the diversity of bioeroding sponge species in the eastern Aegean Sea, and to assess their distributional and morphological features.

Materials and Methods

Specimens of sponges were collected between 0 and 35 m depths at 15 stations in Ildırı Bay (eastern Aegean Sea) in August 2012 by scuba diving and snorkeling (Figure 1). In the field, sponge specimens were collected with a hammer and chisel. The materials were put in jars and fixed with a 4% formaldehyde solution. The estimation of the percentage coverage of the species at stations was approximate and determined by swimming along a 10 m horizontal line put on substrata and considering a swept area which covered 1 m distance from the each side of the line.

In the laboratory, sponge specimens were washed under tap water and preserved in 70% alcohol. Sponge tissues were taken from bioerosion chamber by using a fine-tipped forceps. Permanent preparations of spicules were made following the standard procedure proposed by Ruetzler (1978). A minimum of 20 spicules of each type were measured with an ocular micrometer. The classification used in this work was that proposed by Hooper and Van soest (2002), with the amendments given in the World Porifera Database (Van Soest *et al.* 2015).

The specimens presented here are deposited at the Museum of the Faculty of Fisheries, Ege University (ESFM).

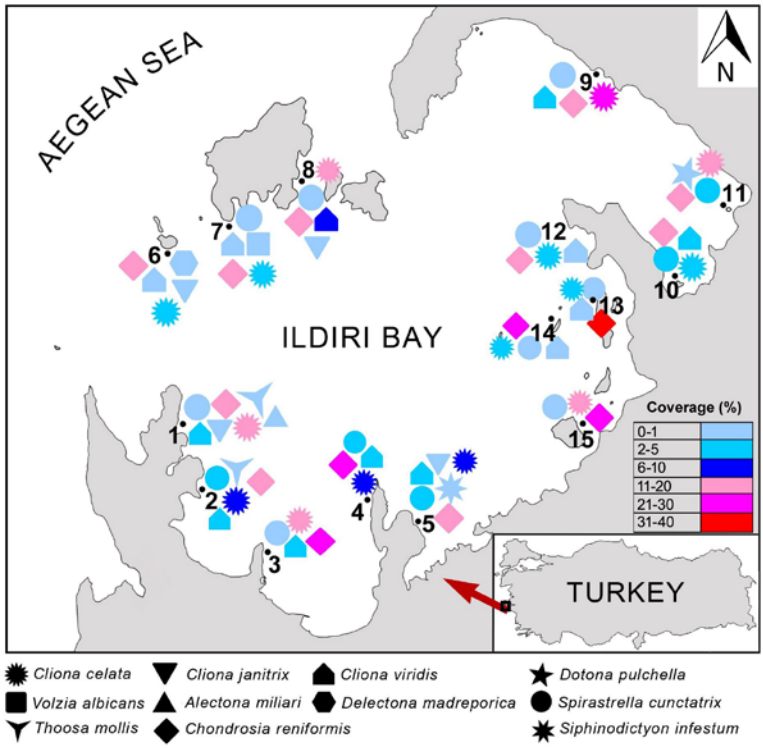

Figure 1. Locations of sampling sites and the percentage coverage of bioeroding sponges at stations.

Results and Discussion

Bioeroding sponge species in Ildırı Bay

A total of 11 bioeroding sponge species belonging to the families Clionidae, Thoosidae, Phloeodictyidae and Chondrillidae were encountered in Ildırı Bay. Five species (*Dotona pulchella mediterranea*, *Volzia albicans*, *Delectona madreporica*, *Siphonodictyon infestum*, *Thoosa mollis*) are new records for the eastern Mediterranean fauna and six species (*Cliona janitrix*, *Dotona pulchella mediterranea*, *Volzia albicans*, *Delectona madreporica*, *Thoosa mollis*, *Siphonodictyon infestum*) for the marine fauna of the eastern part of the Aegean sea (Turkey). The morphological and ecological features of the species are as follows.

Clionaidae d'Orbigny, 1851
Cliona Grant, 1826
Cliona celata Grant, 1826
Cliona celata Grant 1826: 78; Ackers *et al*. 1992: 69.

Material examined: Station 1, 5–10 m (ESFM–POR/2011–130); Station 2, 5–10 m (ESFM–POR/2011–131); Station 3, 0–5 m (ESFM–POR/2011–132); Station 4, 0–5 m (ESFM–POR/2011–133); Station 5, 5–10 m (ESFM–POR/2011–134); Station 6, 5–10 m (ESFM–POR/2011–135); Station 7, 5–10 m (ESFM–POR/2011–136); Station 8, 5–10 m (ESFM–POR/2011–137); Station 9, 0–10 m (ESFM–POR/2011–138); Station 10, 0–5 m (ESFM–POR/2011–139) ; Station 11, 0–5 (ESFM–POR/2011–140); Station 12, 0–5 m (ESFM–POR/2011–141); Station 13, 0–5 m (ESFM–POR/2011–142); Station 14, 0–5 m (ESFM–POR/2011–143); Station 15, 3–5 m (ESFM–POR/2011–144).

Description: It has a shiny and yellow appearance under water (Figure 2A), but it becomes brownish in alcohol. It builds galleries by constituting spherical and interconnecting chambers, having a diameter of 1-8 mm within the substrate. Its development has three different stages, namely alpha (=papillae), beta (encrusting) and gamma (developed form). Colonies observed in the study area were at the alpha stage. There is no any structural differentiation between the ectosomal and choanosomal skeletons. Its spicules are only composed of tylostyles (270–450 x 2–9 µm) (Figure 3; 1).

Habitat and distribution: This species were found at all stations in the study area. Its highest coverage (20%) was encountered at station 9, while the lowest coverage (2-5%) at stations 6, 7, 10, 12, 13 and 14. It was previously reported from the Sea of Marmara (Topaloğlu 2001a; 2001b) and Mediterranean Sea (Schmidt 1862; Schmidt 1864; Lendenfeld 1898; Babic 1922; Vatova 1928; Volz 1939; Sarà and Melone 1963; Ruetzler 1965; Grubelić 2001; Pansini and Longo 2008; Demir and Okus 2010; Bakran-Petricioli *et al.* 2012; Evcen and Cinar 2012) This species was reported on calcareous substrata from shallow waters up to a depth of 200 m in the world's oceans (Rosell and Uriz 2002; Voultsiadou 2005; Xavier *et al.* 2010).

Cliona janitrix Topsent, 1932
Cliona janitrix Topsent 1932: 575; Rosell and Uriz 2002: 72, Figure. 11.

Material examined: Station 1, 0–5 m (ESFM–POR/2011–145); Station 5, 5–10 m (ESFM–POR/2011–146); Station 6, 5–10 m (ESFM–POR/2011–147); Station 8, 0–5 m (ESFM–POR/2011–148).

Description: It has a light yellow appearance under water (Figure 2B), but it becomes white in alcohol. It remains always in the alpha stage of growing (Rosell and Uriz 2002). This sponge does not have any significant papillae space sticking out of the substrate. It builds 2-3 mm wide spherical galleries within the substrate (Figure 2B). The galleries are filled up with soft sponge tissue. The skeletal elements are only tylostyles (150–200 × 3–20 µm) (Figure 3; 2), and these form small groups and spread into the choanosome.

Habitat and distribution: This species was previously reported in association with the bivalve shells (Topsent 1932), but we found it on calcareous rocks at stations 1, 5, 6 and 8, as well as in the shady areas of the rocky walls. Its coverage percentage is less than 1% at all stations. It is a new record for the coasts of Turkey. It was previously reported from the Adriatic Sea (Pansini and Longo 2008), western Mediterranean (Topsent 1932) and Caribbean coasts (Miloslavich *et al.* 2010).

Cliona viridis (Schmidt, 1862)
Vioa viridis Schmidt 1862: 77, lev. 7, Lev. 14.
Cliona viridis Rosell and Uriz 2002: 78-82, Figure 17-19.

Material examined: Station 1, 5–10 m (ESFM–POR/2011–149); Station 2, 0–10 m (ESFM–POR/2011–150); Station 3, 5–10 m (ESFM–POR/2011–151); Station 4, 0–5 m (ESFM–POR/2011–152); Station 6, 5–10 m (ESFM–POR/2011–153); Station 8, 5–10 m (ESFM–POR/2011–154); Station 9, 0–10 m (ESFM–POR/2011–155); Station 10, 0–5 m (ESFM–POR/2011–156); Station 12, 0–5 m (ESFM–POR/2011–157) ; Station 13, 0–5 m (ESFM–POR/2011–158) Station 14, 0–5 m (ESFM–POR/2011–159).

Description: This species has globular and oval papillae of 0.8-12 mm in diameter, sticking out of the substrata. They abrade substrata in the form of small chambers. They develop in three different stages, namely alpha, beta and gamma. The specimens observed were at the alpha stage. Their spicules include tylostyles (400–550 x 10–12 µm) (Figure 3a) and spirasters (15-45 x 1-2 µm) (Figure 3b). While tylostyles are in the form of palisades within the ectosome, their distribution is hardly visible in the choanosome. On the other hand, the spirasters are seen only in the choanosome.

Habitat and distribution: It generally inhabits coralligenous substrata and half-dark cave entrances (Rosell and Uriz 2002). It was found at nine stations in the study area. Its highest coverage (6-8%) was encountered at station 8, while the lowest coverage (1%) at stations 6, 7, 12, 13 and 14. It was previously reported from the Sea of Marmara (Ostroumoff 1896) and the Aegean Sea (Sarıtaş 1972; 1973; 1974; Kocatas 1978). This species was reported in the Mediterranean Sea (Schmidt 1862; Lendenfeld 1898; Topsent 1925; Vatova 1928; Volz 1939; Sarà and Melone 1963; Labate 1964; Ruetzler 1965; Pulitzer-Finali 1983; Grubelić 2001; Pansini and Longo 2008; Bakran-Petricioli *et al.* 2012) and the North Atlantic, Pacific and Indian Oceans (Rosell and Uriz 2002), from the shallow waters up to a depth of 367 m (Van Soest *et al.* 2015).

Dotona Carter, 1880
Dotona pulchella mediterranea Rosell and Uriz, 2002
Dotona pulchella mediterranea Rosell and Uriz 2002: 62, Lev. 4, 6.
Material examined: Station 11, 0–5 m (ESFM–POR/2011–161).

Description: This sponge species has a soft and fragile tissue, which can be easily distinguished from the substrata (Figure 2E). It always grows in the alpha stage. It forms spherical excavation chambers with a width of 3-5 mm and filled up with sponge tissue. Its spicules include styles, which are straight (90–280 x 2–3 μm) or slightly bent in the form of palisades within the skeleton (280–420 x 5–13 μm) (Figure 4a, b), oxeas bent in the middle (115–311 x 6–12 μm) (Figure 4c, d), spiral-spined microstrongyles (40–82 x 5–11 μm) (Figure 4e), and small amphiasters (10–15 x 1–3 μm).

Habitat and distribution: This species was only found on calcareous rocks at station 11. Its coverage percentage was below 1%. It is a new record for the coasts of the eastern Mediterranean and Turkey, while it was previously reported from the western Mediterranean (Rosell and Uriz 2002).

Volzia Rosell and Uriz, 1997
Volzia albicans (Volz, 1939)
Volzia albicans Volz 1939: 19; Ruetzler 2002b: 185, Lev. 19.
Material examined: Station 7, 0–5 m (ESFM–POR/2011–171).

Description: This sponge species always exhibits growth in the alpha stage. Papillae are very small (1-2 mm), and have brown-white color (Figure 4D). This species forms small (2 mm) chambers at an average depth of 25 mm beneath the substrate surface. The interior of such chambers are filled up with whitish fragile sponge tissue. The skeletal elements comprises tylostyles (290–350 x 4–8 μm) (Figure 3; 6a) and oxeas (90–110 μm) (Figure 3; 6b), localized in the excavation chambers of the sponge in the form of palisades in the papillae.

Habitat and distribution: It was previously found on rocks in the shallow waters (Volz 1939). This species is one of the rare species in the present study, occurring solely at station 7. Its coverage percentage is below 1%. It is a new record for the marine fauna of the eastern Mediterranean and Turkey. It is a species endemic to the Mediterranean Sea, previously known from the Adriatic Sea (Volz 1939; Ruetzler 1965; Ruetzler 2002a; Bakran-Perticioli *et al.* 2012; Pansini and Longo 2008).

Remarks: The Aegean Sea specimen does not have any microsclerites, but Volz (1939) questionably reported the presence of this kind of spicule in this species. The size range of oxeas (90-110 μm) we found was slightly larger than that (88–95 m) given for the Adriatic specimens (Volz 1939).

Spirastrellidae Ridley and Dendy, 1886
Spirastrella Schmidt, 1868
Spirastrella cunctatrix Schmidt, 1868
Spirastrella cunctatrix Schmidt, 1868: 17, Lev. 4–5; Ruetzler 2002c: 224, Lev. 4–5.

Material examined: Station 1, 0–10 m (ESFM–POR/2011–174); Station 2, 5–10 m (ESFM–POR/2011–175); Station 3, 0–10 m (ESFM–POR/2011–176); Station 4, 0–5 m (ESFM–POR/2011–177); Station 5, 0–5 m (ESFM–POR/2011–178); Station 7, 5–10 m (ESFM–POR/2011–179); Station 8, 0–10 m (ESFM–POR/2011–180); Station 9, 0–10 m (ESFM–POR/2011–181); Station 10, 0–10 m (ESFM–POR/2011–182); Station 11; 0–10 (ESFM–POR/2011–183); Station 12, 0–10 m (ESFM–POR/2011–184); Station 13, 0–5 m (ESFM–POR/2011–185); Station 14, 0–5 m (ESFM–POR/2011–186); Station 15, 3–5 m (ESFM–POR/2011–187).

Description: It has a shiny orange and red color under the water (Figure 2G). The excavation rooms they form by invading calcareous substrata have various shapes, but their excavation tendency is less than other bioeroding species. There are apparent canals connected to raised osculum above the sponge tissue. The skeletal system comprises small spirasters (10–20 x 5–15 µm) (Figure 3; 5) and tylostyles (400–500 x 8–10 µm). While spirasters are placed in wide gaps, tylostyles are located within smaller spaces and less in number.

Habitat and distribution: This species is common in sea caves, subsurface of the rocks and shady sites. It also occurs in many tropical and subtropical shallow water habitats including coral reefs in particular (Calcinai *et al.* 2000). It is a common species in Ildırı Bay. The high coverage of this species (5%) was observed at stations 2, 4, 5, 10 and 11. It was previously reported from the Levant coast of Turkey (Demir and Okus 2010; Evcen and Cinar 2012). It is a cosmopolitan species (Calcinai *et al*. 2000; Voultsiadou 2005).

Phloeodictyidae Carter, 1882
Siphonodictyon Bergquist, 1965
Siphonodictyon infestum (Johnson, 1889)
Acca infesta Johnson 1899: 211; Schoenberg and Beuck 2007: 149–1476 Lev.1–3.

Material examined: Station 5, 0–5 m (ESFM–POR/2011–172).

Description: The papillae of this species have white-greenish pale color under water, and the endolithic tissue (within the substrate) has more creamy white or yellowish color (Figure 2F). The tiny papillae stick out of substrata through holes, which are smaller than 1 mm at various distances. Papillae are fragile; the endolithic tissue is weak and soft. The skeletal system comprises monotype, smooth oxeas (110–50 x 10–2 µm) (Figure 3; 8), which are widely bent.

Habitat and distribution: This species lives on sea shells and calcareous rocks. It was found in the Mediterranean at depths down to 679 m (Schoenberg and Beuck 2007). This species was only encountered at station 5, and its coverage percentage was below 1%. It is a new record for the coasts of Turkey. It was

previously reported from the Ionian Sea (Johnson 1899; Schoenberg and Beuck 2007) and North Atlantic Coast (Van Soest 1993).

Remarks: Schoenberg and Beuck (2007) reported strongyles in the chaonosom, but we did not observe this spicule in our sample.

Thoosidae Cockerell, 1925
Alectona Carter, 1879
Alectona millari Carter, 1879
Alectona millari Carter, 1879: 495, Fig. 1–7; Pulitzer–Finali 1983: 501 Fig. 29.

Material examined: Station 1, 0–5 m (ESFM–POR/2011–128).

Description: It has pale rose, small papillae (1-1.5 mm) and brownish endolithic tissue. It always grows in the alpha stage. It has very distinctive diactines (oxeas) and amphiaster. Oxeas are divided into two categories: aconthoxeas (heavily spined or warty tuberculated) (200-320 x 12-18 μm) and smooth oxeas (64–132 x 6–16 μm), which were sharply bent in the center (Figure 3; 7a). Microscleres are amphiasters (35–50 x 8–12 μm) (Figure 3; 7b), with slender or conical rays.

Habitat and distribution: This species was found only at station 1 and its coverage percentage was below 1%. In Turkey, it was previously reported from the coasts of Levant (Evcen and Çınar 2012) and Aegean Seas (Sarıtaş 1972). It was also reported from the Indo-Pacific, Atlantic, and the Mediterranean Sea (Ruetzler 2002a).

Delectona de Laubenfels, 1936
Delectona madreporica Bavestrello, Calcinai, Cerrano, Sarà, 1997
Delectona madreporica Bavestrello *et al*. 1997: 273–277 Lev. 1–4.
Material examined: Station 6, 5–10 m (ESFM–POR/2011–125).

Description: This species has greyish color in alcohol. It does not have any significant papillae on the exterior part of the specimen. The boring chambers are spherical and ovoid (2–4 mm). The main skeletal system includes tangled, thick rhabds (15–25 x 5–7 μm) (Figure 3; 9a). However, it rarely has toxiform oxeas (60 x 0,5–1 μm) (Figure 3; 9b) and thin amphiasters (18–20 x 1–2 μm) (Figure 3; 9c).

Habitat and distribution: This species inhabits semi-dark caves with *Leptopsammia pruvoti* Lacaze-Duthiers 1897 and *Madracis pharensis* (Heller 1868) (Bavestrello *et al.* 1997). It was only found at station 6, with a low (1%) coverage percentage. It is a new species for the marine fauna of the eastern Mediterranean and Turkey. It is a species endemic to the Mediterranean Sea and

was previously reported from the western Mediterranean (Ligurian Sea) (Bavestrello *et al*. 1997).

Thoosa Hancock, 1849
Thoosa mollis Volz, 1939
Thoosa mollis Volz, 1939: 29; Pulitzer–Finali 1983: 502, Lev. 30.

Material examined: Station 1, 0–5 m (ESFM–POR/2011–126); Station 2, 5–10 m; (ESFM–POR/2011–127).

Description: This species has a shiny white color under the water; creamy color in alcohol. The individuals we observed did not have any significant papillae. The sponge tissue penetrates into calcareous rocks. Boring chambers have 3-5 mm width. The skeletal elements comprises smooth tylostyles (210–330 x 3–4 μm), oxiaster (20–1 μm) (Figure 3; 10a) and amphiasters (5–0.5 μm) (Figure 3; 10b).

Habitat and distribution: This species was previously found on calcareous rocks between 0–10 meters (Pulitzer–Finali 1983). This species was encountered at two stations in Ildırı Bay, with coverage below 1%. It is a new record for the coasts of Turkey. It is a species endemic to the Mediterranean Sea and was previously reported from the Adriatic (Volz 1939) and Ionian Seas (Pulitzer–Finali 1983).

Chondrillidae Gray, 1872
Chondrosia Nardo, 1847
Chondrosia reniformis Nardo, 1847
Chondrosia reniformis Nardo, 1847: 267.

Material examined: Station 1, 0–5 (ESFM–POR/2011–271); Station 2, 0–10 (ESFM–POR/2011–272); Station 3, 0–5 m (ESFM–POR/2011–273); Station 4, 0–5 m (ESFM–POR/2011–274); Station 5, 0–5 m (ESFM–POR/2011–275); Station 6, 5–10 m (ESFM–POR/2011–276); Station 7, 0–10 m (ESFM–POR/2011–277); Station 8, 5–10 m (ESFM–POR/2011–278) ; Station 9, 5–10 m (ESFM–POR/2011–279); Station 10, 0–10 m (ESFM–POR/2011–280); Station 11; 0–10 (ESFM–POR/2011–281); Station 12, 0–10 m (ESFM–POR/2011–282); Station 13, 0–5 m (ESFM–POR/2011–283); Station 14, 0–5 m (ESFM–POR/2011–284)

Description: This species was found either alone or in colonies. It has a brownish color under water and in alcohol (Figure 2H). It has a cortex developed by the adhesion of collagenous fibers. The individuals were maximally 20 cm in length, while they reached up to 3 cm in thickness. It does not have any spicules. It etches the substrate by releasing ascorbic acid, and lets

various minerals such as quartz mix in the ectosomal structure (Bavestrello *et al*. 1995).

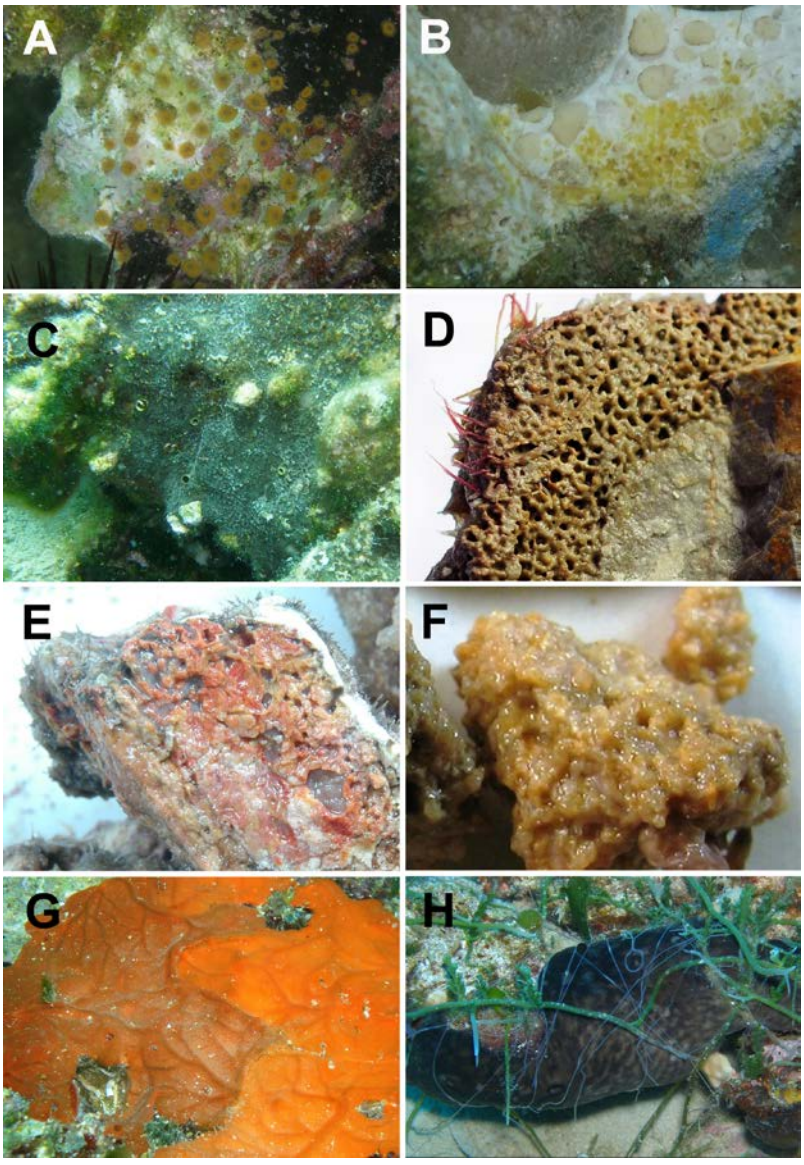

Figure 2. Some bioeroding sponge species found in Ildırı Bay. A. *Cliona celata*, B. *Delectona madreporica*, C. *Cliona viridis*, D. *Cliona janitrix*, E. *Dotona pulchella mediterranea*, F. *Siphonodictyon infestum*, G. *Spirastrella cunctatrix*, H. *Chondrosia reniformis*

Habitat and distribution: This species was a common species in Ildırı Bay, inhabiting rocky substrata and having a high coverage percentage (generally > %20) at all stations. It was also found at the entrance of submarine caves, and on the vertical walls of caves (Burton 1956). It was previously reported from the Aegean (Yazici 1978; Erguven *et. al*. 1988; Topaloğlu 2001b) and Levantine (Demir and Okus 2010; Evcen and Cinar 2012) Seas. It seems to be a cosmopolitan species (Boury–Esnault 2002).

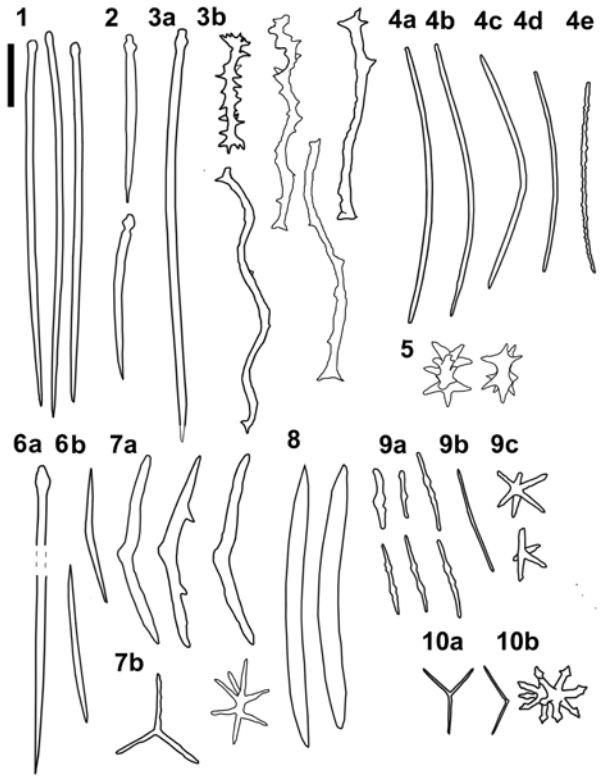

Figure 3. Spicules of bioeroding sponges: 1. *Cliona celata* (tylostyles: 80 μm); 2. *Cliona janitrix* (tylostyles: 80 μm); 3. *Cliona viridis* (a. tylostyles 90 μm, b. spirasters 10 μm); 4. *Dotona pulchella mediterranea* (a,b. styles and straight styles: 70 μm, c,d. oxeas: 100 μm, e. microstrongyl: 30 μm); 5. *Spirastrella cunctatrix* (spirasters: 10 μm) 6. *Volzia albicans* (a. tylostyles: 80 μm, b oxeas: 60 μm); 7. *Alectona millari* (a. diactines: 30 μm, b. amphiasters: 30 μm); 8. *Siphonodictyon infestum* (oxeas: 25 μm); 9. *Delectona madreporica* (a. rhabd: 15 μm, b. amphiaster: 15 μm, c. oxeas: 30 μm); 10. *Thoosa mollis* (a. oxiaster: 20 μm, b. 3 μm)

Bioeroding sponge species in the Mediterranean Sea

Rosell and Uriz (2002) reported a total of 22 bioeroding sponge species from the Mediterranean Sea. However, almost 39 sponge species belonging to five

families Clionidae, Thoosidae, Phloeodictyidae, Chondrosiidae and Spirastrellidae are known to take part in bioeroding processes in the Mediterranean so far (see Table 1, compiled with the help of Dr. Schoenberg). The bioeroding activity of the families Chondrosiidae and Spirastrellidae is disputable (Bavestrello *et al*. 1995, Hutchings 2011). *Chondrosia reniformis* is known to embed sediment, shell fragments, but has not been generally accepted as a bioeroding sponge. However, according to Bavestrello *et al*. (1995), it has an ability to transform quartz into free silica particles by utilizing the ascorbic acid. According to Calcinai *et al.* (2000; 2006), spirastrellids have bioerosion capabilities and appear to erode a bit its attachment area. In this respect, we included these two species in the list of bioeroding sponge species in the Mediterranean Sea.

The family Clionidae ranked first in terms of the number of bioeroding species (20 species) in the Mediterranean Sea, followed by Thoosidae (6 species) and Spirastrellidae (3 species).

The boring sponge species are generally reported from the Western Mediterranean (33 species) and the Adriatic Sea (23 species), whereas only 14 species are found in the Aegean Sea, 12 species in the Ionian Sea and eight species in the Levantine Sea (Table 1). In the Sea of Marmara and Black Sea, a total of four (*Chondrosia reniformis*, *Cliona celata*, *Cliona viridis*, *Diplastrella bistellata*) and three (*Cliona lobata*, *Pione stationis*, *Pione vastifica*) species have been reported up to date, respectively (Topaloğlu and Evcen 2014; Nassonow, 1883; Kaminskaya 1968; Bacescu *et al.*1971). Among them, 17 species (*Cliona adriatica*, *C. parenzani*, *C. burtoni*, *C. rhodensis*, *C. topsenti*, *Volzia albicans*, *V. rovignensis*, *Spiroxya sarai*, *S. heteroclita*, *S. corallophila*, *Thoosa mollis*, *T.tortonesei*, *Delectona alboransis*, *D. ciconiae*, *D. madreporica*, *Diplastrella ornata*, *D. bistellata*) are endemic to the Mediterranean Sea, the other species are of the Atlantic origin or cosmopolitan. No alien bioeroding sponge species have been reported up to date in the Mediterranean Sea, whereas a spinculan worm, *Aspidosiphon elegans* (Chamisso and Eysenhardt 1821), which is a Lessepsian invader, is known as a bioeroding alien species (Acik 2008).

The present study sheds more light on the knowledge of bioeroding sponge species diversity in the eastern Mediterranean and increased the number of bioeroding species in the region. Future studies would focus on understanding the diversity of bioeroding sponge species in the eastern Mediterranean and their ecological requirements.

Table 1. A list of bioeroding sponge species in the Mediterranean Sea

Group/Species	Western Mediterranean	Ionian Sea	Adriatic Sea	Aegean Sea	Levantine Sea
Clionidae					
Cliona adriatica Calcinai, *et al.* 2011			Calcinai *et al.* 2011		
Cliona amplicavata Rützler, 1974	Rosell and Uriz 2002				
Cliona burtoni Topsent, 1932	Topsent 1932				
Cliona carteri (Ridley, 1881)	Rützler 1973				
Cliona celata Grant, 1826	Boury-Esnault 1971; Rützler 1973; Pulitzer-Finali 1983; Bertolino *et al.* 2013	Pulitzer-Finali 1983	Schmidt 1862, Lendenfeld 1898; Topsent 1925; Volz 1939; Vatova 1928; Volz 1939; Sarà and Melone 1963; Labate 1964; Ruetzler 1965; Pulitzer-Finali 1983; Grubelić 2001; Pansini and Longo 2008; Bakran-Petricioli *et al.* 2012	Voultsiadou 2005	Evcen and Çınar 2012
Cliona janitrix Topsent, 1932	Rosell and Uriz 2002; Mustapha *et al.* 2003		Pansini and Longo 2008		
Cliona lobata Hancock, 1849	Rosell and Uriz 2002		Pansini and Longo 2008		
Cliona parenzani Corriero and Scalera -Liaci, 1997		Corriero and Scalera-Liaci 1997			
Cliona rhodensis Rützler & Bromley, 1981	Rosell and Uriz 2002; Mustapha *et al.* 2003	Pulitzer-Finali 1983	Pansini and Longo 2003; Pansini and Longo 2008; Bakran-Petricioli *et al.* 2012	Rützler and Bromley 1981	
Cliona schmidtii (Ridley, 1881)	Rützler 1973 Pulitzer-Finali; 1983; Mustapha *et al.* 2003; Rosell and Uriz; 2002; Bertolino *et al.* 2013	Pulitzer-Finali 1983	Lendenfeld 1898; Volz 1939; Pansini and Longo 2003; Pansini and Longo 2008; Bakran-Petricioli *et al.* 2012	Voultsiadou 2005	Lévi 1957; Evcen and Çınar 2012
Cliona thoosina Topsent, 1888	Rosell and Uriz 2002		Pansini nd Longo 2008	Pulitzer-Finali 1983; Voultsiadou 2005	
Cliona topsenti (Lendenfed, 1898)			Lendenfeld 1898; Pansini and Longo 2003; Pansini and Longo 2008; Bakran-Petricioli *et al.* 2012		
Cliona vermifera Hancock, 1867	Rosell and Uriz 2002	Pulitzer-Finali 1983	Lendenfeld 1898; Volz 1939; Pansini and Longo 2003; Pansini and Longo 2008; Bakran-Petricioli *et al.* 2012	Voultsiadou 2005	
Cliona viridis (Schmidt, 1862)	Sarà 1958 Boury-Esnault 1971; Rützler 1973; Bibiloni 1981; Pulitzer-Finali 1983; Rosell and Uriz 2002 ; Bertolino *et al.* 2013	Pulitzer-Finali 1983	Schmidt 1862; Lendenfeld 1898; Topsent 1925; Volz 1939; Vatova 1928; Volz 1939; Sarà and Melone 1963; Labate 1964; Ruetzler 1965; Pulitzer-Finali 1983; Grubelić 2001; Pansini and Longo 2008; Bakran-Petricioli *et al.* 2012	Pulitzer-Finali 1983; Voultsiadou 2005	Lévi 1957; Evcen and Çınar 2012
Cliothosa hancocki (Topsent, 1888)	Ruetzler 1973; Rosell and Uriz	Pulitzer-Finali 1983	Lendenfeld 1898; Ruetzler 1965; Pansini	Voultsiadou 2005	

Table 1. Continued

Group/Species	Western Mediterranean	Ionian Sea	Adriatic Sea	Aegean Sea	Levantine Sea
	2002; Mustapha *et al*. 2003		and Longo 2003		
Dotona pulchella mediterranea Rosell and Uriz, 2002	Rosell andUriz 2002				
Pione hancocki (Schmidt, 1862)			Schmidt 1862		
Pione vastifica (Hancock, 1849)	Sarà 1958; Boury-Esnault 1971; Ruetzler 1973, Maldonado 1992 ; Rosell and Uriz 2002; Mustapha *et al*. 2003	Pulitzer-Finali 1983	Schmidt 1862; Lendenfeld 1898; Topsent 1925; Volz 1939; Vatova 1928; Volz 1939; Sarà and Melone 1963; Ruetzler 1965; Pulitzer-Finali 1983; Pansini 1987; Grubelić 2001; Pansini Longo 2003; Pansini and Longo 2008		
Spiroxya corallophila (Calcinai, Cerrano and Bavestrello, 2002)	Mustapha *et al.* 2003; Bertolino *et al*. 2013				
Spiroxya heteroclita Topsent, 1896	Boury-Esnault 1971; Bertolino *et al*. 2013			Voultsiadou and Vafidis 2004	
Spiroxya levispira (Topsent, 1898)	Boury-Esnault *et al.* 1994				
Spiroxya pruvoti (Topsent, 1900)	Rosell and Uriz 2002				
Spiroxya sarai (Melone, 1965)	Melone 1965		Pansini and Longo 2008		
Volzia albicans (Volz, 1939)	Rosell and Uriz 2002		Volz 1939; Ruetzler 1965; Pansini and Longo 2008		
Volzia rovignensis (Volz, 1939)	Rosell and Uriz 2002		Volz 1939; Pansini and Longo 2003; Pansini and Longo 2008		
Thoosidae					
Alectona millari Carter, 1879	Maldonado 1992	Pulitzer-Finali 1983	Ruetzler 1965; Pansini and Longo 2003; Pansini and Longo 2008	Voultsiadou 2005	Evcen and Çınar 2012
Delectona alboransis Rosell, 1996	Rosell 1996				
Delectona ciconiae Bavestrello, Calcinai and Sarà, 1996	Bavestrello *et al*. 1996; Bertolino *et al*. 2013				
Delectona madreporica Bavestrello, Calcinai, Cerrano, Sarà, 1997	Bavestrello *et al*. 1997				
Thoosa armata Topsent, 1888	Rosell and Uriz 2002				
Thoosa mollis Volz, 1939		Pulitzer-Finali 1983	Volz 1939; Pansini and Longo 2003; Pansini and Longo 2008; Bakran-Petricioli *et al.* 2012		
Thoosa tortonesei Sarà, 1958	Sarà 1958				
Phloeodictyidae					
Siphonodictyon infestum (Johnson, 1889)		Schoenberg and Beuck 2007		Voultsiadou 2005	Evcen and Çınar 2012
Siphonodictyon labyrinthicum (Hancock, 1849)	Pulitzer-Finali 1983; Schoenberg and Beuck 2007				
Spirastrellidae					
Diplastrella bistellata (Schmidt, 1862)	Boury-Esnault 1971;Maldonado 1992 ;Harmelin *et al*. 2003;Bertolino *et al*. 2013		Topsent 1925	Voultsiadou 2005	Evcen and Çınar 2012
Diplastrella ornata Rützler and Sarà, 1962	Harmelin *et al.* 2003		Rützler and Sarà 1962	Voultsiadou 2005	

Table 1. Continued

Group/Species	Western Mediterranean	Ionian Sea	Adriatic Sea	Aegean Sea	Levantine Sea
Spirastrella cunctatrix Schmidt, 1868	Sarà 1958; Boury-Esnault 1971; Pulitzer-Finali 1983; Mustapha *et al.* 2003; Harmelin *et al.* 2003 Harmelin *et al.* 2003; Bertolino *et al.* 2013	Pulitzer-Finali 1983	Topsent 1925; Sarà and Melone 1963; Pulitzer-Finali 1983; Pansini and Longo 2003; Pansini and Longo 2008; Bakran-Petricioli *et al.* 2012	Pulitzer-Finali 1983; Voultsiadou 2005	Lévi 1957; Evcen and Çınar 2012
Trachycladus minax (Topsent, 1888)	Boury-Esnault 1971; Harmelin *et al.* 2003		Topsent 1892		
Chondrosiidae					
Chondrosia reniformis Nardo 1847	Sarà 1958; Boury-Esnault 1971; Pulitzer-Finali 1983; Melone 1965; Mustapha *et al.* 2003; Harmelin *et al.* 2003; Bertolino *et al.* 2013		Schmidt 1862; Lendenfeld 1898; Topsent 1925; Volz 1939; Vatova 1928; Volz 1939; Sarà and Melone 1963; Labate 1964; Ruetzler 1965; Pulitzer-Finali 1983; Grubelić 2001; Pansini and Longo 2008; Bakran-Petricioli *et al.* 2012	Pulitzer-Finali 1983; Voultsiadou 2005	Evcen and Çınar 2012

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Ege Denizi'ndeki (Doğu Akdeniz) delici sünger (Porifera) türleri

Özet

Bu çalışmada, Ildırı Körfezi'nde (Doğu Akdeniz) kayalık diplerde 4 familyaya ait toplam 11 delici sünger türü tepit edilmiş olup, bu türlerden 5 tanesi (*Dotona pulchella mediterranea*, *Volzia albicans*, *Delectona madreporica*, *Siphonodictyon infestum* ve *Thoosa mollis*) Doğu Akdeniz faunası için yeni kayıttır. Araştırma bölgesinin genelinde *Chondrosia reniformis*, *Spirastrella cuntatrix* ve *Cliona celata* türleri) en yüksek frekans ve bolluk değerine sahip türlerdir. Türkiye deniz faunası için yeni türlerin morfolojik ve dağılım özellikleri sunulmuştur. Ayrıca, Akdeniz kıyılarından rapor edilen delici sünger türleri için bir kontrol listesi verilmiştir.

References

Acik, S. (2008) Occurrence of the alien species Aspidosiphon (Aspidosiphon) elegans (Sipuncula) on the Levantine and Aegean coasts of Turkey. *Turk. Jour. Zool.* 32: 443-448.

Ackers, R.G.A., Moss, D., Picton, B.E. (1992) Sponges of the British Isles ("Sponge V"), A Colour Guide and Working Document. Marine Conservation Society, Ross-on-Wye, UK. 66 pp.

Babic, K. (1922) Monactinellida und Tetractinellida des Adriatischen Meeres. *Zoologische Jahrbücher, Abteilung für Systematik Geog. Biol. Tiere* 46: 217-302, pls 8–9.

Bacescu, M.C., Müller, G.I., Gomoiu, M.T. (1971) Ecologie Marina. Cercetari de Ecologie Bentala in Marea Neagra. Romania. *Editura Academiei Republic Socialiste* 4: 1-357.

Bakran-Perticioli, T., Radolović, M., Petricioli, D. (2012) How diverse is sponge fauna in the Adriatic Sea? *Zootaxa* 3172: 20-38.

Bavestrello, G., Arillo, A., Benatti, U., Cerrano, C., Cattaneo-Vietti, R., Cortesogno, L., Gaggero, A., Giovine, M., Tonetti, M., Sari, M. (1995) Quartz dissolution by the sponge *Chondrosia reniformis* (Porifera, Demospongiae). *Nature* 378: 374-376.

Bavestrello, G., Benatti, U., Cattaneo-Vietti, R., Cerrano, C., Giovine, M. (2003) Sponge cell reactivity to various forms of silica. *Micros. Res. Tech.* 62: 327-335.

Bavestrello, G., Calcinai, B., Cerrano, C., Sarà, M. (1997) *Delectona madreporica* sp. (Porifera, Demospongiae) boring the corallites of some scleractinians from the Ligurian Sea. *Ital. Jour. Zool.* 64: 273-277.

Bavestrello, G., Calcinai, B., Sarà, M. (1996) *Delectona ciconiae* sp. nov. (Porifera, Demospongiae) boring in the scleraxis of *Corallium rubrum*. *Jour. Mar. Biol. Ass. UK.* 76: 867-873.

Bertolino, M., Cerrano, C., Bavestrello, G., Carella, M., Pansini, M., Calcinai, B. (2013) Diversity of Porifera in the Mediterranean coralligenous accretions, with description of a new species. *Zookeys.* 336: 1-37.

Bibiloni, M.A. (1981) Estudi faunistic del litoral de Blanes (Girona). II Sistemàtica d'esponges. *Butll Ist. Cat. His. Nat.* 47: 5-59.

Boury-Esnault, N. (1971) Spongiaires de la zone rocheuse de Banyuls-sur-Mer. II. Systématique. *Vie et Milieu.* 22: 287-349.

Boury-Esnault, N. (2002) Order Chondrosida Boury-Esnault and Lopes, 1985 Family Chondrillidae Gray, 1872. In: Systema Porifera. A Guide to the Classification of Sponges 1 (eds., J.N.A.R. Hooper, W.M. Van Soest), Kluwer Academic/Plenum Publishers, New York, pp. 291-298.

Boury-Esnault, N., Pansini, M., Uriz, M.J. (1994) Spongiaires bathyaux de la mer d'Alboran et du golfe ibéro-marocain. *Mém. Mus. Nat. Hist. Nat.* 160: 1-174.

Burton, M. (1956). The sponges of West Africa. Atlantide Report (Scientific Results of the Danish Expedition to the Coasts of Tropical West Africa 1945–1946, Copenhagen) 4, pp. 111-147.

Calcinai, B., Azzin, F., Bavestrello, G., Cerrano, C., Pansını M., Thung, D.C. (2006) Boring Sponges from the Ha Long Bay, Tonkin Gulf. *Vietnam. Zool. Stud. Taip.* 45: 201 pp.

Calcinai, B., Bavestrello, G., Cuttone, G., Cerrano, C. (2011) Excavating sponges from the Adriatic Sea: description of *Cliona adriatica* sp. nov. (Demospongiae: Clionaidae) and estimation of its boring activity. *Jour. Mar. Biol. Assoc. UK*. 91: 339-346.

Calcinai, B., Cerrano, C., Bavestrello, G. (2002) A new species of Scantiletta (Demospongiae, Clionaidae) from the Mediterranean precious red coral with some remarks on the genus. *Bull. Mar. Sci.* 70: 919-926.

Calcinai, B., Cerrano, C., Sarà, M., Bavestrello, G. (2000) Boring sponges (Porifera, Demospongiae) from the Indian Ocean. *Ital. Jour. Zool.* 67: 203-219.

Carter, H.J. (1880) VIII. Report on specimens dredged up from the Gulf of Manaar and presented to the Liverpool Free Museum by Capt. WH Cawne Warren. *Ann. Magaz. Natur. Hist. 6: 35-61.*

Corriero, G., Scalera-Liaci, L. (1997) *Cliona parenzani* n.sp. (Porifera, Hadromerida) from the Ionian Sea. *Ital. Jour. Zool.* 64: 69-73.

Demir, V., Okus, E. (2010) Marine sponges from Datça-Bozburun Peninsula - a Specially Protected Area in the South Eastern Aegean Sea (Turkey). *Rapp. Comm. int. Mer Medit.* 39, 490.

Erguven, H., Ulutürk, T., Öztürk, B. (1988) Porifera (sponges) fauna of the Gokceada and production facilities. *İst. Üniv. Su Ürün. Der.* 2: 173-189. (in Turkish)

Evcen, A., Çınar, M.E. (2012) Sponge (Porifera) from the Mediterranean coast of Turkey (Levantine Sea, eastern Mediterranean), with a checklist of sponges from the coasts of Turkey. *Turk. Jour. Zool.* 36(4): 460–464.

Grant, R.E. (1826) Notice of a new zoophyte (*Cliona celata* Gr.) from the Firth of Forth. Edin. *N. Phil. Jour.* 1: 78-81.

Grubelić, I. (2001) Sponges of mobile bottoms in the open waters of the Adriatic. Dissertation, University of Zagreb, Zagreb, 238 pp.

Harmelin, J.-G., Boury-Esnault, N., Fichez, R., Vacelet, J., Zıbrowıus, H. (2003) Peuplement de la grotte sous-marine de l'ile de Bagaud (parc national de Port-Cros, France, Méditerranée). *Rapp. Scient. Nat. Port-Cros.* 19: 117-134.

Hooper, J.N.A., Van Soest, R.W.M. (2002) Systema Porifera: A Guide to the Classification of Sponges. Kluwer Academic/Plenum Publishers: New York, 1726 pp.

Hutchings, P. (2011) Bioerosion. In: Encylopedia of Modern Coral Reefs-Structure, Form and Processes, (ed. D. Hopley), Springer Verlag, Berlin, Heidelberg, pp. 139-156.

Johnson, J.Y. (1899) Notes on some sponges belonging to the Clionidae obtained at Madeira. *Jour. Roy. Micr. Soc. Trans. Soc.* 9: 461-463.

Kaminskaya, L.D. (1968) Klass gubok-Porifera (Sponge-Porifera). In: Opredelitel' fauny Chernogo i Azovskogo morey. Kiev, Ukraine: Noukova Dumka, pp. 35-55.

Kocataş, A. (1978) Qualitative and quantitative research on benthic forms from the rocky coast of the Gulf of Izmir. *Ege Üniv. Fen Bil. Mon. Ser.* 12: 1-93. (in Turkish)

Labate, M. (1964) Poriferi di grotta superficiale del litorale adriatico pugliese. *Ann. Pont. Istit. Sci. Lett.* 14: 319-342.

Lendenfeld, R. Von (1898) Die Clavulina der Adria. *Nova acta Acad. Caes. Leop. Carol. germ. natür.* 69: 1-251.

Lévi, C. (1957) Spongiaires des côtes d'Israel. *Bull. Res. Counc. Isr. Sect. B. Biol. Geol.* 6: 201-202.

Maldonado, M. (1992) Demosponges of the red coral bottoms from the Alboran Sea. *Jour. Nat. Hist.* 26: 1131-1161.

Melone, N. (1965) I Poriferi associati a *Corallium rubrum* (L.) della Sardegna. *Ann. Mus. Civ. Stor. Natür. G.* 75: 344-358.

Miloslavich, P., Díaz, J.M., Klein, E., Alvarado, J.J., Díaz, C., Gobin, J., Escobar-Briones, E., Cruz-Motta, J.J., Weil, E., Cortés, J., Bastidas, A.C., Robertson, R., Zapata, F., Martín, A., Castillo, J., Kazandjian, A., Ortiz, M.

(2010) Marine biodiversity in the Caribbean: regional estimates and distribution patterns. *PloS ONE* 5: e11916.

Mustapha, K.B., Zarrouk, S., Souissi, A., El Abed, A. (2003) Diversité des Démosponges Tunisiennes. *Bull. Inst. Natn. Scien. Tech. Mer de Salammbô Vol. 30.*

Nardo, G.D. (1847) Prospetto della fauna marina volgare del Veneto Estuario con cenni sulle principali specie commestibili dell'Adriatico. *Sulle Venete Pesche* 113-156.

Nassonow, N. (1883) Zur Biologie und Anatomie der Clione. *Zeitschrift für Wissenschaftliche Zoologie* 39: 295-308, pls. 18-19.

Neumann, A.C. (1966) Observations on coastal erosion in Bermuda and measurements of the boring rate of the sponge. *Limn. Ocean.* 11: 92-108.

Ostroumoff, A. (1896) Comptes-rendus des dragages et du plankton de l'expédition de 'Selianik'. *Bull. Acad. Scien. S.P.* 5: 33-93.

Pansini, M. (1987) Report on a collection of Demospongiae from soft bottoms of the Eastern Adriatic Sea. In: European Contributions to the Taxonomy of Sponges (ed. W.C. Jones). Sherkin Island Marine Station Edition, Litho Press, Cork, pp. 41-53.

Pansini, M., Longo, C. (2003) A review of the Mediterranean Sea sponge biogeography with, in appendix, a list of the demosponges hitherto recorded from this sea. *Biogeographia* 24: 59-90.

Pansini, M., Longo, C. (2008) Checklist della flora e della fauna dei mari italiani. Porifera. *Biol. Mar. Medit. 15 (suppl.)* 42-66.

Pulitzer-Finali, G. (1983) A collection of Mediterranean demosponges (Porifera) with, in appendix, a list of the Demospongiae hitherto recorded from the Mediterranean Sea. *Ann. Mus. Civ. Stor. Natur.* 84: 445-621.

Pulitzer-Finali, G. (1993) A collection of marine sponges from East Africa. *Ann. Mus. Civ. Stor. Natur.* 89: 247-350.

Reis, M.A.C., Leão, Z.M.A.N. (2000) Bioerosion rate of the sponge *Cliona celata* (Grant 1826) from reefs in turbid waters, north Bahia, Brazil. Proceedings 9th International Coral Reef Symposium Bali Indonesia, pp. 23-27.

Rosell, D. (1996) A new diagnosis of the genus *Delectona* (Porifera, Demospongiae), with a description of a new species from the Alboran Sea (western Mediterranean). *Helg. Meer.* 50: 425-432.

Rosell, D., Uriz, M.J. (2002) Excavating and endolithic sponge species (Porifera) from the Mediterranean: species descriptions and identification key. *Org. Div. Evol.* 1-32.

Rosell, D., Uriz, M.J., Martin, D. (1997) Infestation by excavating sponges on the oyster (Ostrea edulis) populations of the Blanes littoral zone (northwestern Mediterranean Sea). *Jour. Mar. Biol. Assoc. UK.* 79: 409-413.

Ruetzler, K. (1965) Systematik und Ökologie der Poriferen aus Litoral-schattengebieten der Nordadria. *Zeitschrift für Morphologie und Ökologie der Tiere.* 55: 1-82.

Ruetzler, K. (1975) The role of burrowing in bioerosion. *Oecologia* 19: 203-216.

Ruetzler, K. (1978) Sponges in coral reefs. In: Coral Reefs: Research Methods (eds. D.R. Stoddart, R.E. Johannes), UNESCO, Paris, pp. 209-313.

Ruetzler, K. (2002a) Family Alectonidae Rosell, 1996. In: Systema Porifera: A Guide to the Classification of Sponges (eds., J.N.A. Hooper, R.W.M. Van Soest). Kluwer Academic/Plenum Publishers, New York, pp. 281-290.

Ruetzler, K. (2002b) Family Clionaidae D'Orbigny, 1851. In: Systema Porifera: A Guide to the Classification of Sponges (eds., J.N.A. Hooper, R.W.M. Van Soest). Kluwer Academic/Plenum Publishers, New York, pp. 173-185.

Ruetzler, K. (2002c) Family Spirastrellidae Ridley and Dendy, 1886. In: Systema Porifera: A Guide to the Classification of Sponges (eds., J.N.A. Hooper, R.W.M. Van Soest). Kluwer Academic/Plenum Publishers, New York, pp. 220-223.

Ruetzler, K., Rieger, G. (1973) Sponge burrowing: Fine structure of *Cliona lampa* penetrating calcareous substrata. *Mar. Biol.* 21: 144-162.

Ruetzler, K., Sarà, M. (1962) *Diplastrella ornata*, eine neue mediterrane Art der Familie Spirastrellidae (Demospongiae). *Zool. Anz.* 169: 231-236.

Sarà, M. (1958) Contributo all consoscenza dei Poriferi del Mar Ligure (1). *Ann. Mus. Civ. Stor. Natur. G.* 70: 207-244.

Sarà, M., Melone, N. (1963) Poriferi di acque superficiali del litorale pugliese presso Bari. *Ann. Pont. Istit. Sci. Lett.* 13: 1-28.

Sarıtaş, M.Ü. (1972) A preliminary study on the silicious sponge (Porifera) fauna of Engeceli Harbor in the Gulf of Izmir (Aegean Sea). *Sci. Rep. Fac. Sci. Ege Univ.* 143: 3-25. (in Turkish)

Sarıtaş, M.Ü. (1973) Report on the sponges (Porifera) occurring on *Posidonia oceanica* (L.) at the coast of Altinoluk, Edremit Bay (Aegean Sea). *Sci. Rep. Fac. Sci. Ege Univ.* 168: 3-21. (in Turkish)

Sarıtaş, M.Ü. (1974) Systematic research on the silicious sponges (Porifera) from the Gulf of Izmir. PhD, Diyarbakır University, Diyarbakır, Turkey. 54 pp.

Schmidt, O. (1862) Die Spongien des adriatischen Meeres. *Wilhelm Engelmann: Leipzig* i–viii, 1–88: 1–7.

Schmidt, O. (1864) Supplement der Spongien des adriatischen Meeres (Enthaltend die Histiologie und systematische Ergänzungen), Verlag von Wilhelm Engelmann, Leipzig, pp. 48.

Schoenberg, C.H.L. (2002) Substrate effects on the bioeroding demosponge *Cliona orientalis*. 1. Bioerosion Rates. *Mar. Ecol.* 23: 313-326.

Schoenberg, C.H.L. (2003) Substrate effects on the bioeroding demosponge *Cliona orientalis*. 2. Substrate colonisation and tissue growth. *Pubb. Staz. Zool. N. Mar. Ecol.* 24: 59-74.

Schoenberg, C.H.L., Beuck, L. (2007) Where topsent went wrong: *Aka infesta* a.k.a. *Aka labyrinthica* (Demospongiae: Phloeodictyidae) and implications for other *Aka* species. *Jour. Mar. Biol. Assoc. UK.* 87: 1459-1476.

Scott, P.J.B., Moser, K.A., Risk, M.J. (1988) Bioerosion of concrete and limestone by marine organisms: a 13 year esperiment from Jamaica. *Mar. Poll. Bull.* 5: 219-222.

Topaloğlu, B. (2001a) Sponge fauna in the littoral zone of the Marmara Sea. *Rapp. Comm. int. Mer Medit.*, 36: 421.

Topaloğlu, B. (2001b) A preliminary study on the sponge fauna from the northern coast of Gokceada. In: National Meeting of the Aegean Islands (eds., B. Öztürk, V. Aysel). TUDAV.Pub. No. 7. pp. 97-102.

Topaloğlu, B., Evcen, A. (2014) Updated checklist of sponges (Porifera) along the coasts of Turkey. *Turk. Jour. Zool.* 38: 665-676.

Topsent, E. (1892) Diagnoses d'éponges nouvelles de la Méditerranée et plus particulièrement de Banyuls. *Archives de Zoologie expérimentale et générale.* (2) 10 (Notes et Revue 6) 17-28.

Topsent, E. (1925) Étude des Spongiaires du Golfe de Naples. *Arch. Zool. Expér. Gén.* 63: 623-725.

Topsent, E. (1932) Notes sur des Clionides. *Arch. Zool. Exp. Gén.* 74: 549-579.

Van Soest, R.W.M. (1993) Affinities of the marine demospongiae fauna of the Cape Verde Islands and Tropical West Africa. *Cour. Forsch. Senck.* 159: 205-219.

Van Soest, R.W.M., Boury-Esnault, N., Hooper, J.N.A., Ruetzler, K., De Voogd, N.J., Alvarez De Glasby, B., Hajdu, E., Pisera, A.B., Manconi, R., Schoenberg, C., Janussen, D., Tabachnick., K.R., Klautau, M., Picton, B., Kelly, M., Vacelet, J. (2015) World Porifera Database, at www.marinespecies.org/porifera/ index.php. (Accessed 01.06.2015)

Vatova, A. (1928) Compendio della flora e fauna del mare Adriatico presso Rovigno con la distribuzione geografica delle specie bentoniche. R. Comitato Talassografico Italiano, Venezia, Memoria 143: pp. 614.

Volz, P. (1939) Die Bohrschwämme (Clioniden) der Adria. *Thalassia Salentina* 3: 1-64.

Voultsiadou, E. (2005) Sponge diversity in the Aegean Sea: Check list and new information. *Ital. Zool.* 72: 53-64.

Voultsiadou, E., Vafidis, D. (2004) Rare sponge (Porifera: Demospongiae) species from the Mediterranean Sea. *Jour. Mar. Biol. Ass. UK.* 84: 593-598.

Xavier, J.R., Rachello-Dolmen, P.G, Parra-Velandia, F., Schoennberg, C.H.L., Breeuwer, J.A.J.,Van Soest, R.V.M. (2010) Molecular evidence of cryptic speciation in the "cosmopolitan" excavating sponge *Cliona celata* (Porifera, Clionaidae). *Mol. Phy. Evol.* 56: 13-20.

Yazıcı, M. (1978) The porifera species determined on Gökçeada and Bozcada. *IUFS Jour. Biol.* 28 (1–4): 109–121. (in Turkish)

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