

## Sponge (Porifera) species from the Mediterranean coast of Turkey (Levantine Sea, eastern Mediterranean), with a checklist of sponges from the coasts of Turkey

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**Abstract:** The present study deals with sponge species collected along the Mediterranean coast of Turkey in 2005. A total of 29 species belonging to 19 families were encountered, of which *Phorbas plumosus* is a new record for the eastern Mediterranean, 8 species are new records for the marine fauna of Turkey (*Clathrina clathrus*, *Spirastrella cunctatrix*, *Desmacella inornata*, *Phorbas plumosus*, *Hymerhabdia intermedia*, *Haliclona fulva*, *Petrosia vansoesti*, and *Ircinia dendroides*), and 19 species are new records for the Levantine Sea (*C. clathrus*, *Sycon raphanus*, *Erylus discophorus*, *Alectona millari*, *Cliona celata*, *Diplastrella bistellata*, *Mycale contareni*, *Mycale cf. rotalis*, *Mycale lingua*, *D. inornata*, *P. plumosus*, *Phorbas fictitius*, *Lissodendoryx isodictyalis*, *Hymerhabdia intermedia*, *H. fulva*, *P. vansoesti*, *I. dendroides*, *Sarcotragus spinosulus*, and *Aplysina aerophoba*). The morphological and distributional features of the species that are new to the Turkish marine fauna are presented. In addition, a check-list of the sponge species that have been reported from the coasts of Turkey to date is provided.

**Key words:** Sponges, Porifera, biodiversity, distribution, Levantine Sea, Turkey, eastern Mediterranean

### Türkiye'nin Akdeniz kıyılarından (Levantin Denizi, doğu Akdeniz) sünger (Porifera) türleri ile Türkiye kıyılarından kaydedilen süngerlerin kontrol listesi

**Özet:** Bu çalışma, 2005 yılında Türkiye'nin Akdeniz kıyılarında bulunan bazı sünger türlerini ele almaktadır. Bölgede 19 familyaya ait toplam 29 tür tespit edilmiş olup, bunlardan *Phorbas plumosus* Doğu Akdeniz, 8 tür Türkiye faunası (*Clathrina clathrus*, *Spirastrella cunctatrix*, *Desmacella inornata*, *Phorbas plumosus*, *Hymerhabdia intermedia*, *Haliclona fulva*, *Petrosia vansoesti* ve *Ircinia dendroides*) ve 19 tür Levantin Denizi (*C. clathrus*, *Sycon raphanus*, *Erylus discophorus*, *Alectona millari*, *Cliona celata*, *Diplastrella bistellata*, *Mycale contareni*, *Mycale cf. rotalis*, *Mycale lingua*, *D. inornata*, *P. plumosus*, *Phorbas fictitius*, *Lissodendoryx isodictyalis*, *Hymerhabdia intermedia*, *H. fulva*, *P. vansoesti*, *I. dendroides*, *Sarcotragus spinosulus* ve *Aplysina aerophoba*) için yeni kayıtlardır. Türkiye deniz faunası için yeni türlerin morfolojik ve dağılım özellikleri sunulmuştur. Ayrıca, Türkiye kıyılarından rapor edilen sünger türleri için bir kontrol listesi verilmiştir.

**Anahtar sözcükler:** Süngerler, Porifera, biyoçeşitlilik, dağılım, Levantin Denizi, Türkiye, Doğu Akdeniz

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## Introduction

The eastern Mediterranean, especially the Levantine Sea, is one of the oligotrophic areas of the world's oceans. The primary production of the sea has been estimated as  $45 \text{ mgC m}^{-2} \text{ day}^{-1}$  (Ediger and Yılmaz, 1996), which is almost 10 times lower than that of the western Mediterranean ( $350\text{-}450 \text{ mgC m}^{-2} \text{ day}^{-1}$ ) (Moutin and Raimbault, 2002). The biodiversity of the region was known to be impoverished, accounting for less than 50% of the total number of species reported in the Mediterranean Sea (Coll et al., 2010). This west-east decline of the biodiversity in the Mediterranean is also obvious for sponges. In the Levantine Sea, almost 85 sponge species have been reported to date (Burton, 1936; Lévi, 1956; Tturnamal, 1967, 1969; İlan et al., 1994, 2003; Perez et al., 2004; Vacelet et al., 2007; Vacelet and Perez, 2008; Voultsiadou, 2009), whereas 681, 432, and 200 species have been listed in the whole Mediterranean, western Mediterranean, and Aegean Sea (Coll et al., 2010; Voultsiadou, 2005b), respectively. However, this picture could be biased and might indicate the scarcity in the number of faunistic studies performed in the Levantine Sea (Çinar, 2003).

The Levantine Sea was greatly influenced by the Lessepsian migrants after the opening of the Suez Canal in 1869. Some species belonging to different groups such as *Caulerpa racemosa* (Algae), *Rhopilema nomadica* (Scyphozoa), *Pomatoleios kraussi* (Polychaeta), *Branchidontes pharaonis* (Mollusca), and *Siganus* spp. (Pisces) have become dominant components of the benthic and pelagic communities in the area. Almost 955 alien species have been reported from the Mediterranean Sea so far (Zenetos et al., 2010). The majority of alien species (almost 75%) are known from the eastern part of the Mediterranean. According to a recent review (Zenetos et al., 2010), no alien sponge species exist in the Mediterranean Sea. However, Burton (1936) and (Tturnamal, 1969) considered 7 species [*Callyspongia viridis* (as *Haliclona viridis*), *Chrotella cavernosa* (cited as *Cinachyrella australiensis*), *Damiriana schmidti* (cited as *Lissodendoryx schmidti*), *Geodia micropunctata*, *Heteroneme erecta* (cited as *Hyrtios erecta*), *Mycale erythraeana*, and *Reniera spinosella*] to be Lessepsian migrants. These species were later excluded from the alien list of the Mediterranean due to debates regarding their taxonomic positions (see Zenetos et al., 2005).

Studies on sponges along the coasts of Turkey date back to 1885. Colombo (1885) reported 5 species [*Leucandra aspera*, *Geodia gigas*, *Suberites domuncula*, *Petrosia* (*Petrosia*) *ficiformis*, and *Siphonochalina coriacea*] in the Çanakkale Strait. Later, Ostroumoff (1896) listed 31 sponges from different depths of the Sea of Marmara and the İstanbul Strait. Sponge diversity in the Sea of Marmara was also taken into account by Demir (1952-1954), Caspers (1968), and Topaloğlu (2001a). In the Aegean Sea, Sarıtaş (1972, 1973, 1974) encountered a total of 50 sponge species in İzmir Bay. Yazıcı (1978) studied some sponge species collected around Gökçeada (northern Aegean Sea). Some sponge species were later reported in faunistic and ecological works performed in the Aegean Sea (Geldiay and Kocataş, 1972; Kocataş, 1978; Ergüven et al., 1988; Katagan et al., 1991; Ergen et al., 1994; Cinar and Ergen, 1998; Kocak et al., 1999; Topaloğlu, 2001a, 2001b; Çinar et al., 2002). On the Levantine and Black Sea coasts of Turkey, no sponge species have been reported to date.

This study deals with the sponge species collected within the framework of a project by the Scientific and Technological Research Council of Turkey (TÜBİTAK; No: 104Y065) concerning the structures of zoobenthic communities on the southern coast of Turkey. The aims of this study were to assess the sponge diversity in the shallow-water benthic habitats of the southern coast of Turkey and to present morphological and distributional features of the species that are new to the fauna of Turkey. This paper also provides a checklist of the sponge species that have been reported on the coasts of Turkey to date.

## Materials and methods

Sponge specimens were collected in the shallow-water benthic habitats (depths of 0-5 m) of the southern coast of Turkey in September and October 2005 by scuba diving and snorkeling (Figure 1). However, a soft-bottom benthic sample (with shell fragments) that included a specimen of *Phorbas plumosus* was also taken into account in this study. In the field, sponge specimens collected were put in jars and fixed with a 4% formaldehyde solution.

In the laboratory, sponge specimens sorted from other benthic groups were washed under tap water and preserved in 70% alcohol. Preparations of

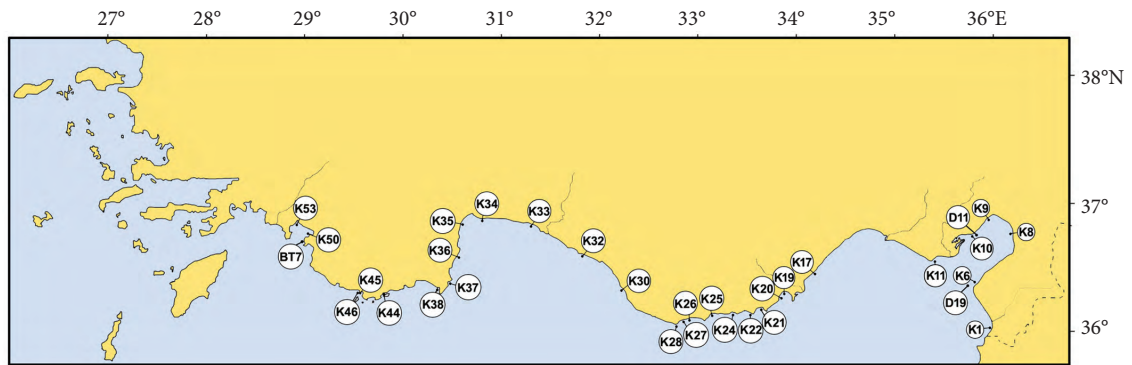


Figure 1. Map of the investigated area with the locations of sampling sites.

spicules and skeletons followed the standard practice proposed by Rützler (1978). Spicule preparations were made by dissolving sponge fragments in boiling nitric acid, and after rinsing in water and ethanol, spicules were permanently mounted on microscope slides. 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., 2011). The author's citations in the species presentation include the original description, where available, completed with the most recent publications giving a complete description.

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

## Results

The materials collected along the southern coast of Turkey yielded a total of 29 sponge species belonging to 2 classes and 19 families (Table 1). All species are new to the Mediterranean coast of Turkey. *Phorbaspilosus plumosus* is new to the eastern Mediterranean fauna, 8 species (*Clathrina clathrus*, *Spirastrella cunctatrix*, *Desmacella inornata*, *Phorbaspilosus plumosus*, *Hymerhabdia intermedia*, *Haliclona (Halichoelona) fulva*, *Petrosia (Strongylophora) vansoesti*, and *Ircinia dendroides*) are new to the marine fauna of Turkey, and 19 species (*C. clathrus*, *Sycon raphanus*, *Erylus discophorus*, *Alectona millari*, *Cliona celata*, *Diplastrella bistellata*, *Mycale (Aegogropila) contareni*, *Mycale (A.) cf. rotalis*, *Mycale (Mycale) lingua*, *D. inornata*, *Phorbaspilosus plumosus*, *P. fictitius*, *Lissodendoryx (Lissodendoryx)*

*isodictyalis*, *Hymerhabdia intermedia*, *H. (H.) fulva*, *P. (S.) vansoesti*, *I. dendroides*, *Sarcotragus spinosulus*, and *Aplysina aerophoba*) are new to the Levantine fauna.

The descriptions and distributional features of the species that are new to the marine fauna of Turkey are as follows.

Class CALCAREA Bowerbank, 1864

Family CLATHRINIDAE Minchin, 1900

*Clathrina clathrus* (Schmidt, 1864)

*Grantia clathrus* Schmidt 1864: 24, Fig III. Taf 3. 3a.

*Clathrina clathrus*; Klautau and Valentine 2003: 17-18, Fig. 12.

Material examined: Many specimens were photographed at station K38 (29.09.2005, on rock, 3 m).

**Notes:** This species has a yellow irregular mass of anastomosed tubes, massively encrusting to globular, but without stalk (Figure 2). It has a smooth surface. Schmidt (1864) reported that the sulfur-yellow color is characteristic for this species. Klautau and Valentine (2003) reported that its skeleton has no organization, comprising equiradial and equiangular triactines only. Actines are cylindrical with rounded tips and undulated at their distal parts.

**Distribution:** It is widely distributed in the European waters (Mediterranean and eastern Atlantic) (Van Soest et al., 2011).

Class DEMOSPONGIAE Sollas, 1885

Family SPIRASTRELLIDAE Ridley & Dendy, 1886

Table 1. Sponge species found along the southern coast of Turkey. Abbreviations: R: rocks and stones, P: *Posidonia oceanica*, A: algae, Hs: hard substrate in sandy bottoms. \*Species new to the eastern Mediterranean fauna, \*\*species new to the Turkish marine fauna, \*\*\*species new to the Levantine fauna.

	Specimens	Substrate	Stations
<b>CALCAREA</b>			
<b>Clathrinidae</b>			
* <i>Clathrina clathrus</i> (Schmidt, 1864)	Photograph	R	K38
<b>Sycettidae</b>			
** <i>Sycon raphanus</i> Schmidt, 1862	15	R,A	D11, K6, K11, K19, K24, K26, K27, K28, K30, K33, K44, K45, K46
<b>DEMOSPONGIAE</b>			
<b>Geodiidae</b>			
** <i>Erylus discophorus</i> (Schmidt, 1862)	2	R	K44, K45
<b>Thoosidae</b>			
** <i>Alectona millari</i> Carter, 1879	1	R	K44
<b>Clionidae</b>			
** <i>Cliona celata</i> Grant, 1826	Photograph	R	K6
** <i>Cliona schmidtii</i> (Ridley, 1881)	Photograph	R	K45
<b>Spirastrellidae</b>			
* <i>Spirastrella cunctatrix</i> Schmidt, 1868	Photograph	R	K6, K46
** <i>Diplastrella bistellata</i> (Schmidt, 1862)	1	R	K50
<b>Tethyidae</b>			
** <i>Tethya aurantium</i> (Pallas, 1766)	5	R	K21, K36, K44, K45
<b>Mycalidae</b>			
** <i>Mycale (Aegogropila) contareni</i> (Bowerbank, 1874)	1	R	K53
** <i>Mycale (Aegogropila) cf. rotalis</i> (Bowerbank, 1874)	Photograph	R	K9
* <i>Mycale (Mycale) lingua</i> (Bowerbank, 1866)	3	R,A	K11, K50
** <i>Mycale (Mycale) massa</i> (Schmidt, 1862)	1	R	K44
<b>Desmacellidae</b>			
* <i>Desmacella inornata</i> (Bowerbank, 1866)	1	R	K10
<b>Hymedesmiidae</b>			
* <i>Phorbos plumosus</i> (Montagu, 1818)	1	Hs	D19
** <i>Phorbos fictitius</i> (Bowerbank, 1866)	Photograph	R	K6
<b>Crambeidae</b>			
<i>Crambe crambe</i> (Schmidt, 1862)	Photograph	R	K6
<b>Coelosphaeridae</b>			
** <i>Lissodendoryx (Lissodendoryx) isodictyalis</i> (Carter, 1882)	1	P	K53
<b>Bubaridae</b>			
* <i>Hymenhabdia intermedia</i> Sarà & Siribelli, 1960	1	R	K6, K37
<b>Chalinidae</b>			
* <i>Haliclona (Halichoelona) fulva</i> (Topsent, 1893)	1	R	K10
<b>Petrosiidae</b>			
** <i>Petrosia (Petrosia) ficiformis</i> (Poirot, 1789)	Photograph	R	K22
* <i>Petrosia (Strongylophora) vansoesti</i> Boury-Esnault, Pansini & Uriz, 1994	1	R	K44
<b>Dysideidae</b>			
** <i>Dysidea fragilis</i> (Montagu, 1818)	Photograph	R	K8
<b>Irciniidae</b>			
** <i>Ircinia variabilis</i> (Schmidt, 1862)	18	R	K6, K10, K17, K19, K21, K20, K22, K24, K25, K27, K33, K34-36, K44, K45, K50
** <i>Ircinia dendroides</i> (Schmidt, 1862)	2	P,R	K25, K30
** <i>Sarcotragus spinosulus</i> (Schmidt, 1862)	17	R	K6, K17, K19, K20, K22, K25, K26, K27, K32, K33, K36, K37, K44, K53
** <i>Sarcotragus foetidus</i> Schmidt, 1862	3	R,A	K21, K33
<b>Aplysinidae</b>			
** <i>Aplysina aerophoba</i> Nardo, 1843	2	R	K53
<b>Chondrillidae</b>			
** <i>Chondrosia reniformis</i> Nardo, 1847	15	P,R	K1, K9, K10, K17, K19, K20, K25, K26, K27, K30, K33, BT7

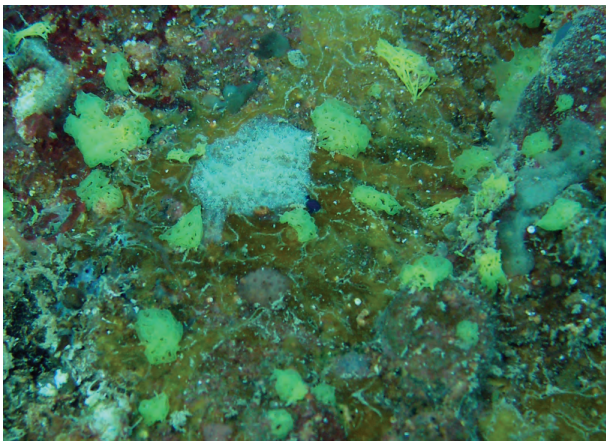


Figure 2. Underwater photograph of *Clathrina clathrus* at station K38.

***Spirastrella cunctatrix* Schmidt, 1868**

*Spirastrella cunctatrix* Schmidt 1868: 17, Fig 8. Taf III; Rützler 2002: 222, Fig. 4.

**Material examined:** Many specimens were photographed at stations K6 and K46 (on rocks, 1-3 m).

**Notes:** The color of the species was generally orange or red. The elevated osculae and connected channels are clearly visible (Figure 3). Specimens were approximately 5-10 cm in diameter.

**Distribution:** This species was previously reported from the Mediterranean Sea (Schmidt, 1868; Voultsiadou, 2005a), Red Sea (Lévi, 1965) and Atlantic Ocean (Vacelet and Vasseur, 1971).

Family Mycalidae Lundbeck, 1905

***Mycale (Mycale) lingua* (Bowerbank, 1866)**

*Desmacidon constrictus* Bowerbank 1866: 350-352.

*Mycale lingua*; Boury-Esnault et al. 1994: 96, fig. 70.

*Mycale (Mycale) lingua*; Van Soest & Hajdu, 2002: 672, fig. 2.

**Material examined:** ESFM-POR/2005-63, 15.09.2005, K11, on rock, 2 m, 1 specimen; ESFM-POR/2005-64, 5.10.2005, K50, on *Cystoseira* sp., 0.1 m, 2 specimens.

**Notes:** Sponge fragments were white, formless, approximately 1 × 1.5 cm in diameter. The ectosomal skeleton has a mass of tangential spicules. The choanosomal skeleton is plumoreticulate, consists of ascending multispicular fibers of styles,

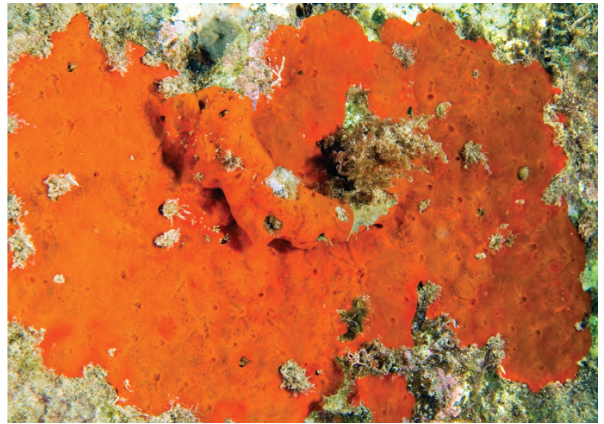


Figure 3. Underwater photograph of *Spirastrella cunctatrix* at station K6.

with small amounts of spongin binding fibers. Microscleres include palmate anisochelae, sigma, and trichodragmas. Anisochelae have 3 distinct size classes (Figure 4A): 1) 40-52 × 8-10 μm; 2) 20-38 × 2-4 μm; 3) rarely 15-20 × 1-1.4 μm. Sigmas (Figure 4B) are 30-50 × 0.5-1 μm. Raphides (trichodragma)

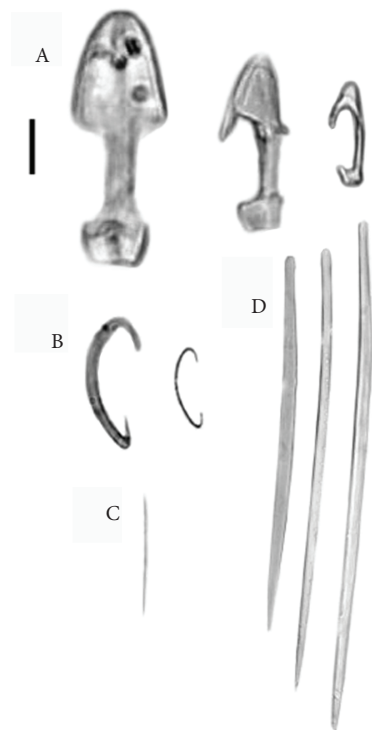


Figure 4. Spicules of *Mycale (Mycale) lingua*: A) anisochelae, B) sigmas, C) raphid, D) subtylostyles (ESFM-POR/2005-63). Scale bars: A) 10 μm, B) 20 μm, C) 20 μm, D) 40 μm.

(Figure 4C) are  $40-70 \times 0.4-0.8 \mu\text{m}$ . Megascleres include only subtylostyles (Figure 4D),  $280-380 \times 10-12 \mu\text{m}$ .

**Distribution:** This species is widely distributed in the Mediterranean Sea (Boury-Esnault et al., 1994; Voultsiadou, 2005a), east Atlantic Ocean (Topsent, 1913, 1928), and Arctic Ocean (Boury-Esnault et al., 1994).

Family Desmacellidae Ridley & Dendy, 1886

*Desmacella inornata* (Bowerbank, 1866)

*Halichondria inornatus* Bowerbank, 1866: 271-272.

*Desmacella inornata*; Boury-Esnault et al., 1994: 103, fig. 77.

**Material examined:** ESFM-POR/2005-66, 15.09.2005, K10, on *Jania rubens*, 0.5 m, 1 specimen.

**Notes:** Only a small specimen was collected. It has irregular and creeping branches. Spicules include megascleres and microscleres. Megascleres only include tylostyles (Figure 5A),  $190-400 \mu\text{m} \times 5-10 \mu\text{m}$ . Microscleres only include sigmas (Figure 5B),  $20-50 \mu\text{m} \times 2-4 \mu\text{m}$ .



Figure 5. *Desmacella inornata* (ESFM-POR/2005-66): A) sigma, B) tylostyle. Scale bars: A)  $5 \mu\text{m}$ , B)  $200 \mu\text{m}$ .

**Remarks:** In deep-water specimens (depths of 395-948 m) of this species collected from the Alboran Sea and Atlantic Ocean, the sizes of tylostyles were reported to be  $245-1000 \times 2-24 \mu\text{m}$  (Boury-Esnault et al., 1994).

**Distribution:** This species was previously reported from the Mediterranean Sea (Vacelet, 1969; Voultsiadou, 2005b) and Atlantic Ocean (Bowerbank, 1866; Topsent, 1892).

Family HYMEDESMIIDAE Topsent, 1928

*Phorbos plumosus* (Montagu, 1818)

*Spongia plumosa* Montagu, 1818: p. 116.

*Phorbos plumosus*; Van Soest, 2002: 589, fig. 8b-e.

**Material examined:** ESFM-POR/2005-65, 10.09.2005, D19, on hard substrate in sandy bottom, 75 m, 1 specimen.

**Notes:** This species has a plumose skeleton of ascending multispicular fibers of acanthostyles, echinated by smaller acanthostyles. It has a well-developed ectosomal skeleton of tornotes arranged in vertical brushes. Spongin is scarce. Spicules include megascleres and microscleres. Megascleres have ectosomal tornotes (Figure 6A),  $150-300 \mu\text{m} \times 6-7 \mu\text{m}$ . Spicules of the main skeleton have large acanthostyles (Figure 6B),  $240-350 \mu\text{m} \times 7-8 \mu\text{m}$ .

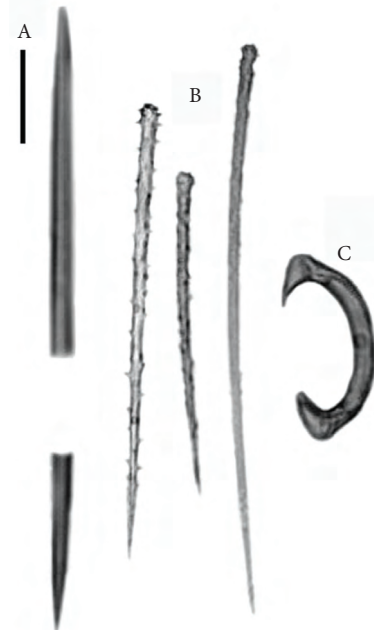


Figure 6. Spicules of *Phorbos plumosus* (ESFM-POR/2005-65): A) oxea, B) acanthostyles, C) arcuate isochela. Scale bars: A)  $40 \mu\text{m}$ , B)  $70 \mu\text{m}$ , C)  $10 \mu\text{m}$ .

They are sparsely spined and echinating. Smaller acanthostyles are densely, entirely spined and  $80\text{-}140 \times 3\text{-}6 \mu\text{m}$ . Microscleres have arcuate isochelae of a distinctive shape (Figure 6C). They are small and fine, and  $15\text{-}20 \mu\text{m}$  long.

**Distribution:** This species is newly reported from the eastern Mediterranean Sea. In the western Mediterranean, it was previously reported on the coast of Italy (Naples) (Corriero et al., 2007). It was also found in the eastern Atlantic Ocean (Ackers et al., 1992; Van Soest, 2002).

Family BUBARIDAE Topsent, 1894

*Hymerhabdia intermedia* Sarà & Siribelli, 1960

*Hymerhabdia intermedia* Sarà & Siribelli, 1960: 48-49, Fig. 9.

**Material examined:** ESFM-POR/2005-70, 13.09.2005, K6, on rocks, 2 m, 1 specimen; ESFM-POR/2005-93, 29.09.2005, K37, on rocks, 2 m, 2 specimens.

**Notes:** Specimens are fragments, white-greyish in color. The basal skeleton has monactines (rhabdostyles) and diactines. Diactines are bending or like angulate oxeas. Megascleres include large styles (Figure 7A), 400-500  $\times$  10-15  $\mu\text{m}$ . Rhabdostyles (Figure 7B) are 140-410  $\times$  3-10  $\mu\text{m}$ . Curved strongyles are centrotlyote (Figure 7C), 150-265  $\times$  5-12  $\mu\text{m}$ . Microscleres are absent. Styles erect from basal curved strongyles. The sizes of spicules are in accordance with the original description of the species (Sarà and Siribelli, 1960).

**Distribution:** It is a species endemic to the Mediterranean Sea. It was previously reported from the Gulf of Napoli (type locality) (Sarà and Siribelli, 1960) and Aegean Sea (Voultsiadou, 2005b).

Family CHALINIDAE Gray, 1867

*Haliclona (Halichoclona) fulva* (Topsent, 1893)

*Reniera fulva* Topsent, 1893: 39.

*Haliclona (Halichoclona) fulva* Kefalas & Castritsi-Catharios, 2007: 1534.

**Material examined:** ESFM-POR/2005-57, 15.09.2005, K10, on rocks, 2 m, 1 specimen.

**Notes:** The surface of the specimen is irregular and slightly hispid. The ectosomal and choanosomal skeletons have a regular, delicate, unispicular, and

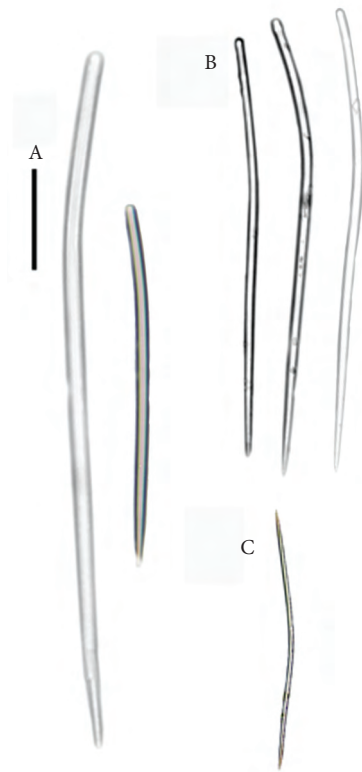


Figure 7. *Hymerhabdia intermedia* (ESFM-POR/2005-70): A) large styles, B) rhabdostyles, C) curved strongyle. Scale bar: 70  $\mu\text{m}$ .

isotropic reticulation. Color is dark orange. The primary and secondary fibrils are not separated. Spongin is present at the nodes of the spicules. Oxeas are slender, frequently blunt-pointed to strongylole (Figure 8). Microscleres are absent. Straight or slightly curved oxeas have a long and sharp point (Figure 8), 160-300  $\mu\text{m} \times 5\text{-}11 \mu\text{m}$ .

**Distribution:** It is a species endemic to the Mediterranean Sea. It was previously reported from the western Mediterranean (Topsent, 1893), Alboran Sea (Maldonado, 1992), and Aegean Sea (Voultsiadou, 2005a).

Family PETROSIIDAE Van Soest, 1980

*Petrosia (Strongylophora) vansoesti* Boury-Esnault, Pansini & Uriz, 1994

*Petrosia vansoesti* Boury-Esnault et al. 1994: 126, fig. 97.

*Petrosia vansoesti*; Voultsiadou & Vafidis, 2004: 596, fig. 2-3.



Figure 8. *Haliclona (Halichoelona) fulva* (ESFM-POR/2005-57): straight or slightly curved oxeas. Scale bar: 35  $\mu$ m.

**Material examined:** ESFM-POR/2005-59, 05.10.2005, K44, on rocks, 0.1-3 m, 1 specimen.

**Notes:** The ectosomal skeleton of this species has a reticulation of spicules. The choanosomal skeleton has thick tracts, obscured by the irregular masses of spicules in some places. Spicules include oxeas and strongyles. Oxeas are not divided into categories in terms of size. Strongyles are  $65-360 \times 8-20 \mu\text{m}$  (Figure 9). Oxeas are dominant at ectosomal skeleton,  $120-300 \times 5-8 \mu\text{m}$  (Figure 9). Oxeas styles and strongyles are densely found in choanosomal skeleton.

**Distribution:** This species was previously reported from the eastern Atlantic Ocean (Boury-Esnault et al., 1994) and the Aegean Sea (Voultsiadou and Vafidis, 2004).

Family IRCINIIDAE Gray, 1867

*Ircinia dendroides* (Schmidt, 1862)

*Hircinia dendroides* Schmidt, 1862: 32, Taf III. 40.



Figure 9. *Petrosia (Strongylophora) vansoesti* (ESFM-POR/2005-59): strongyles and oxeas. Scale bar: 60  $\mu$ m.

*Ircinia dendroides*; Uriz 1986: 13.

**Material examined:** ESFM-POR/2005-20, 21.09.2005, K25, on *P. oceanica*, 3 m, 1 specimen; ESFM-POR/2005-21, 24.09.2005, K30, on *P. oceanica*, 2 m, 1 specimen.

**Notes:** The body of this species has cylindrical or flattened branches of 1-2 cm in diameter. The color is greyish. The surface of the body has many conules that are almost 1 mm high. No apparent osculae are present. Choanosomal skeletons are formed by spongin fibrils and these primary fibrils are covered with a foreign material (like sand grains). Primary fibrils are 110-190  $\mu\text{m}$  long. In secondary fibrils, sand and similar structures are not seen. They are 20-80  $\mu\text{m}$  long. Filaments are formed in a clean and quite thin structure. They are 3-6  $\mu\text{m}$  long.

**Distribution:** It was previously reported from the Mediterranean Sea [Adriatic Sea (Schmidt, 1862); Aegean Sea (Voultsiadou, 2005a); Tunisia (Mustapha et al., 2003)], and eastern Atlantic Ocean [Canary Islands (Burton, 1956)].



## Discussion

The present collection included a total of 29 sponge species, 1 of which is new to the eastern Mediterranean fauna and 8 of which are new to the Turkish marine fauna. Prior to this study, a total of 108 sponges were reported from the Sea of Marmara and Aegean Sea (see Table 2 for reports). A total of 56 and 80 sponge species were previously reported in the Sea of Marmara and Aegean Sea (Turkish coast), respectively. With the results of the present study, the number of sponge species known from the coasts of Turkey has increased from 108 to 116. No study regarding the diversity of sponges along the Mediterranean coast of Turkey has been carried out so far. Thus, all species presented here are new records for the area.

Ostroumoff (1896) reported 2 new species from the Sea of Marmara, *Cometella stolonifera* (Ostroumoff, 1896) and *Suberites appendiculatus* (Ostroumoff, 1896), without giving descriptions or figures. Although Arndt (1947) gave some information about the morphological features of *C. stolonifera* (without figures) from the Romanian Black Sea coast, these 2 species are actually considered to be *nomen nudum* (J. Vacelet, personal communication). Therefore, these species were not included in Table 2.

Sponge species on the coasts of Turkey have been generally reported in some ecological works (i.e. Kocatas, 1978; Ergen et al., 1994; Çinar et al., 2002). However, Saritaş (1972, 1973, 1974), Yazıcı (1978), Ergüven et al. (1988), and Topaloğlu (2001a) provided taxonomical and ecological features of sponges inhabiting the coast of Turkey. In addition, sponge fisheries (Devedjian, 1926; Katagan et al., 1991; Topaloglu, 1998; Yılmaz and Buhan, 1998; Akkayan, 2009; Çoruh, 2009) and aquaculture (Dalkılıç, 1982; Yılmaz, 2003) have also been studied on the coasts of Turkey.

The biodiversity of sponges has rarely been a subject of study in the Levantine Sea. The first study on this group was made by Bodenheimer (1935), who reported 2 species [*Spongia* (*Spongia*) *officinalis* (cited as *Euspongia officinalis* var. *mollissima*) and *Hippospongia communis* (cited as *Hippospongia equina*)] of economical importance on the coast of Israel. In the other studies (Burton, 1936; Lévi, 1956; Tsumamal, 1967; Ilan et al., 1994; Galil and Zibrowius, 1998; Perez et al., 2004) performed on this group along the coasts of Israel, Egypt, and Lebanon, a total

of 39 species belonging to 32 families and 3 classes were reported. This study adds a total of 18 species (*C. clathrus*, *S. raphanus*, *E. discophorus*, *A. millari*, *C. celata*, *D. bistellata*, *M. (A.) contareni*, *M. (A.) cf. rotalis*, *M. (M.) lingua*, *D. inornata*, *P. plumosus*, *P. fictitius*, *L. (L.) isodictyalis*, *H. intermedia*, *H. (H.) fulva*, *P. (S.) vansoesti*, *I. dendroides*, *S. spinosulus*, and *A. aerophoba*) to the inventory of marine fauna in the Levantine Sea.

*Phorbos plumosus* is being newly reported for the eastern Mediterranean Sea. This species was found on a stone at 75 m in İskenderun Bay. It was previously reported from the Atlantic coasts of France, Spain, and Portugal (Ackers et al., 1992; Van Soest, 2002), and the western Mediterranean (Naples) (Corriero et al., 2007). This species was previously reported to inhabit hard substrata from shallow waters to 680 m (Ackers et al., 1992).

The genus *Desmacella* is represented by 2 species in the Mediterranean: *D. inornata* and *D. annexa* Schmidt, 1870. The present study includes only *D. inornata*. This species is morphologically very close to *D. annexa* (also present in the eastern Mediterranean; see Voultziadou, 2005b) but differs from it in the absence of toxiform microscleres (present in *D. annexa*). The dimensions of the tylots of the eastern Mediterranean specimen (190-400 µm long, 5-10 µm wide) of *D. inornata* were smaller than those (245-1000 µm long, 2-24 µm wide) found in the western Mediterranean Sea (Boury-Esnault et al., 1994).

This study was the first attempt to assess the diversity of sponges from the Mediterranean coast of Turkey. This study also gives a check-list for the sponge species that have been reported on the coasts of Turkey to date and thus provides a baseline for future studies. We think that sponges along the coasts of Turkey are more diverse than is actually presented. Future studies to be carried out in the region would enhance our knowledge about their diversity and functional roles in the ecosystems.

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Table 2. Checklist of sponge species from the coasts of Turkey. 1: Colombo (1885); 2: Ostroumoff (1896); 3: Demir (1952-1954); 4: Caspers (1968); 5: Geldiay and Kocataş (1972); 6: Saritaş (1972); 7: Saritaş (1973); 8: Saritaş (1974); 9: Kocataş (1978); 10: Yazıcı (1978); 11: Ergüven et al. (1988); 12: Balkıs (1994); 13: Ergen and Çınar (1994); 14: Ergen et al. (1994); 15: Cinar and Ergen (1998); 16: Kocak et al. (1999); 17: Topaloğlu (2001a); 18: Topaloğlu (2001b); 19: Çınar et al. (2002); 20: this study.

	Sea of Marmara	Aegean Sea	Mediterranean Sea
<b>CALCAREA</b>			
<b>Sycattidae</b>			
<i>Sycon tuba</i> Lendenfeld, 1891	2	-	-
<i>Sycon raphanus</i> Schmidt, 1862	3	10, 11, 13, 14, 16	20
<i>Sycon ciliatum</i> (Fabricius, 1780)	2	-	-
<b>Grantiidae</b>			
<i>Ute glabra</i> Schmidt, 1864	2	-	-
<b>Leucosoleniidae</b>			
<i>Leucosolenia variabilis</i> (Haeckel, 1870)	3	-	-
<i>Leucandra aspera</i> (Schmidt, 1862)	1, 2, 3	9, 10, 11	-
<b>Clathrinidae</b>			
<i>Clathrina clathrus</i> (Schmidt, 1864)	-	-	20
<i>Clathrina reticulum</i> (Schmidt, 1862)	-	9	-
<i>Clathrina coriacea</i> (Montagu, 1818)	-	10, 11	-
<b>DEMOSPONGIA</b>			
<b>Tethyidae</b>			
<i>Tethya aurantium</i> (Pallas, 1766)	2,3	5, 7, 8, 10, 11, 14	20
<b>Spirastrellidae</b>			
<i>Diplastrella bistellata</i> (Schmidt, 1862)	2	-	20
<i>Spirastrella cunctatrix</i> Schmidt, 1868	-	-	20
<b>Clionidae</b>			
<i>Cliona celata</i> Grant, 1826	17	18	20
<i>Cliona vermifera</i> Hancock, 1867	-	6	-
<i>Cliona viridis</i> (Schmidt, 1862)	2	6, 8, 9	-
<i>Cliona schmidtii</i> (Ridley, 1881)	-	6, 8	20
<i>Cliothisoosa hancocki</i> (Topsent, 1888)	-	6, 8	-
<b>Suberitidae</b>			
<i>Suberites carnosus</i> (Johnston, 1842)	3, 17	5	-
<i>Suberites domuncula</i> (Olivi, 1792)	1, 2, 3, 17	5, 10, 11, 14, 18	-
<i>Suberites massa</i> Nardo, 1847	2	-	-
<i>Protosuberites epiphytum</i> (Lamarck, 1815)	3	7	-
<i>Suberites ficus</i> (Johnston, 1842)	17	-	-
<i>Rhizaxinella pyrifer</i> (Delle Chiaje, 1828)	-	11	-
<i>Aaptos aaptos</i> (Schmidt, 1864)	17	-	-
<b>Placospongiidae</b>			
<i>Placospongia decorticans</i> (Hanitsch, 1895)	-	6, 8	-
<b>Timeidae</b>			
<i>Timea stellata</i> (Bowerbank, 1866)	-	9, 7	-
<i>Timea mixta</i> (Topsent, 1896)	-	7	-
<b>Chalinidae</b>			
<i>Haliclona alba</i> (Schmidt, 1862)	2	-	-
<i>Haliclona (Reniera) aqueductus</i> (Schmidt, 1862)	2	-	-
<i>Haliclona (Reniera) cratera</i> (Schmidt, 1862)	-	11	-
<i>Haliclona (Reniera) cinerea</i> (Grant, 1826)	3	11	-
<i>Haliclona (Reniera) mediterranea</i> Griessinger, 1971	17	-	-
<i>Haliclona (Haliclona) simulans</i> (Johnston, 1842)	-	10, 11	-
<i>Haliclona (Haliclona) fulva</i> (Topsent, 1893)	-	-	20
<i>Haliclona (Gellius) dubia</i> (Babic, 1922)	-	7, 8	-
<i>Haliclona (Gellius) fibulata</i> (Schmidt, 1862)	-	7, 8	-
<i>Chalinula limbata</i> (Montagu, 1818)	3	-	-
<b>Niphatidae</b>			

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<i>Pachychalina rustica</i> Schmidt, 1868	2	-	-
<b>Phloeodictyidae</b>			
<i>Oceanapia robusta</i> (Bowerbank, 1866)	2	-	-
<b>Callyspongiidae</b>			
<i>Siphonochalina coriacea</i> Schmidt, 1868	1	-	-
<b>Petrosiidae</b>			
<i>Petrosia (Petrosia) ficiformis</i> (Poiret, 1789)	1, 17	7, 8, 11, 18	20
<i>Petrosia (Strongylophora) vansoesti</i> Boury-Esnault, Pansini & Uriz, 1994	-	-	20
<i>Petrosia pulitzeri</i> (Pansini, 1996)	17	-	-
<b>Dictyonellidae</b>			
<i>Dictyonella obtusa</i> (Schmidt, 1862).	2, 17	-	-
<i>Acanthella acuta</i> Schmidt, 1862	17	-	-
<b>Axinellidae</b>			
<i>Axinella cannabina</i> (Esper, 1794)	2, 17	10, 11, 18	--
<i>Axinella damicornis</i> (Esper, 1794)	2, 17	18	-
<i>Axinella polypoides</i> Schmidt, 1862	17	10, 11, 18	-
<i>Axinella verrucosa</i> (Esper, 1794)	-	10, 11	-
<b>Halichondriidae</b>			
<i>Ciocalypa penicillus</i> (Schmidt, 1862)	17	-	-
<i>Hymeniacion perlevis</i> (Montagu, 1818)	-	9	-
<i>Halichondria (Halichondria) panicea</i> (Pallas, 1766)	3	11	-
<b>Bubaridae</b>			
<i>Hymerhabdia intermedia</i> Sarà & Siribelli, 1960	-	-	20
<b>Ancorinidae</b>			
<i>Stelletta dorsigera</i> Schmidt, 1864	-	8, 9	-
<i>Stelletta stellata</i> Topsent, 1893	-	8	-
<i>Stelletta grubii</i> (Schmidt, 1862)	-	8	-
<i>Ancorina cerebrum</i> (Schmidt, 1862)	2	8	-
<i>Penares helleri</i> (Schmidt, 1864)	-	11	-
<i>Stryphnus ponderosus</i> (Bowerbank, 1866)	-	8	-
<i>Holoxea furtiva</i> Topsent, 1892	-	6, 8	-
<b>Pachastrellidae</b>			
<i>Thenea muricata</i> (Bowerbank, 1858)	2	8	-
<i>Stoeba plicata</i> (Schmidt, 1868)	-	8	-
<b>Geodiidae</b>			
<i>Geodia tuberosa</i> Schmidt, 1862	2	-	-
<i>Geodia cydonium</i> (Jameson, 1811)	17	7, 8, 10, 11	-
<i>Geodia placenta</i> Schmidt, 1862	2	-	-
<i>Geodia conchilega</i> Schmidt, 1862	-	7, 8	-
<i>Geodia barretti</i> Bowerbank, 1858	3	-	-
<i>Geodia gigas</i> Schmidt, 1862	1	-	-
<i>Erylus discophorus</i> (Schmidt, 1862)	-	7, 8	20
<i>Erylus euastrum</i> (Schmidt, 1868)	-	8	-
<b>Calthropellidae</b>			
<i>Calthropella stelligera</i> (Schmidt, 1868)	-	8	-
<b>Thoosidae</b>			
<i>Alectona millari</i> Carter, 1879	-	6	20
<b>Mycalidae</b>			
<i>Mycale (Mycale) massa</i> (Schmidt, 1862)	-	6	20
<i>Mycale (Aegogropila) contareni</i> (Martens, 1824)	2	7	20
<i>Mycale (Mycale) lingua</i> (Bowerbank, 1866)	-	-	20
<i>Mycale (Aegogropila) rotalis</i> (Bowerbank, 1874)	-	7	20
<i>Mycale (Carmia) macilenta</i> (Bowerbank, 1866)	-	7, 8	-
<i>Mycale (Aegogropila) tunicata</i> (Schmidt, 1862)	-	7	-
<b>Tetillidae</b>			
<i>Craniella cranium</i> (Müller, 1776)	-	8	-
<b>Samidae</b>			

<i>Samus anonymus</i> Gray, 1867	-	8	-
<b>Plakinidae</b>			
<i>Plakina monolopha</i> Schulze 1880	-	8	-
<i>Agelas oroides</i> (Schmidt, 1862)	17	8, 11, 18	-
<b>Myxillidae</b>			
<i>Myxilla (Myxilla) rosacea</i> (Lieberkühn, 1859)	-	6, 7, 8, 11	-
<i>Myxilla (Myxilla) prouhoi</i> (Topsent, 1892)	-	8	-
<b>Coelosphaeridae</b>			
<i>Lissodendoryx (Lissodendoryx) isodictyalis</i> (Carter, 1882)	-	6, 8	20
<i>Lissodendoryx (Anomodoryx) cavernosa</i> (Topsent, 1892)	-	7	-
<b>Crambeidae</b>			
<i>Crambe crambe</i> (Schmidt, 1862)	-	6, 8	20
<b>Crellidae</b>			
<i>Crella (Pytheas) fusifera</i> Sarà, 1969	-	8	-
<i>Crella (Crella) elegans</i> (Schmidt, 1862)	4	-	-
<b>Hymedesmiidae</b>			
<i>Phorbas fictitius</i> (Bowerbank, 1866)	2	-	20
<i>Phorbas armatus</i> Schmidt, 1868	2	-	-
<i>Phorbas plumosus</i> (Montagu, 1818)	-	-	20
<i>Hemimycale columella</i> (Bowerbank, 1874)	-	11	-
<b>Acaridae</b>			
<i>Acarnus tortilis</i> Topsent, 1892	-	6, 7, 8	-
<b>Tedaniidae</b>			
<i>Tedania (Tedania) anhelans</i> (Lieberkühn, 1859)	2	7, 8, 10, 11	-
<b>Rhabderemiidae</b>			
<i>Rhabderemia indica</i> Dendy, 1905	-	7	-
<b>Raspailiidae</b>			
<i>Raspailia (Raspailia) viminalis</i> Schmidt, 1862	-	5, 8, 11	-
<b>Microcionidae</b>			
<i>Clathria (Thalysias) jolicoeuri</i> (Topsent, 1892)	-	7, 9	-
<i>Clathria (Clathria) coralloides</i> (Olivi, 1792)	-	11	-
<i>Clathria (Microcionia) strepsitoxa</i> (Hope, 1889)	17	18	-
<b>Desmacellidae</b>			
<i>Desmacella inornata</i> (Bowerbank, 1866)	-	-	20
<b>Irciniidae</b>			
<i>Ircinia variabilis</i> (Schmidt, 1862)	2	11	20
<i>Sarcotragus foetidus</i> Schmidt, 1862	2	9, 11, 14, 15, 19	20
<i>Sarcotragus fasciculatus</i> (Pallas, 1766)	-	11	-
<b>Dysideidae</b>			
<i>Dysidea avara</i> (Schmidt, 1862)	2	10, 11	-
<i>Dysidea tupha</i> (Martens, 1824)	-	11	-
<i>Dysidea fragilis</i> (Montagu, 1818)	2	11	20
<b>Thorectidae</b>			
<i>Fasciospongia cavernosa</i> (Schmidt, 1862)	2	-	-
<i>Cacospongia mollior</i> Schmidt, 1862	2	-	-
<i>Scalarispongia scalaris</i> (Schmidt, 1862)	-	11	-
<b>Spongiidae</b>			
<i>Hippospongia communis</i> (Lamarck, 1814)	2	10, 11	-
<i>Spongia (Spongia) officinalis</i> Linnaeus, 1759	2, 12, 17	10, 11, 14	-
<i>Spongia (Spongia) virgultosa</i> (Schmidt, 1868)	-	11, 14	-
<b>Aplysinidae</b>			
<i>Aplysina aerophoba</i> Nardo, 1843	2	5, 11, 14, 18	20
<b>Chondrillidae</b>			
<i>Chondrosia reniformis</i> Nardo, 1847	-	10, 11, 18	20

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