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# Adriatic species of *Schizomavella* (Bryozoa: Cheilostomata)

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**ABSTRACT**

In this paper, material belonging to the genus *Schizomavella*, collected along the Croatian coast of the Adriatic Sea, is revised. Nine species were identified, including five species new to science: *S. cornuta*, *S. halimedae*, *S. linearis*, *S. mamillata*, *S. adriatica* sp. nov.,*S. mystacea* sp. nov., *S. rosae* sp. nov., *S. stanislavi* sp. nov. and *S. tubulata* sp. nov. Previous records of *Schizomavella* from the Adriatic are also discussed. The checklist of Adriatic *Schizomavella* species is updated to 11 species; a further two species are doubtful owing to wrong previous identifications. The presence of a calcified 'hood' covering the opesia of the suboral avicularium is described and its function is discussed. The morphological diversity of ovicells within the genus *Schizomavella* is compiled and discussed.

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Bitectiporidae; new species; ovicell; avicularium; Atlantic; Mediterranean



## Introduction

*Schizomavella* Canu and Bassler, 1917 is a speciose genus with about 36 Recent species reported from all over the world (Bock 2012, 2014). About six species are supposedly endemic to the Mediterranean Sea, where several 'varieties' have also been described; another six species are presumed to be distributed in the Atlantic and the Mediterranean.

The first record in the Adriatic of what would be the genus *Schizomavella* comes from Heller (1867). He recorded *Lepralia linearis* Hassall, 1841 encrusting a shell, collected on Hvar Island (Croatian coast), and the new species *Lepralia cornuta*, collected in the Kvarner region (Croatian coast). Since then, several authors have reported species of *Schizomavella*, mainly along the Croatian coast of the Adriatic Sea: Gräffe (1884), Hincks (1886, 1887), Brusina (1907), Friedl (1918), Kolosváry (1943), Igić (forthcoming 1975), McKinney (2000), McKinney and Jaklin (2000), Zavodnik et al. (2000), Hayward and McKinney (2002) and Novosel et al. (2004). Altogether, 13 species of *Schizomavella* have been reported in the Adriatic Sea, and these were summarised by Novosel and Požar-Domac (2001), Novosel (2007), Chimenz Gusso et al. (2007) and Rosso et al. (2010).

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However, the true identity of the species in many of these records is not always clear, owing to the widespread confusion surrounding the specific characters of some species, for instance: *Lepralia auriculata* Hassall, 1842, *Lepralia discoidea* Busk, 1859, *Lepralia hastata* Hincks, 1862, *Lepralia ochracea* Hincks, 1862, *Lepralia rudis* Manzoni, 1869, *Schizoporella auriculata* var. *cuspidata* Hincks, 1880, *Schizoporella auriculata* var. *asymetrica* Calvet, 1927, and *Smittina halimedae* Gautier, 1955 (see Hayward and Thorpe 1995; Reverter-Gil and Fernández-Pulpeiro 1996; López de la Cuadra and García-Gómez 2001; Hayward and McKinney 2002; Reverter-Gil et al. 2012).

Although several new species have been described in recent years, both in the Atlantic (Hayward and Thorpe 1995; Reverter-Gil and Fernández-Pulpeiro 1996; Reverter-Gil et al. forthcoming) and in the Mediterranean (Reverter-Gil and Fernández-Pulpeiro 1997; Hayward and McKinney 2002), and some species have been totally redescribed (Hayward and Thorpe 1995; López de la Cuadra and García-Gómez 2001; Hayward and McKinney 2002; Souto et al. 2013), the precise diversity of the genus *Schizomavella* is probably still poorly known, especially in the Mediterranean. Moreover, the morphology of the genus is not well understood yet. For instance, some species previously classified as belonging to *Schizomavella* have been recently redescribed and assigned to a new lanceoporid genus, *Stephanotheca* Reverter-Gil et al., 2012, owing to the structure of the ovicell and its closure. Other *Schizomavella* species, from the southwest Pacific, have been reassigned to the genera *Parkermavella* Gordon and d'Hondt, 1997 and *Calypthotheca* Harmer, 1957 (see Tilbrook 2006).

In the present paper we deal with *Schizomavella* material collected along the Croatian coast of the Adriatic Sea. Nine species were identified, including five species new to science. Previous records from the Adriatic are also revised and discussed. The presence of a calcified 'hood' covering the opesia of the suboral avicularium is described and its function is discussed. The morphological diversity of ovicells in the genus is compiled and discussed.

## Material and methods

The *Schizomavella* samples are part of a large Adriatic bryozoan collection held at the University of Zagreb. Bryozoans were systematically sampled by SCUBA diving, between 1997 and 2006, along the entire Croatian coast. Samples of *Schizomavella* species were found at 18 localities (Figure 1; Table 1). Material has been deposited at the Croatian Natural History Museum, Zagreb (CNHM), the Natural History Museum, London (NHMUK) and the Museo Nacional de Ciencias Naturales, Madrid (MNCN).

Other reference material in the Muséum National d'Histoire Naturelle, Paris (MNHN), the Natural History Museum, London (NHMUK), the Manchester Museum (MM) and the Musée Océanographique de Monaco (MOM) was revised. Material collected at Armaçao de Pêra (Algarve, S. Portugal) by H. De Blauwe, and from the Cassidaigne Canyon by J.G. Harmelin, was also examined.

Part of the material was treated with bleach and in an ultrasound bath in preparation for observations using a scanning electron microscope (SEM). SEM-generated images were taken using uncoated material with a Zeiss EVO LS15 and an FEI Inspect S50, with a back-scattered electron detector in low variable vacuum mode. Measurements were taken with the software ImageJ® on the SEM images.

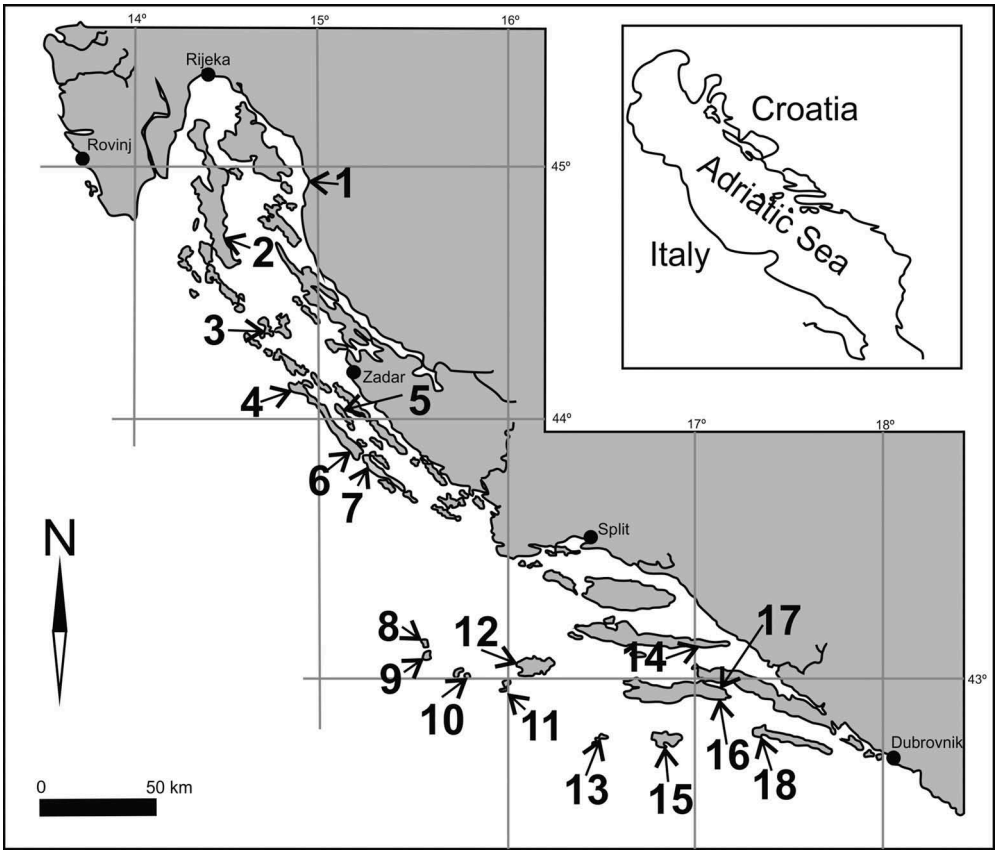


**Figure 1.** Adriatic Sea localities where *Schizomavella* species were found. 1 – Ždralova Bay (Velebit Channel); 2 – Ćutin Islet (Cres); 3 – Silba; 4 – Dugi otok (North); 5 – Iž Island; 6 – Dugi otok Vele stijene; 7 – Kornati; 8 – Jabuka Shoal; 9 – Jabuka Islet; 10 – Brusnik; 11 – Biševo; 12 – Vis (Komiža); 13 – Sušac; 14 – Hvar (Kozja); 15 – Lastovo; 16 – Korčula; 17 – Pelješac; 18 – Mljet.

## Results

Superfamily **SMITTINOIDEA** Levinsen, 1909
Family **BITECTIPORIDAE** MacGillivray, 1895
Genus ***Schizomavella*** Canu and Bassler, 1917
***Schizomavella cornuta*** (Heller, 1867)
(Figures 2, 3; Table 2)

*Lepralia cornuta* Heller, 1867: 110, pl. 6, fig. 6.
?*Lepralia auriculata* var. *leontiniensis* Waters, 1878: 8, pl. 1, fig. 5.
*Lepralia auriculata* var. *leontiniensis*: Waters 1879: 32, pl. 11, fig. 3.
*Schizoporella auriculata* var. *cuspidata* Hincks 1880: 261, pl. 29, fig. 8.
*Schizoporella auriculata* var. *spathulata* Hincks 1886: 270, pl. 10, fig. 8c.
*Schizomavella auriculata* var. *ornata* Canu and Bassler 1930: 35, pl. 3, figs 11–14.
*Schizomavella auriculata*: Gautier 1962: 132.
*Schizomavella auriculata* var. *leontiniensis*: Gautier 1962: 137.

**Table 1.** Adriatic Sea localities where *Schizomavella* species were found for the present study.

| Locality No. | Locality name | Coordinates | Depth (m) |
|---|---|---|---|
| 1 | Ždralova Bay (Velebit Channel) | 44.884317ºN, 14.890967ºE | 20–30 |
| 2 | Ćutin Islet (Cres) | 44.723930ºN, 14.493740ºE | 10–15 |
| 3 | Silba | 44.381567ºN, 14.663233ºE | 5–10 |
| 4 | Dugi otok (North) | 44.170417ºN, 14.805117ºE | 5–12 |
| 5 | Iž Island | 44.030780ºN, 15.111860ºE | 29 |
| 6 | Dugi otok Vele stijene | 43.904700ºN, 15.132567ºE | 20–40 |
| 7 | Kornati | 43.798700ºN, 15.274200ºE | 10–15 |
| 8 | Jabuka Shoal | 43.101000ºN, 15.436833ºE | 10–50 |
| 9 | Jabuka Islet | 43.091667ºN, 15.460000ºE | 5–25 |
| 10 | Brusnik | 43.004333ºN, 15.792667ºE | 10–20 |
| 11 | Biševo | 42.955200ºN, 16.004350ºE | 10–20 |
| 12 | Vis (Komiža) | 43.044300ºN, 16.072130ºE | 5–15 |
| 13 | Sušac | 42.766783ºN, 16.508833ºE | 10–20 |
| 14 | Hvar (Kozja) | 43.113740ºN, 17.049300ºE | 15–20 |
| 15 | Lastovo | 42.723780ºN, 16.884290ºE | 10–40 |
| 16 | Korčula | 42.949730ºN, 17.160260ºE | 15–40 |
| 17 | Pelješac | 42.946120ºN, 17.285220ºE | 5–10 |
| 18 | Mljet | 42.756400ºN, 17.383890ºE | 35–38 |



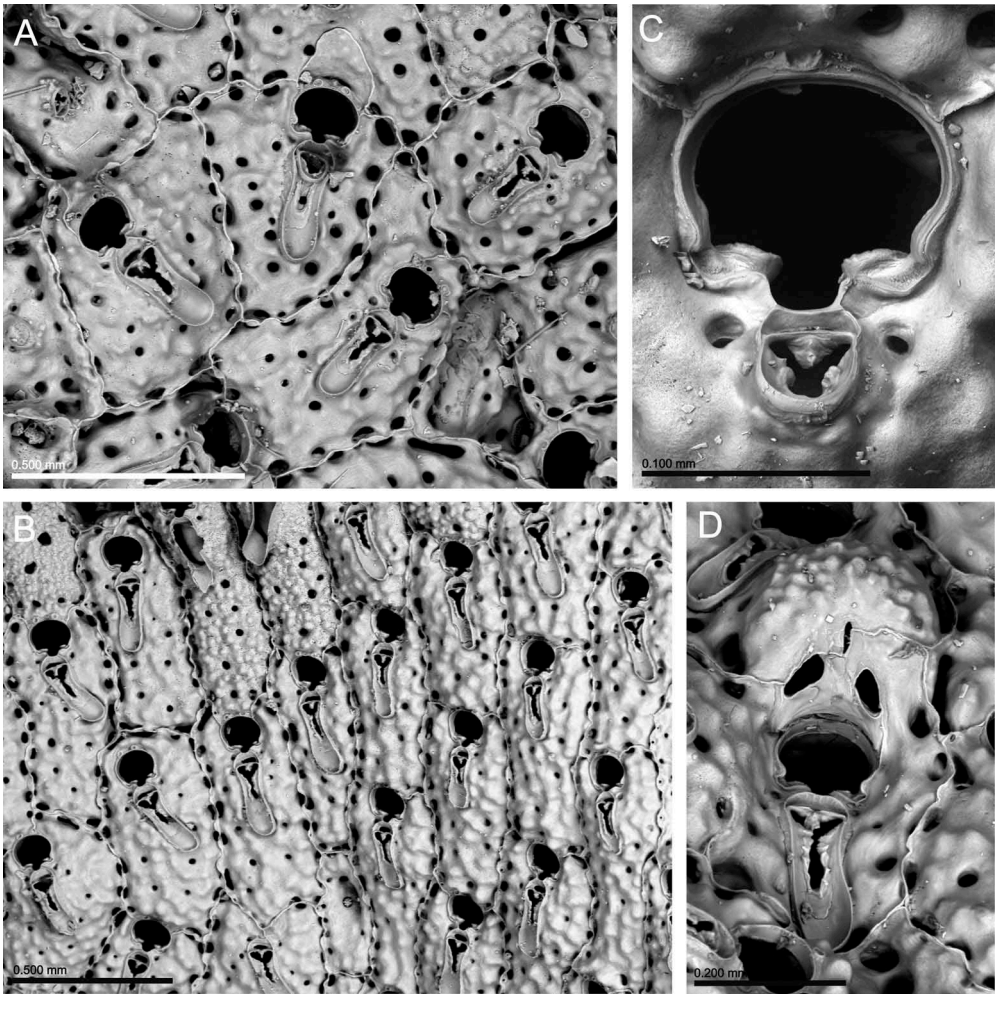


**Figure 2.** *Schizomavella cornuta*. (A, B) Autozooids with spatulate avicularia (MNCN 25.03/3888, St. 7, Kornati); (C) primary orifice with small suboral avicularium (MNCN 25.03/3898, St. 16, Korčula Island); (D) ovicellate zooid with spatulate avicularium (MNCN 25.03/3888, St. 7, Kornati).

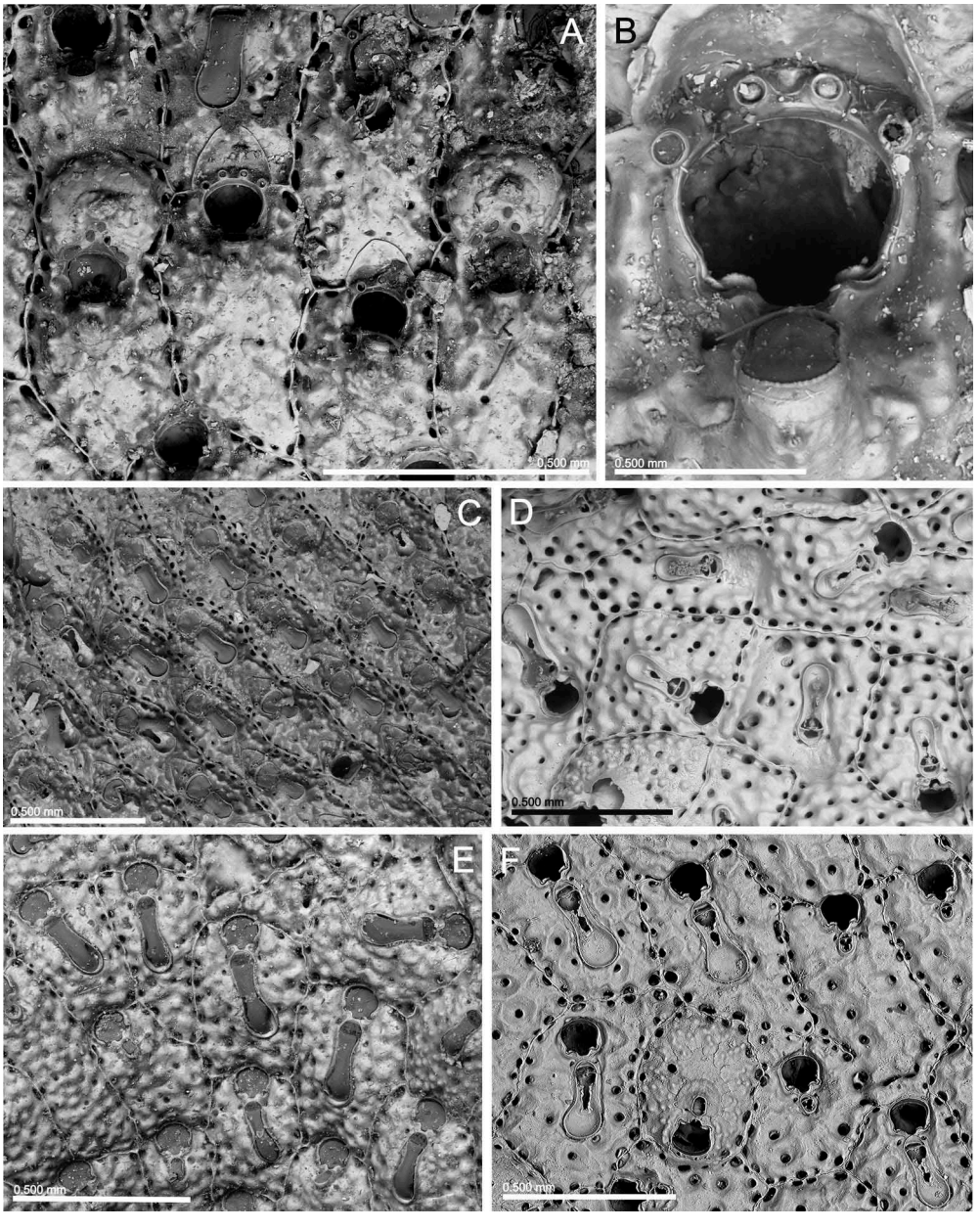


**Figure 3.** *Schizomavella cornuta*. (A) Ovicellate and non-ovicellate zooids (lectotype of *Schizomavella cuspidata*, NHMUK 1899.5.1.894); (B) (same) primary orifice; (C) a colony of *S. cuspidata* with spatulate avicularia, from Guernsey (NHMUK 1897.5.1.723); (D) *Schizoporella auriculata* var. *leontiniensis*, Taranto Bay (MM 3024); (E) type of *Schizomavella cuspidata* var. *spathulata*, Adriatic (NHMUK 1899.5.1.985) (F) type of *Schizomavella auriculata* var. *ornata*, Djerba (Tunisie).

*Schizomavella cuspidata*: Hayward and Thorpe 1995: 665, pl. 2; Reverter-Gil and Fernandez-Pulpeiro 1996: 263, fig. 4A–C (only); Hayward and Ryland 1999: 286, fig. 131 A, C (not 131B, D).

**Table 2.** Measurements (in mm) of *Schizomavella cornuta* (Kornati).

| | Mean | SD | Minimum | Maximum | N |
|---|---|---|---|---|---|
| Autozooid length | 0.653 | 0.2011 | 0.476 | 0.788 | 22 |
| Autozooid width | 0.332 | 0.0760 | 0.284 | 0.394 | 22 |
| Orifice length | 0.104 | 0.0222 | 0.092 | 0.114 | 22 |
| Orifice width | 0.121 | 0.0258 | 0.104 | 0.127 | 22 |
| Ovicell length | 0.225 | 0.0667 | 0.198 | 0.247 | 11 |
| Ovicell width | 0.266 | 0.0805 | 0.203 | 0.297 | 11 |
| Avicularium length | 0.223 | 0.0575 | 0.165 | 0.277 | 20 |
| Avicularium width | 0.078 | 0.0199 | 0.057 | 0.096 | 20 |

Note: SD, standard deviation; N, number of measurements.

*Schizomavella cornuta*: Hayward and McKinney 2002: 57, fig. 26 A–C; Novosel 2007: 62 (in part), fig. 26 E.

*Schizomavella gautieri*: Novosel 2007: 64.

Not *Schizoporella auriculata* var. *asymetrica* Calvet, 1927: 20, fig. 2. [= *Schizomavella asymetrica* (Calvet, 1927), see Hayward and McKinney, 2002].

Not *Schizomavella auriculata* var. *asymetrica*: Gautier 1962: 134. [= *Schizomavella asymetrica* (Calvet, 1927), see Hayward and McKinney, 2002].

Not *Schizoporella auriculata* var. *hirsuta* Calvet, 1927: 20. [= *Schizomavella hirsuta* (Calvet, 1927), see below].

Not *Schizomavella auriculata* var. *cuspidata*: Gautier 1962: 135.

Not *Schizomavella cornuta*: Novosel 2007: 62 (in part), fig. 26 F.

### *Material examined*

CNHM Inv. br. 52: St. 5, Iž Island, 44°03.078 N, 15°11.186 E, 2005, 29 m.

CNHM Inv. br. 53: St. 8, Jabuka Shoal (PJ-2), 43°06.060 N, 15°26.210 E, 28 August 2001, 19 m.

CNHM Inv. br. 54: St. 16, Korčula Island (Lucnjak), 42°94.973 N, 17°16.026 E, 24 April 2004, 15–20 m.

CNHM Inv. br. 55: St. 18, Mljet, 42°75.640 N, 17°38.389 E, June 2000, 35–38 m.

MNCN 25.03/3885: St. 1, Ždralova Bay, 44°53.059 N, 14°53.458 E, 07/05/2000, 35–40 m.

MNCN 25.03/3886: St. 2, Ćutin Islet (Cres), 44°72.393 N, 14°49.374 E, 7 October 2001, 1–12 m.

MNCN 25.03/3887: St. 4, Dugi otok, 44°10.225 N, 14°48.307 E, 12 July 2003, 30–40 m.

MNCN 25.03/3888: St. 7, Kornati (Mana), 43°47.922 N, 15°16.452 E, 10 July 2003, 10–20 m (Figure 2A, B, D).

MNCN 25.03/3889: St. 8, Jabuka Shoal (PJ-1), 43°06.060 N, 15°26.210 E, 27 August 2001, 24 m.

MNCN 25.03/3890: St. 8, Jabuka Shoal (PJ-2), 43°06.060 N, 15°26.210 E, 28 August 2001, 16 m.

MNCN 25.03/3891: St. 9, Jabuka Islet (J4), 43°05.500 N, 15°27.600 E, 29 August 2001, 10–15 m.

MNCN 25.03/3892: St. 10, Brusnik (BR-2), 43°00.260 N, 15°47.560 E, 30 August 2001, 10–20 m.

MNCN 25.03/3893: St. 11, Biševo (BI-01), 42°57.312 N, 16°00.261 E, 25 September 1998, 40 m.

MNCN 25.03/3894: St. 12, Vis (VS-02), 43°04.430 N, 16°07.213 E, 02 October 1998, 30 m.

MNCN 25.03/3895: St. 13, Sušac, 42°46.007 N, 16°30.530 E, 15 February 2006, 10–20 m.

MNCN 25.03/3896: St. 15, Lastovo Island (LA-3), 42°72.378 N, 16°88.429 E, 15 May 1998, 30 m.

MNCN 25.03/3897: St. 15, Lastovo Island (Struga), 42°72.378 N, 16°88.429 E, 07 March 2002, 30–35 m.

MNCN 25.03/3898: St. 16, Korčula Island (Lučnjak), 42°94.973 N, 17°16.026 E, 24 April 2004, 15–20 m (Figure 2C).

MNCN 25.03/3899: St. 18, Mljet, 42°75.640 N, 17°38.389 E, June 2000, 35–38 m.

### Other material examined

MM 2857, MM 3024: *Schizoporella auriculata* var. *leontiniensis*, Taranto Bay, Italy, RNS Washington, 11 September 1893, Waters coll.

NHMUK 1899.5.1.894: *Schizomavella cuspidata*, lectotype, Guernsey, Hincks coll.

NHMUK 1897.5.1.723: *Schizomavella cuspidata*, Guernsey, Hincks coll.

NHMUK 1899.5.1.985: *Schizomavella cuspidata* var. *spathulata*, type, Adriatic, Hincks coll.

MNHN-Paléontologie (no registration number): *Schizomavella auriculata* var. *ornata*, type, Djerba (Tunisie), Canu coll.

### Remarks

The Adriatic material studied in the present work fully matches the redescription of *Schizomavella cornuta* by Hayward and McKinney (2002).

*Schizomavella cuspidata* (Hincks 1880) was for a long time confused with *S. auriculata*, until the redescription of both species by Hayward and Thorpe (1995). Many varieties of *S. cuspidata* were described from the western Mediterranean (see e.g. Calvet 1927; Canu and Bassler 1930; Gautier 1962), which have been considered by Reverter-Gil and Fernández-Pulpeiro (1996) as belonging to morphotypes of this species without taxonomic relevance. Later, Hayward and McKinney (2002) revised samples from the Heller collection, and found that the material of *Lepralia cornuta* was identical to *S. cuspidata* s. l., and consequently they renamed it as *Schizomavella cornuta; S. cuspidata* is a junior synonym. However, it is not definitively clear if *S. auriculata* var. *cuspidata* s. s. and *L. cornuta* are actually conspecific. We have examined samples labelled as *S. cuspidata* from both the Atlantic and Mediterranean, including the lectotype of *S. cuspidata* (see Figure 3). As stated by previous authors, the frequency of enlarged avicularia and the degree of development of the suboral umbo are rather variable in different colonies; the width of the sinus is also variable. Hincks (1880) characterised his var. *cuspidata* (from Guernsey, English Channel) as having a conspicuous spike-like process on the front of the ovicell, and a very prominent avicularium. The lectotype specimen has a wide sinus with small condyles; only a few avicularia are enlarged, most of the time they are small, steeply inclined or even perpendicular to the frontal plane (Figure 3A, B). Notwithstanding, in other Atlantic material (e.g. NHMUK 1897.5.1.723, from Guernsey, Figure 3C) the condyles appear larger, the proximolateral corners of the orifice are more marked and the avicularia are more frequently enlarged; all of these characters seem to be more similar to the Mediterranean material of *S. cuspidata*.

On the other hand, Waters (1878) described *Lepralia auriculata* var. *leontiniensis* from the Pliocene of Bruccoli (Sicily) which Reverter-Gil and Fernández-Pulpeiro (1996) considered to be a senior synonym of *S. cuspidata*. However, the identity of Waters' variety is unclear. Original material could not be checked, while the original

figure (Waters 1878, fig. 5) seems to show a different-shaped orifice, and avicularia somewhat triangular in shape and frequently detached from the orifice, thus resembling *Stephanotheca arrogata* (Waters, 1879) (see Reverter-Gil et al. 2012). However, the record of var. *leontiniensis* made by Waters (1879) from Taranto Bay, Naples, does seem to correspond to *S. cornuta*. Original material no longer exists in the Waters collection, but we have examined two specimens (MM 2857, MM 3024, Figure 3D) that came from the same locality, first assigned to *Schizoporella auriculata* var. *ornata* but later changed to var. *leontiniensis*. Years later, Hincks (1886) defined *Schizoporella auriculata* var. *spathulata* from the Adriatic as having an enlarged suboral avicularium. Having re-examined the type material (Figure 3E), we believe that this variety is conspecific with *S. cornuta*.

The 'umbonate' form of *S. cuspidata* seems to be absent from the Mediterranean. Previous records of similar material from this area (Gautier 1962, as *S. auriculata* var. *cuspidata*; revised by Reverter-Gil and Fernández-Pulpeiro 1996), actually belong to a different species (see *S. mystacea* sp. nov. below). A thorough revision of material assigned to *S. cuspidata*, and related species from the Atlanto–Mediterranean region will be necessary to ascertain the conspecificity of *S. auriculata* var. *cuspidata* and *L. cornuta*, if at all, but this is outside the constraints of the present paper. Therefore, we provisionally accept the synonymy proposed by Hayward and McKinney (2002).

Hayward and McKinney (2002) stated that in *S. cornuta*, both small and enlarged avicularia show a distinct Y-shaped foramen, but this shape is actually also present in other species (see below *Schizomavella mystacea* sp. nov. and *Schizomavella rosae* sp. nov.). According to Hayward and Thorpe (1995) and Hayward and Ryland (1999) this distinct foramen shape is only present in enlarged avicularia.

On the other hand, Hayward and McKinney (2002) also stated that the specimen figured by Hayward and Ryland (1999, fig. 131D) is not *S. cornuta*, but rather *S. asymetrica* (Calvet, 1927). We have examined the figured sample (NHMUK 1911.10.1.1538, Norman coll., British), and consider it to be *Schizomavella teresae* Reverter-Gil and Fernández-Pulpeiro, 1996, a species already reported from the British Isles. However, another figured specimen (Hayward and Ryland, 1999, fig. 131B) does belong to *S. asymetrica*.

*Schizomavella cornuta* seems to be common on the northwest European coast. Its distribution in the Mediterranean, where it has been often reported as *S. auriculata* (see Reverter-Gil and Fernández-Pulpeiro 1996), is imprecisely known owing to the frequency of its confusion with other species. That being said, *S. cornuta* must be common in the western Mediterranean as it was the most common species among the Adriatic material studied here.

## ***Schizomavella mystacea*** sp. nov.
(Figures 4, 5; Table 3)

*Schizomavella auriculata* var. *cuspidata* (Hincks): Gautier 1962: 135 (in part or whole).
*Schizomavella cuspidata*: Reverter-Gil and Fernández-Pulpeiro 1996: 267 (in part: only fig. 4F).
*Schizomavella cornuta*: Novosel 2007: 62 (in part).

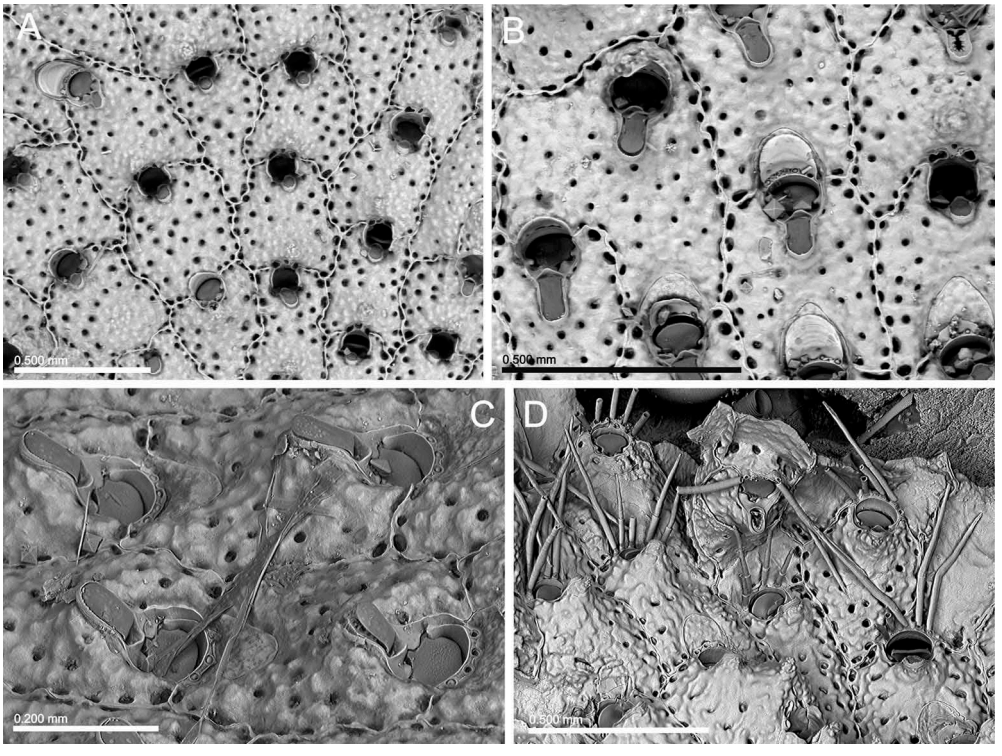


**Figure 4.** *Schizomavella mystacea* sp. nov. (A, B) Ovicellate and non-ovicellate autozooids with variably developed avicularia (CNHM Inv. br. 34, holotype, St. 8, Jabuka Shoal); (C) (same) lateral view of inclined avicularia and the calcified 'hood'; (D) autozooids with long oral spines (MNCN 25.03/3900, paratype, Algarve).

? *Schizomavella auriculata* var. *cuspidata*: Zabala 1986: 466, pl. 12, fig. D; Zabala and Maluquer 1988: pl. 16, fig. B.

? *Schizomavella cornuta*: Hayward and McKinney 2002: fig. 26D.

Not *Schizomavella cornuta*: Hayward and McKinney 2002: 57, fig. 26 A–C; Novosel 2007: 62 (in part).

Not *Schizomavella cuspidata*: Hayward and Thorpe 1995: 665, pl. 2; Hayward and Ryland 1999: 286, fig. 131.

### *Type material*

***Holotype.*** CNHM Inv. br. 34: St. 8, Jabuka Shoal (PJ-2), 43°06.060 N, 15°26.210 E, 28 August 2001, 32 m, several fragments on algae (Figures 4A–C, 5 B–D, F).

***Paratypes.*** CNHM Inv. br. 35: St. 8, Jabuka Shoal (PJ-2), 43°06.060 N, 15°26.210 E, 28 August 2001, 32 m, two fragments.

MNCN 25.03/3900: Armaçao de Pêra (Algarve, S. Portugal) two ovicellate colonies (marked in red and black) on a stone collected in fishing nets (together with 21 species more; Figures 4D and 5A, E, G).

NHMUK 2015.3.4.1: St. 11, Biševo (B1-01), 42°57.312 N, 16°00.261 E, 25 September 1998, 30 m.

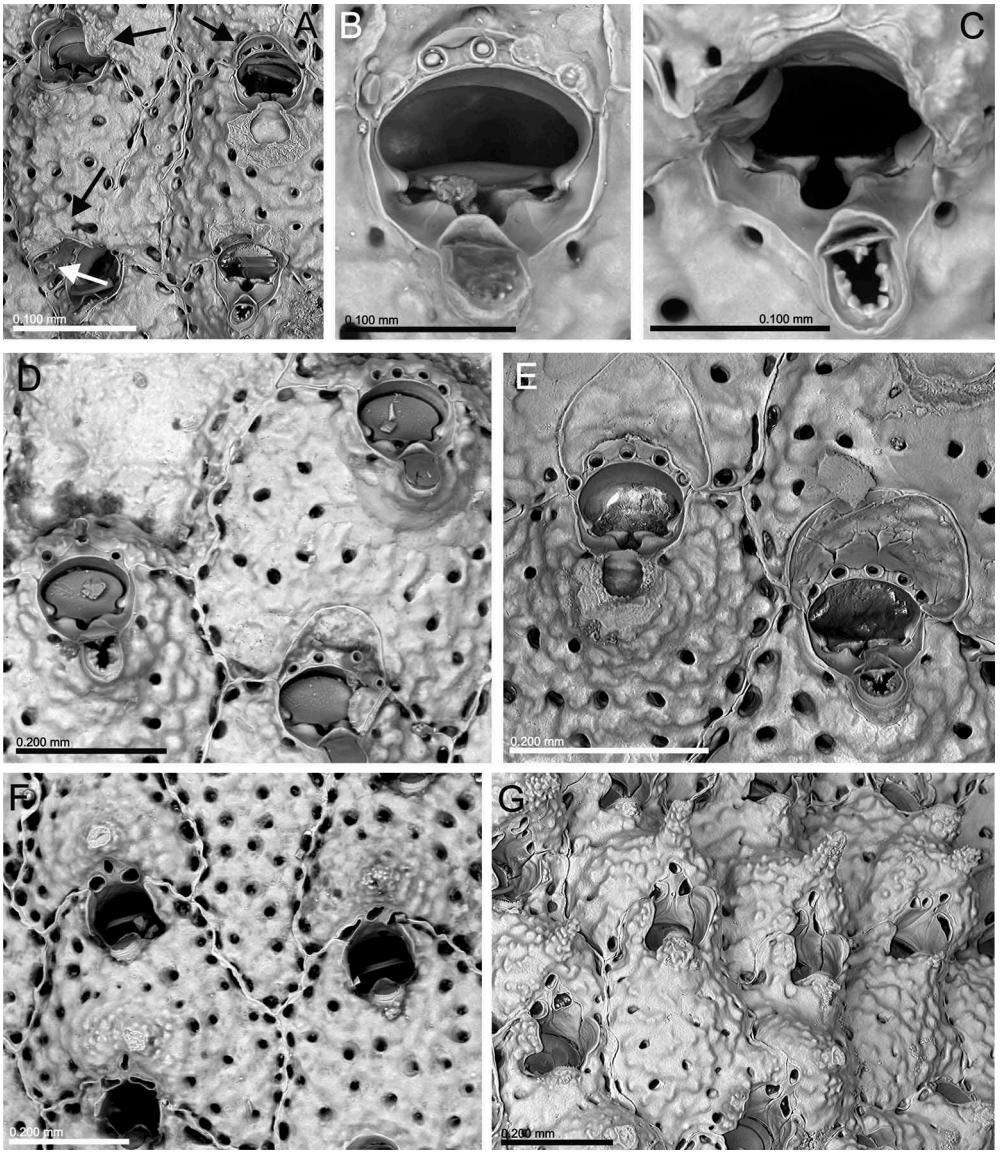


**Figure 5.** *Schizomavella mystacea* sp. nov. (A) Non-ovicellate zooids with a projecting arch distal to the orifice (black arrows), one of them with an inner avicularium (white arrow; MNCN 25.03/3900, paratype, Algarve); (B) zooidal orifice with the bases of five spines, operculum and avicularian mandible (CNHM Inv. br. 34, holotype, St. 8, Jabuka Shoal); (C) (same) zooidal orifice showing the broad, triangular condyles, and Y-shaped palatal foramenof the rostrum; (D) (same) primary orifices and avicularia, holotype; (E) primary orifices and avicularia, Algarve (MNCN 25.03/3900, paratype); (F) ovicellate zooids, holotype (CNHM Inv. br. 34, St. 8, Jabuka Shoal); (G) ovicellate zooids, Algarve; note the lateral lappets and the development of the median prominence (MNCN 25.03/3900, paratype).

**Table 3.** Measurements (in mm) of *Schizomavella mystacea* sp. nov. (holotype).

| | Mean | SD | Minimum | Maximum | N |
|---|---|---|---|---|---|
| Autozooid length | 0.457 | 0.0493 | 0.377 | 0.614 | 24 |
| Autozooid width | 0.362 | 0.0459 | 0.263 | 0.440 | 24 |
| Orifice length | 0.064 | 0.0062 | 0.057 | 0.076 | 11 |
| Orifice width | 0.100 | 0.0074 | 0.088 | 0.115 | 11 |
| Ovicell length | 0.172 | 0.0138 | 0.158 | 0.208 | 13 |
| Ovicell width | 0.205 | 0.0142 | 0.183 | 0.232 | 13 |
| Avicularium length | 0.100 | 0.0216 | 0.074 | 0.130 | 11 |
| Avicularium width | 0.046 | 0.0066 | 0.037 | 0.062 | 11 |

Note: SD, standard deviation; N, number of measurements.

### Other material examined

MNHN 11176: St. 222, 15 December 1951, Cap Caveaux (Marseille), Gautier Coll.

MNHN 11218: St. 125, 2 June 1950, Entre Saunet et Carry (Marseille), Gautier Coll.

MNHN IB-2013–558: Cassidaigne Canyon, PU 4 B2, 230 m. Harmelin Coll. Two dead ovicellate colonies on a shell fragment.

### Diagnosis

Primary orifice short, with very conspicuous proximal notches, surrounded by an even gymnocystal rim including the distalmost part of the suboral avicularium; three to five oral spines; subrectangular suboral avicularium, proximally directed, sometimes slightly laterally displaced, with a distalmost calcified 'hood'; palatal foramen Y-shaped; non-ovicellate zooids with a projecting arch distal to the orifice, formed by the secondary calcification of the distal/succeeding zooid(s), rarely developing a small avicularium; ovicell imperforate, with a central umbo and three large, elongate pores just above the orifice; ovicellate zooid developing lateral lapets.

### Etymology

From Latin *mystax* (= moustache), alluding to the shape of the proximolateral notches in the primary orifice.

### Description

Colony encrusting, unilaminar to multilaminar, developing as small, irregular crusts.

Autozooids rectangular or irregularly polygonal, in radial series, separated by fine, raised sutures; frontal shield nodular, irregularly perforated by 10–20 pores, plus a row of conspicuous areolar pores. A smaller obvious pore either side of the suboral avicularium, placed just below the rim of the primary orifice, sometimes partially concealed by secondary calcification. In young, marginal autozooids, the frontal wall is slightly convex, distally raised to form a slight suboral umbo with which the avicularian cystid is associated; in older, more heavily calcified, zooids, the frontal wall thickens until it reaches the same level as the top of the peristome, so flattening the zooid's appearance.

Primary orifice deeply immersed, the poster tilted basalwards in well-calcified zooids; horseshoe-shaped, much wider than long, its greatest width at midlength; median sinus small, U-shaped, occupying one third of the proximal border. Lateral borders of the primary orifice distinctly curved inwards, describing deep, sharp notches in the proximal corners, accentuated by the edges of the thick, broad, triangular condyles which extend medially beyond the bounds of the sinus. Primary orifice surrounded by a smooth, fine

and slightly raised rim, which encompasses the distal end of the suboral avicularium. Non-ovicellate zooids with a projecting arch distal to the orifice, formed by the secondary calcification of the succeeding zooid, rarely developing a small avicularium (Figure 5A). Three to five (usually four) oral spines, as long as an autozooid, but frequently broken. Zooid lateral walls with small uniporous septula, placed in rows near the basal wall.

Avicularium median suboral, just proximal to the sinus and sometimes concealing it, or occasionally slightly displaced laterally; elongate, subrectangular, proximally directed, inclined at an angle or even perpendicular to the plane of the orifice; edge of the rostrum sometimes finely denticulated; complete crossbar with a median columella. The distalmost part of the avicularium (the opesia) is placed within the rim of the primary orifice, and covered by a raised, calcified, opesial 'hood'. Rostrum with Y-shaped palatal foramen, with several sharp denticles on the inner edges.

Ovicell not closed by the zooidal operculum, recumbent on succeeding autozooid, covered by a nodular, imperforate secondary calcification, developing a median prominence, sometimes very acute and pronounced. A small, proximal area, immediately above the aperture, with three (rarely four) rounded or elongate pseudopores, frequently two proximal, horizontally orientated, and one medial, smaller, vertically orientated. Ovicellate zooids developing lateral lappets, extending to the ooecium and continuous with the ovicell outer calcification.

Ancestrula unknown.

### *Remarks*

The set of characters of *Schizomavella mystacea* sp. nov. outlined above clearly differentiates this species from the others described in herein.

*Schizomavella mystacea* sp. nov. was first recorded by Gautier (1962) as *S. auriculata* var. *cuspidata* and by Reverter-Gil and Fernández-Pulpeiro (1996, in part) as *S. cuspidata*. As stated above, *S. cuspidata* was considered a junior synonym of *S. cornuta* by Hayward and McKinney (2002), who redescribed the species and designated a neotype, a conclusion with which we tentatively agree. *Schizomavella mystacea* sp. nov., however, differs from the redescription of *S. cornuta* as well as from the lectotype of *S. cuspidata* mainly in terms of its primary orifice morphology. The primary orifice in *S. mystacea* sp. nov. is much wider than long, with extremely marked lateral notches; the larger condyles, extending beyond the edges of the sinus; the development of a smooth, thin, even rim around the primary orifice, including the distalmost part of the avicularium; the projecting proximal arch of autozooids distal to the orifice of infertile zooids; the avicularium variable in length, but never enlarged or spatulate, and with its distalmost portion (opesia) covered by a calcified 'hood'; finally, in well-calcified, ovicellate zooids, the rim of the orifice produces two well-developed lateral lappets (Figure 5G). This final character is also seen in the figures by Hayward and McKinney (2002, fig. 4D), Zabala (1986, pl. 12, fig. D), and Zabala and Maluquer (1988, pl. 16, fig. B), but as the primary orifice is not clearly seen in these illustrations we cannot be sure about the identification of the material. Finally, the number of pores in the frontal shield is higher in *S. mystacea* sp. nov. than in *S. cornuta*, while its ovicell has three large, elongate pores, against c. five in *S. cornuta*.

The Atlantic species *S. auriculata* also often has lateral lappets in ovicellate zooids, though these are less developed than in *S. mystacea* sp. nov., but it differs in several other characters, most notably the shape of the primary orifice and the orificial condyles.

The Mediterranean species *Schizomavella gautieri* Reverter-Gil and Fernández-Pulpeiro, 1997 also develops a stout suboral umbo and a very conspicuous rim around the orifice, but this species differs from *S. mystacea* sp. nov. mainly in the shape of the primary orifice (subquadrate, with distinct shoulders on each side of the sinus), smaller condyles and the absence of proximolateral orificial notches.

In six of the seven *S. mystacea* sp. nov. colonies studied, most of the zooids are ovicellate. Only in specimen MNHN 11218, a multilaminar colony with zooids chaotically arranged, are ovicells infrequent. In other species of the genus, ovicellate zooids are, in general, more scarcely produced. Non-ovicellate zooids of *S. mystacea* sp. nov. have a projecting arch distal to the orifice, formed by the secondary calcification of the succeeding zooid(s) (Figures 4B, 5A). In material from the Algarve, this projection may rarely develop a small, inner avicularium (Figure 5A). This morphology has not been seen in any other European species of *Schizomavella*.

Besides the Adriatic material, we have identified two colonies of *S. mystacea* sp. nov. in the Gautier Collection collected from Marseille, a dead colony collected in the Cassidaigne Canyon at 230 m depth, and a colony collected in the Algarve (S. Portugal). Therefore, *S. mystacea* sp. nov. is present in the western Mediterranean, extending from the Adriatic Sea to the Gulf of Cadiz. It thus follows that *S. mystacea* sp. nov. may have been recorded in this area previously, perhaps as *S. auriculata*, with which it has previously been confused (as *S. cuspidata*; see Hayward and Thorpe 1995; Reverter-Gil and Fernández-Pulpeiro 1996), or as any of their varieties.

## ***Schizomavella rosae*** sp. nov.
(Figure 6; Table 4)

*Schizomavella cornuta*: Novosel 2007: 62 (in part), fig. 26F.

### *Type material*
*Holotype*. CNHM Inv. br. 36: St. 8, Jabuka Shoal (PJ-1), 43°06.060 N, 15°26.210 E, 27 August 2001, 34 m depth, several fragments of one colony on *Smittina cervicornis* (Pallas 1766) (Figure 6).

### *Diagnosis*
Primary orifice rounded trapezoidal, its greatest width across the distal quarter; sinus small, quadrate or U-shaped, occupying one quarter of the proximal border; condyles small, smooth, distal edges of which are angled towards the edges of the sinus. Orifice surrounded by a fine, even rim, describing deep, rounded notches in the proximolateral corners. Three to five long, stout, hollow oral spines; avicularium median suboral, small, close to proximal orifice rim and continuous with it.

### *Etymology*
Named in honour of the senior author's mother, Rosa Mª Gil Carnicer.

### *Description*
Colony encrusting, unilaminar, developing as a small irregular crust.

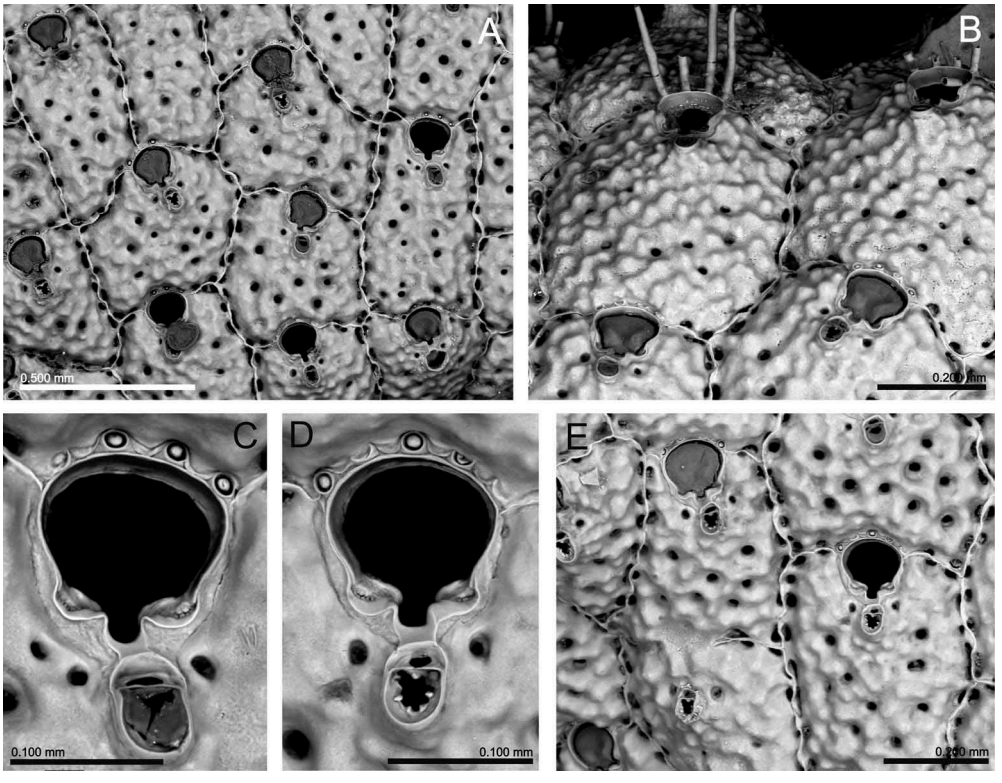


**Figure 6.** *Schizomavella rosae* sp. nov. (CNHM Inv. br. 36, holotype, St. 8, Jabuka Shoal). (A) Group of zooids; (B) development of oral spines; (C, D) primary orifices; (E) autozooids and a kenozooid with adventitious avicularium.

**Table 4.** Measurements (in mm) of *Schizomavella rosae* sp. nov. (holotype).

| | Mean | SD | Minimum | Maximum | N |
|---|---|---|---|---|---|
| Autozooid length | 0.504 | 0.0691 | 0.397 | 0.628 | 16 |
| Autozooid width | 0.352 | 0.0517 | 0.274 | 0.456 | 16 |
| Orifice length | 0.106 | 0.0061 | 0.095 | 0.118 | 16 |
| Orifice width | 0.115 | 0.0050 | 0.101 | 0.122 | 16 |
| Avicularium length | 0.061 | 0.0088 | 0.037 | 0.074 | 16 |
| Avicularium width | 0.037 | 0.0032 | 0.030 | 0.045 | 16 |

Note: SD, standard deviation; N, number of measurements.

Autozooids in radial series, separated by fine, raised sutures; rectangular to polygonal, slightly convex. Frontal shield nodular, irregularly perforated by five to 11 rounded pores, plus a row of especially conspicuous areolar pores. A smaller pore (occasionally two) on each side of the distal portion of the suboral avicularium.

Primary orifice rounded trapezoidal, slightly wider than long, its greatest width across the distal quarter; sinus small, quadrate or U-shaped, occupying one quarter of the proximal border; condyles small, smooth, distal edges angled towards the edges of the sinus. Orifice surrounded by a fine, even rim, producing deep rounded notches in the proximal corners.

Three to five (usually four) long, stout, hollow, oral spines, frequently broken.

Avicularium median suboral; small, monomorphic; slightly inclined to frontal shield on a small prominence; close to proximal orifice rim and continuous with it; rostrum subrectangular, proximally directed; crossbar complete with a small median columella; the edges of the foramen in the rostral palate with several sharp denticles on the inner edges.

Kenozooids rare; small, irregularly shaped, occupying spaces between autozooids, provided with an avicularium, similar in size, shape, and orientation to those of the autozooids.

Zooid lateral walls with small uniporous septula, placed in rows near the basal wall. Ovicell not observed. Ancestrula unknown.

### *Remarks*

*Schizomavella rosae* sp. nov. shows close similarities with two other species of the genus: the Atlantic *Schizomavella hondti* Reverter-Gil and Fernández-Pulpeiro, 1996 and the Mediterranean *Schizomavella triangularis* Reverter-Gil and Fernández-Pulpeiro, 1997.

*Schizomavella hondti* has an orifice with a much narrower proximal border and a smaller sinus; the condyles are larger, rhomboidal, with faceted surfaces. The suboral avicularium in this species is smaller, oval and lacks a palate; moreover, although it is placed near the sinus it remains unattached to the orificial rim.

*Schizomavella triangularis* also possesses a suboral avicularium connected with the orificial rim, but it can be distinguished from *S. rosae* sp. nov. by its roughly triangular primary orifice with its denticulate internal borders, the large condyles extending beyond the edges of the sinus, and the frontal shield perforated by numerous pores.

*Schizomavella rosae* sp. nov. also shows superficial similarities to *S. cornuta*, such as the shape of the orifice and their proximal notches, and the Y-shaped avicularian foramen, which was considered by Hayward and McKinney (2002) as characteristic of the latter species. However, *S. cornuta* produces zooidal orifices that are much wider than long, widest midway, the sinus is wider, and the condyles are oval, with lateral notches and rough distal edge. Finally, *S. cornuta* produces polymorphic avicularia, which can either be orientated perpendicular to the frontal wall on a suboral umbo or enlarged spatulate, proximally directed and recumbent of the frontal shield, although both are directly in contact with the sinus of the orifice.

## ***Schizomavella halimedae*** (Gautier, 1955)
(Figure 7; Table 5)

*Schizoporella discoidea*: Hincks 1887: 303.

*Smittina halimedae* Gautier, 1955: 252, pl. 3, figs 18, 19.

*Schizomavella discoidea*: Gautier 1962: 138 (in part), fig. 13; Hayward and Ryland 1999: 280 (in part), fig. 126D; Zabala 1986: 470, text-fig. 159, pl. 12, figs E, F; Zabala and Maluquer 1988: 130, text-fig. 296, pl. 16, fig. F; Novosel 2007: 62, fig. 27A, B.

*Schizomavella halimedae*: López de la Cuadra and García Gómez 2001: 1720, fig. 2A, B, table 2; Novosel 2007: 64, fig. 27C, D.

### *Material examined*

CNHM Inv. br. 56: St. 7, Kornati (Strižnja), 43°47.922 N, 15°16.452 E, 09 July 2003, 10–15 m.

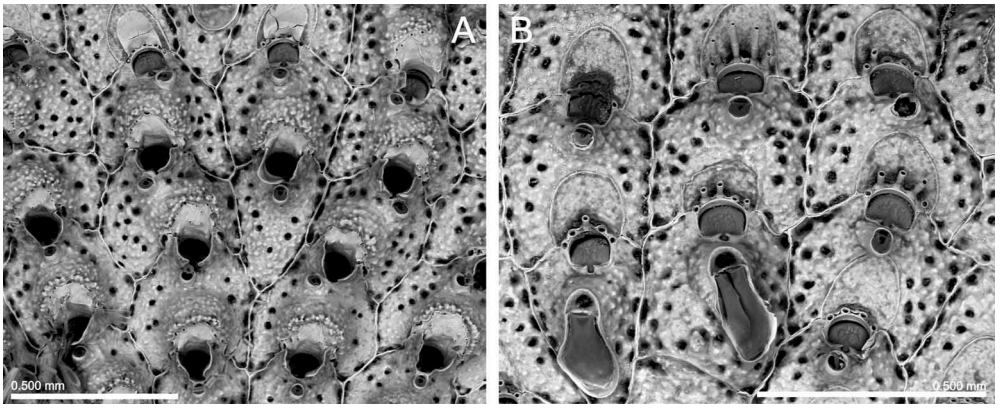


**Figure 7.** *Schizomavella halimedae* (MNCN 25.03/3904, St. 14, Hvar Island). (A) Group of ovicellate zooids with small avicularia; (B) autozooids with oral spines and spatulate avicularia.

**Table 5.** Measurements (in mm) of *Schizomavella halimedae* (Hvar Island and Lastovo).

| | Mean | SD | Minimum | Maximum | N |
|---|---|---|---|---|---|
| Autozooid length | 0.376 | 0.0428 | 0.309 | 0.495 | 24 |
| Autozooid width | 0.313 | 0.0493 | 0.221 | 0.390 | 24 |
| Orifice length | 0.078 | 0.0074 | 0.064 | 0.092 | 24 |
| Orifice width | 0.091 | 0.0038 | 0.076 | 0.106 | 24 |
| Ovicell length | 0.174 | 0.0132 | 0.151 | 0.196 | 17 |
| Ovicell width | 0.208 | 0.0183 | 0.172 | 0.244 | 17 |
| Avicularium length | 0.050 | 0.0053 | 0.041 | 0.060 | 13 |
| Avicularium width | 0.041 | 0.0034 | 0.035 | 0.046 | 13 |
| Spatulate avic. length | 0.245 | 0.0080 | 0.236 | 0.257 | 5 |
| Spatulate avic. width | 0.073 | 0.0046 | 0.068 | 0.080 | 5 |

Note: SD, standard deviation; N, number of measurements.

CNHM Inv. br. 57: St. 8, Jabuka Shoal (PJ-2), 43°06.060 N, 15°26.210 E, 28 August 2001, 32 m.

CNHM Inv. br. 58: St. 8, Jabuka Shoal, 43°06.060 N, 15°26.210 E, 27 August 2001, 40–50 m.

CNHM Inv. br. 59: St. 9, Jabuka Islet (J4), 43°05.500 N, 15°27.600 E, 29 August 2001, 10–20 m.

CNHM Inv. br. 60: St. 15, Lastovo Island (Vrhovine, LA-3), 42°72.378 N, 16°88.429 E, 15 May 1998, 30–40 m.

CNHM Inv. br. 61: St. 15, Lastovo Island (Skrivena luka), 42°72.378 N, 16°88.429 E, 05 March 2002, 10–20 m.

MNCN 25.03/3901: St. 7, Kornati (Strižnja), 43°47.922 N, 15°16.452 E, 09 July 2003, 10–15 m.

MNCN 25.03/3902: St. 11, Biševo (Gatula), 42°57.312 N, 16°00.261 E, 14 February 2006, 10–20 m.

MNCN 25.03/3903: St. 12, Vis (Komiža Bay), 43°04.430 N, 16°07.213 E, 01 September 2001, 5–15 m.

MNCN 25.03/3904: St. 14, Hvar Island (Kozja), 43°11.374 N, 17°04.930 E, 02 April 2005, 15–20 m (Figure 7).

MNCN 25.03/3905: St. 15, Lastovo Island (Vrhovine, LA-3), 42°72.378 N, 16°88.429 E, 15 May 1998, 30–40 m.

MNCN 25.03/3906: St. 15, Lastovo Island (LA-4), 42°72.378 N, 16°88.429 E, 15 May 1998, 20–25 m.

### *Remarks*

The Adriatic material studied in the present work fully matches the redescription of *S. halimedae* made by López de la Cuadra and García-Gómez (2001) who clearly separated it from the very similar species *S. discoidea* (Busk, 1859).

*Lepralia discoidea* was originally described from Madeira, but it is thought that other records from the European continental shelf may correspond to at least one new undescribed species. López de la Cuadra and García-Gómez (2001) also stated that many previous records of *S. discoidea* in the Mediterranean are probably referable to *S. halimedae*, a species restricted to the inner Mediterranean. However, *S. discoidea* s. l. seems to be also present at least in the western Mediterranean, as well as in the Atlantic, so its presence in the Adriatic is not impossible.

## ***Schizomavella tubulata*** sp. nov.

(Figure 8; Table 6)

### *Type material*

***Holotype.*** CNHM Inv. br. 37: St. 16, Korčula Island (Sika), 42°94.973 N, 17°16.026 E, 24 April 2004, 30–40 m depth, one colony on a shell (Figure 8).

### *Diagnosis*

Primary orifice rounded, with distal and lateral edges forming a continuous curve; no proximolateral notches; surrounded laterally and proximally by a fine, raised peristome, containing the suboral avicularium; sinus small, U-shaped, occupying one third of the proximal border; condyles broad and thick; four or five stout, hollow, oral spines; avicularium almost perpendicular to frontal plane, enlarged and slightly spatulate; basal (distalmost) portion of the avicularium (opesia) covered by a raised, calcified opesial 'hood'; ovicell globose, its distal half covered by a thick, imperforate cover of secondary calcification, and a crescent-shaped proximal area of exposed ectooecium perforated by several rounded pseudopores; ovicellate zooids with a tubular peristome, totally incorporating the avicularian cystid.

### *Etymology*

Alluding to the tubular peristome developed in ovicellate zooids.

### *Description*

Colony encrusting, unilaminar, developing as a small subcircular crust.

Autozooids oval or irregularly polygonal, separated by fine sutures, in linear series or losing orientation (perhaps evidence of partial overgrowth or the start of a multilaminar growth).

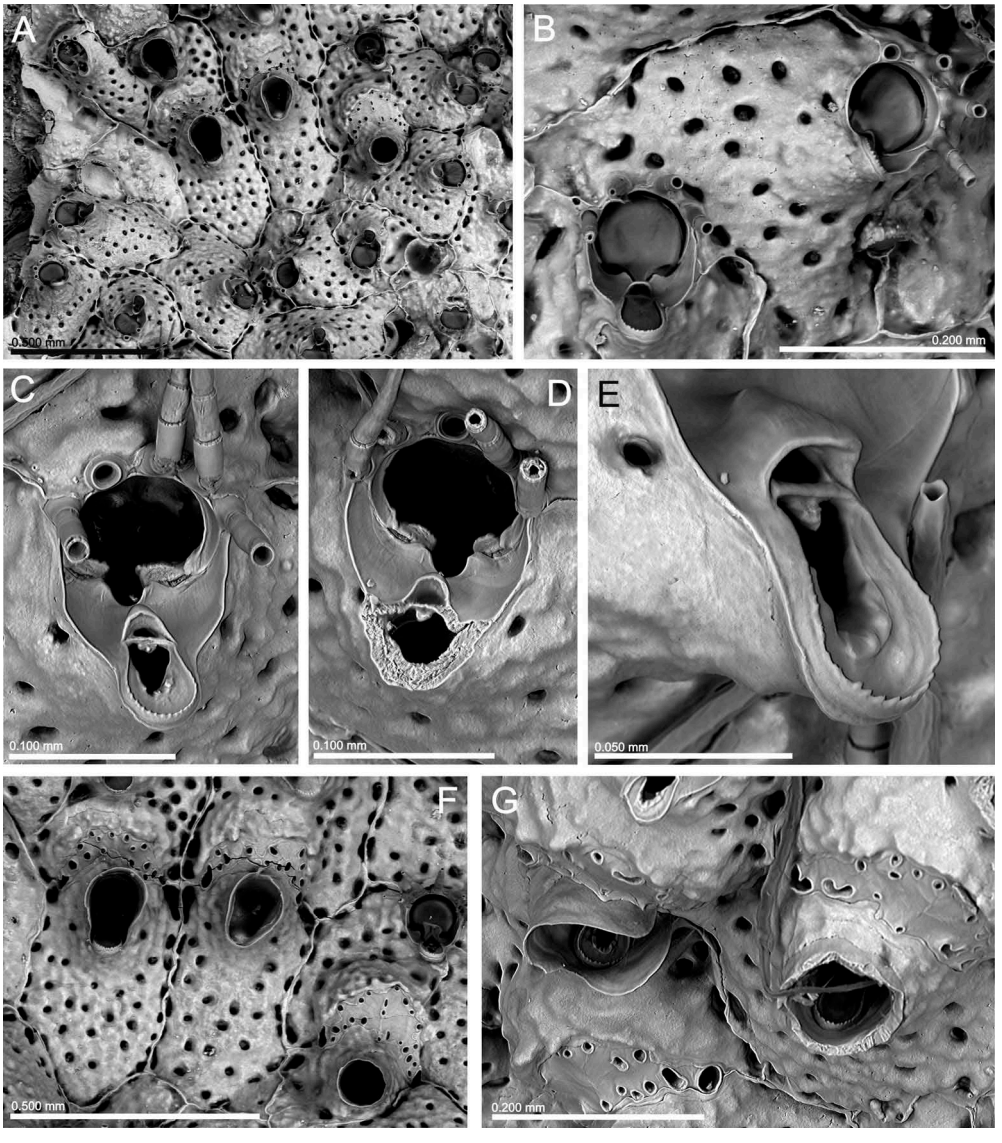


**Figure 8.** *Schizomavella tubulata* sp. nov. (CNHM Inv. br. 37, holotype, St. 16, Korčula Island). (A) Part of the colony; (B) two autozooids showing the opercula, peristome, spines and suboral avicularia with serrated distal edge; (C, D) primary orifices without operculum; (E) suboral avicularium showing the calcified 'hood'; (F) ovicellate zooids; (G) suboral avicularia within the tubular peristome of ovicellate zooids.

Frontal shield slightly nodular, convex, distally raised to form a small suboral prominence; perforated by 12–18 rounded pores, plus a row of elongated areolar pores; a smaller pore (occasionally two) on each side of the suboral avicularium.

Primary orifice rounded, slightly wider than long; distal and lateral edges forming a continuous curve; sinus small, U-shaped, occupying one third of the proximal border; condyles broad and thick, emphasising the sinus and reaching the corners of the orifice (i.e. there are no proximolateral notches).

**Table 6.** Measurements (in mm) of *Schizomavella tubulata* sp. nov. (holotype).

| | Mean | SD | Minimum | Maximum | N |
|---|---|---|---|---|---|
| Autozooid length | 0.409 | 0.0607 | 0.321 | 0.491 | 10 |
| Autozooid width | 0.279 | 0.0360 | 0.211 | 0.328 | 10 |
| Orifice length | 0.072 | 0.0017 | 0.070 | 0.074 | 4 |
| Orifice width | 0.082 | 0.0024 | 0.079 | 0.085 | 4 |
| Ovicell length | 0.167 | 0.0151 | 0.156 | 0.184 | 3 |
| Ovicell width | 0.234 | 0.0104 | 0.222 | 0.242 | 3 |
| Avicularium length | 0.076 | 0.0082 | 0.065 | 0.085 | 5 |
| Avicularium width | 0.037 | 0.0030 | 0.033 | 0.041 | 5 |

Note: SD, standard deviation; N, number of measurements.

Five (sometimes four) stout, hollow, oral spines, articulated, forming an arch around the distal half of the orifice.

The primary orifice is surrounded laterally and proximally by a fine, raised peristome, starting from the first pair of spines and containing the suboral avicularium. The avicularium is almost perpendicular to the frontal plane, enlarged and slightly spatulate, with finely denticulate rostrum; crossbar complete with a thick, triangular columella; basal (distalmost) portion of the avicularium (opesia) covered by a raised, calcified opesial 'hood'; palatal foramen Y-shaped with granular inner edges.

Zooid lateral walls with small uniporous septula, placed in rows near the basal wall.

Ovicell acleithral, globose, prominent, its distal half covered by a thick, imperforate cover of secondary calcification; a crescent-shaped proximal area of exposed ectooecium perforated by several rounded pseudopores, the two in the proximal (outermost) corners clearly enlarged and elongate. Ovicellate zooids with a well-developed peristome, obscuring the primary orifice; the distal portion partially covering the ovicell, the proximal portion enclosing and incorporating the avicularium, forming a tall tube.

Ancestrula unknown.

### *Remarks*

*Shizomavella tubulata* sp. nov. shows superficial similarities with *S. halimedae* and *S. discoidea* s. l. in the general shape of the primary orifice, in the number and shape of the oral spines, and in the development of a tubular peristome in ovicellate zooids; the ovicell morphology in *S. tubulata* sp. nov. is also very similar to that of *S. halimedae*. However, *S. tubulata* sp. nov. differs from both species due to its wider sinus, its larger condyles, the fine peristome in non-ovicellate zooids that encloses the median suboral avicularium (that is not as enlarged and spatulate as that in *S. halimedae*) with its Y-shaped rostral foramen, and a calcified opesial 'hood'. Finally, *S. tubulata* sp. nov. is characterised by the tall tubular peristome in ovicellate zooids which totally encloses the avicularium; in *S. halimedae* the peristome is interrupted proximally, in other words not enclosing the avicularium, while in *S. discoidea* s. l. it is interrupted distally, on the ovicell.

*Schizomavella tubulata* sp. nov. produces a fine peristome which includes the suboral avicularium, with a distal calcified opesial 'hood', as described in *S. mystacea* sp. nov. (see above), but this species differs from *S. tubulata* sp. nov. in, amongst other characters, its extremely short zooidal orifice.

## *Schizomavella stanislavi* sp. nov.
(Figure 9; Table 7)

*Schizomavella asymetrica*: Novosel 2007: 61, fig. 26 A, B.
*Schizomavella auriculata*: Novosel 2007: 62, fig. 26C, D.
*Schizomavella cornuta*: Novosel 2007: 62, fig. 26 E (in part).

### *Type material*

***Holotype.*** CNHM Inv. br. 38: St. 8: Jabuka Shoal (PJ-1), 43°06.060 N, 15°26.210 E, 27 August 2001, 13 m, a colony on alga (Figure 9D, F).

***Paratypes.*** CNHM Inv. br. 39: St. 8, Jabuka Shoal (PJ-1), 43°06.060 N, 15°26.210 E, 27 August 2001, 10 m.

CNHM Inv. br. 40: St. 8, Jabuka Shoal (PJ-1), 43°06.060 N, 15°26.210 E, 27 August 2001, 20 m.

CNHM Inv. br. 41: St. 8, Jabuka Shoal (PJ-3), 43°06.060 N, 15°26.210 E, 28 August 2001, 10–15 m depth, a small colony.

CNHM Inv. br. 42: St. 9, Jabuka Islet (J4), 43°05.500 N, 15°27.600 E, 29 August 2001, 20–25 m.

MNCN 25.03/3907: St. 8, Jabuka Shoal (PJ-1), 43°06.060 N, 15°26.210 E, 27 August 2001, 13 m depth, several fragments on alga.

MNCN 25.03/3908: St. 8, Jabuka Shoal (PJ-3), 43°06.060 N, 15°26.210 E, 28 August 2001, 10–15 m depth, a small colony, on alga.

MNCN 25.03/3909: St. 15, Lastovo Island (Struga), 42°72.378 N, 16°88.429 E, 07 March 2002, 20–35 m, some colonies on alga and one on *Reteporella* sp. (Figure 9A, E).

NHMUK 2015.3.4.2: St. 8, Jabuka Shoal (PJ-1), 43°06.060 N, 15°26.210 E, 27 August 2001, 10 m, some small free fragments.

NHMUK 2015.3.4.3: St. 9, Jabuka Islet (J4), 43°05.500 N, 15°27.600 E, 29 August 2001, 5–10 m, several small free fragments (Figure 9B, C).

### *Other material examined*

*Schizomavella hirsuta* (Calvet, 1927) n. comb.

MOM 421601: Holotype of *Schizoporella auriculata* var. *hirsuta* Calvet, 1927 (by monotypy).

### *Diagnosis*

Primary orifice rounded, without proximolateral notches; sinus small, quadrate or U-shaped, occupying one third of the proximal border; condyles small, inconspicuous; primary orifice surrounded by an even rim, including the suboral avicularium; three or four long and thick distal spines; avicularium median suboral, subrectangular; distalmost part of the avicularium (the opesia) covered by a raised, calcified opesial 'hood'; rostral palate foramen triangular; frontal wall with minute processes between the pseudopores; ovicell prominent, rapidly covered by secondary calcification, becoming similar in appearance to the frontal shield – that is, covered in pores and minute processes.

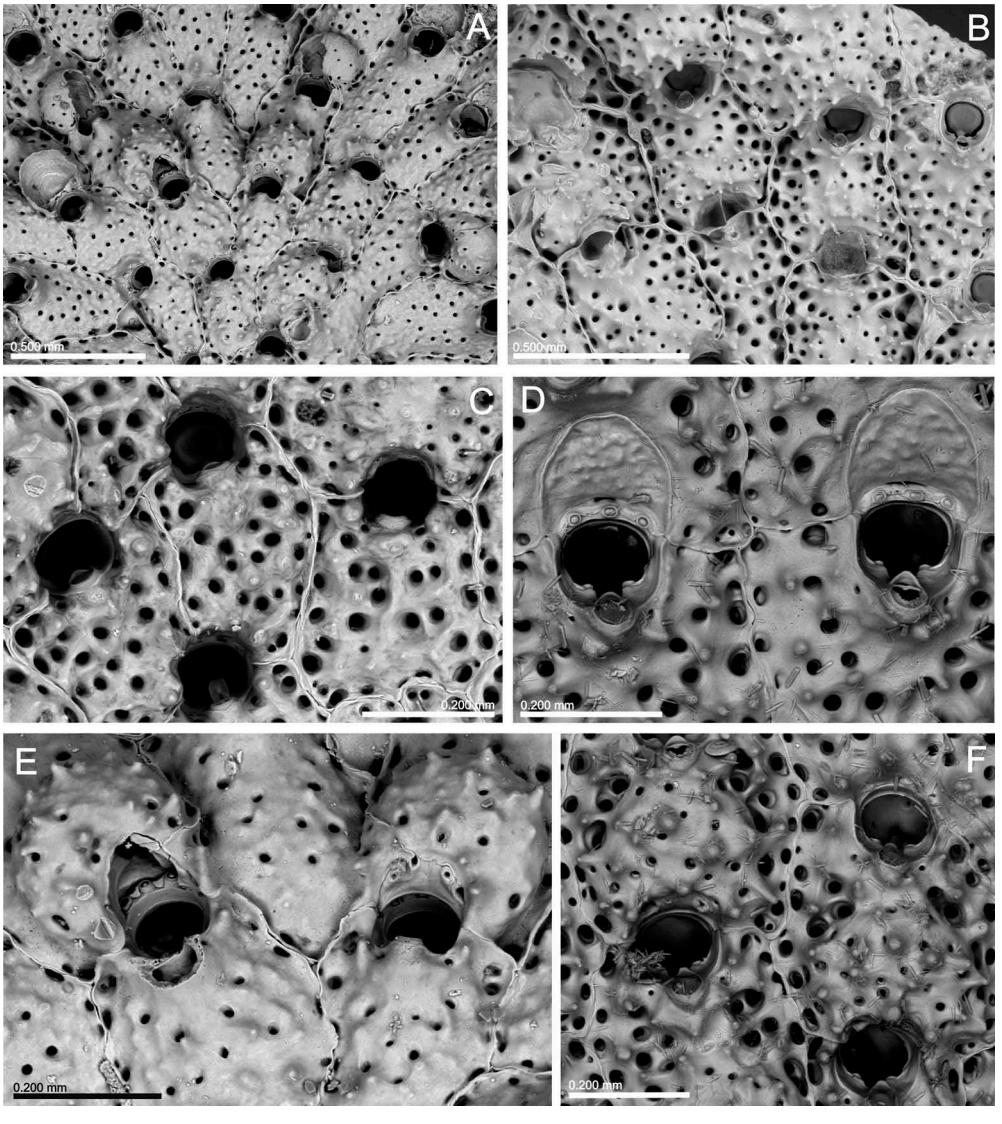


**Figure 9.** *Schizomavella stanislavi* sp. nov. (A) Part of a lightly calcified colony (MNCN 25.03/3909, paratype, St. 15, Lastovo Island); (B, C) heavely calcified colony, showing frontal wall, with pointed processes, reaching the same level as the peristome (NHMUK 2015.3.4.3, paratype, St. 9, Jabuka Islet); (D) primary orifices (CNHM Inv. br. 38, holotype, St. 8, Jabuka Shoal); (E) ovicellate zooids (MNCN 25.03/3909, paratype, St. 15, Lastovo Island); (F) ovicellate zooids (CNHM Inv. br. 38, holotype, St. 8, Jabuka Shoal).

### *Etymology*

Named in honour of the senior author's father, Estanislao Reverter Sequeiros.

### *Description*

Colony encrusting, unilaminar, developing small, irregular, subcircular crusts.

Autozooids rectangular to polygonal, in linear series, separated by fine ridges.

**Table 7.** Measurements (in mm) of *Schizomavella stanislavi* sp. nov. (holotype and paratype).

| | Mean | SD | Minimum | Maximum | N |
|---|---|---|---|---|---|
| Autozooid length | 0.469 | 0.0650 | 0.379 | 0.638 | 37 |
| Autozooid width | 0.329 | 0.0558 | 0.240 | 0.461 | 37 |
| Orifice length | 0.088 | 0.0061 | 0.074 | 0.102 | 37 |
| Orifice width | 0.097 | 0.0114 | 0.071 | 0.122 | 37 |
| Ovicell length | 0.254 | 0.0197 | 0.235 | 0.284 | 5 |
| Ovicell width | 0.325 | 0.0162 | 0.298 | 0.342 | 5 |
| Avicularium length | 0.064 | 0.0079 | 0.055 | 0.077 | 10 |
| Avicularium width | 0.030 | 0.0038 | 0.024 | 0.035 | 7 |

Note: SD, standard deviation; N, number of measurements.

Frontal shield nodular, evenly perforated by round pseudopores, plus a row of conspicuous areolar pores; a single smaller pore on each side of the suboral avicularium. In young zooids the frontal wall is convex; in older zooids the frontal wall calcification increases until it reaches the same level as the top of the peristome and produces minute pointed processes between the pores, while the pores themselves become deeply immersed and larger.

Primary orifice rounded or somewhat quadrate, deeply immersed in well-calcified zooids; slightly wider than long; small median sinus, quadrate or U-shaped, occupying one third of the proximal border, concealed by the suboral avicularium, often difficult to see in frontal view; condyles small, inconspicuous, with a smooth, straight distal edge and rounded end, just reaching the edge of the sinus; proximolateral notches absent or poorly marked. Primary orifice surrounded proximally and laterally by a fine, even rim, into which the suboral avicularium is incorporated.

Three or four, or even five, distal spines, hollow, long and thick, but frequently broken; their bases are present underneath the ovicell along the distal orifice margin.

Zooid lateral walls with small, uniporous septula, placed in rows near the basal wall.

Avicularium median, suboral, monomorphic, placed within the oral rim and nearly perpendicular to the frontal wall; rostrum subrectangular, directed frontally; complete crossbar with a small, median columella; distalmost part of the avicularium (the opesia) covered by a raised calcified opesial 'hood' which may conceal the orificial sinus; palatal foramen triangular, with inner edges slightly denticulate.

Ovicell acleithral, prominent, recumbent on the frontal wall of the succeeding zooid, broader than long; surface with several scattered circular ectooecial pseudopores, smaller than those in the frontal shield; rapidly covered by secondary calcification, becoming similar to the frontal shield, with small processes between scattered pores, but with a small, smooth, vertical area, just distal to the primary orifice.

Ancestrula unknown.

### *Remarks*

Some European species of *Schizomavella* also develop a frontal wall covered by pointed processes, especially around the orifice, for instance: the Atlantic species *S. sarniensis* Hayward and Thorpe, 1995 and *S. teresae*, the Atlanto-Mediterranean *S. grandiporosa* Canu and Bassler, 1925 and the Mediterranean *Schizoporella auriculata* var. *hirsuta* Calvet, 1927.

*Schizomavella sarniensis* differs from *S. stanislavi* sp. nov. in having larger condyles with finely toothed distal edges, a less-developed orificial rim that just touches the suboral avicularium but does not include it, and the larger avicularium without the distal calcified 'hood', which is occasionally enlarged and occupying most of the frontal wall.

*Schizomavella teresae* differs from *S. stanislavi* sp. nov. in the shape of the primary orifice, with its almost drop-shaped outline and narrower proximal edge, its broad condyles with pointed corners projecting above the sinus, and its smaller avicularium, without a palate or distal calcified 'hood', that does not project above the peristome.

*Schizomavella grandiporosa*, as recently redescribed by Souto et al. (2013), differs from *S. stanislavi* sp. nov. in having a wider and shallower sinus, a less developed orificial rim, which is in contact with the shorter suboral avicularium but not engulfing it, and the distinct larger pores in the frontal wall.

Calvet (1927) described *Schizoporella auriculata* var. *hirsuta* based on a single colony from Monaco, characterising it based on the development of frontal calcification covered by minute pointed processes on both the autozooids and ovicells. We have revised the holotype of this variety (MOM 421601, Figure 10), and believe it should be upgraded to species level as *Schizomavella hirsuta*. This species differs from *S. stanislavi* sp. nov. mainly due to the primary orifice, with its straight lateral borders, the distinct shoulders on each side of the sinus and the larger condyles producing lateral notches (Figure 10 B, C). Other differences include a suboral avicularium which projects well above the frontal surface on a somewhat quadrangular prominence (the distal calcified 'hood' of the avicularium is frequently asymmetrical; see Figure 10D), and the heavily developed process-covered peristome that conceals the primary orifice; in *S. stanislavi* sp. nov. the primary orifice is always clearly seen.

However, it must be noted that all four of these species may appear quite similar when studied using only binocular microscope; a clear differentiation is only made possible by using an SEM on thoroughly cleaned material.

The primary orifices of *S. stanislavi* sp. nov. and *S. tubulata* sp. nov. are similar in the absence of proximal notches but *S. tubulata* sp. nov. differs in the stout oral spines forming an arch, and its stouter condyles. Moreover, the peristome in *S. tubulata* sp. nov. is more highly developed, forming a tube, and its ovicell is also different from that of *S. stanislavi* sp. nov.



### ***Schizomavella linearis*** (Hassall, 1841)
(Figure 11; Tables 8–10)

*Lepralia linearis* Hassall, 1841: 368, pl. 9, fig. 8.
*Schizoporella linearis*: Hincks 1880: 247, pl. 38, figs 5–9.
*Schizomavella linearis*: Canu and Bassler 1928: 30, pl. 3, figs 1–6; Gautier 1962: 140; Hayward and Thorpe 1995: 671, pl. 4; Reverter-Gil and Fernández-Pulpeiro 1996: 271, figs 2, 3G; Hayward and Ryland 1999: 282, figs 127, 128; Hayward and McKinney 2002: 59, fig. 26E–G; Novosel 2007: 64, fig. 27E, F.
*Schizomavella hastiformis* Hayward and Ryland 1978: 152, figs C, D.
*Schizomavella hastata*: Novosel 2007: 64, fig. 28A, D.

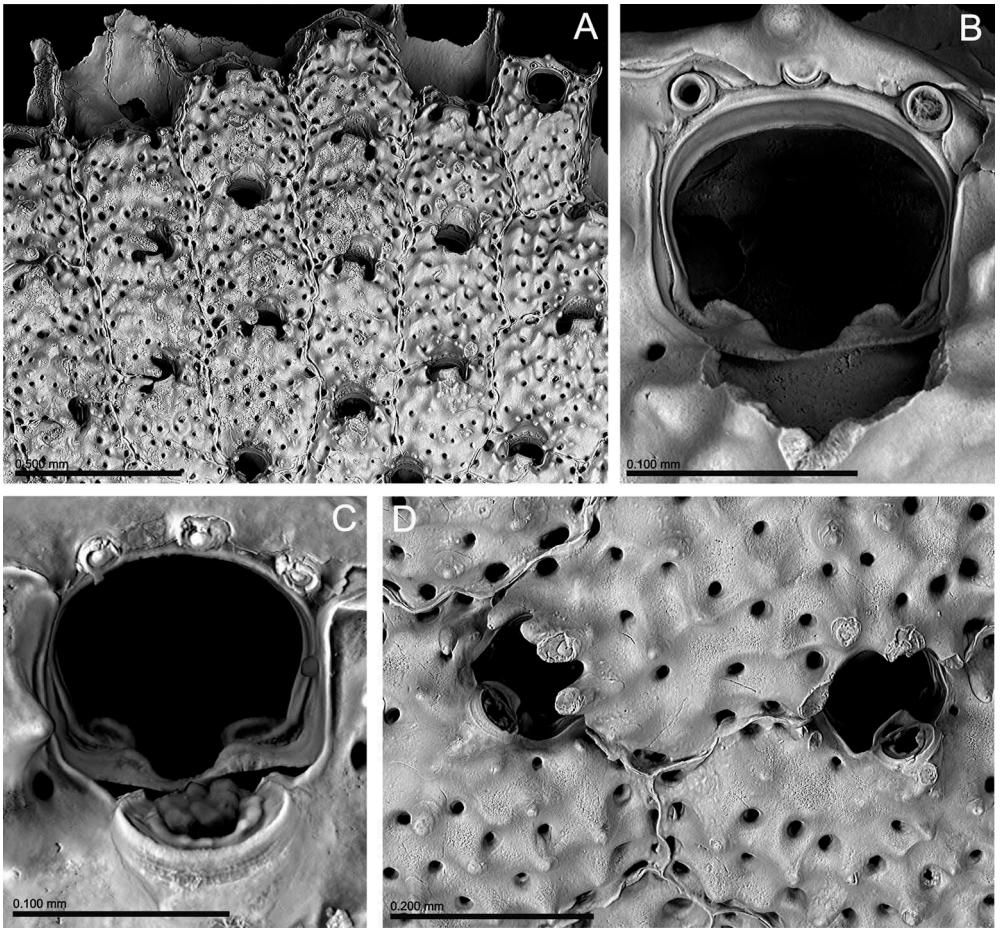


**Figure 10.** *Schizomavella hirsuta* (holotype: MOM 421601). (A) Growing edge of the colony showing developed suboral avicularia; (B, C) primary orifices; (D) development of the oral spikes concealing the primary orifices; note the asymetrical avicularian calcified 'hood'.

### *Material examined*

Morphotype *'typical'*:

CNHM Inv. br. 62: St. 8, Jabuka Shoal (PJ-2), 43°06.060 N, 15°26.210 E, 28 August 2001, 32 m.

CNHM Inv. br. 63: St. 11, Biševo, 42°57.312 N, 16°00.261 E, 14 February 2006, 10–20 m.

MNCN 25.03/3910: St. 7, Kornati (Mana), 43°47.922 N, 15°16.452 E, 10 July 2003, 10–20 m (Figure 11A, B).

Morphotype *'hastiformis'*:

CNHM Inv. br. 64: St. 3, Silba, 44°32.894 N, 14°69.794 E.

CNHM Inv. br. 65: St. 4, Dugi otok (North), 44°10.225 N, 14°48.307 E, 11 October 2004, 5–12 m.

CNHM Inv. br. 66: St. 14, Hvar Island (Kozja), 43°11.374 N, 17°04.930 E, 2 April 2005, 15–20 m.

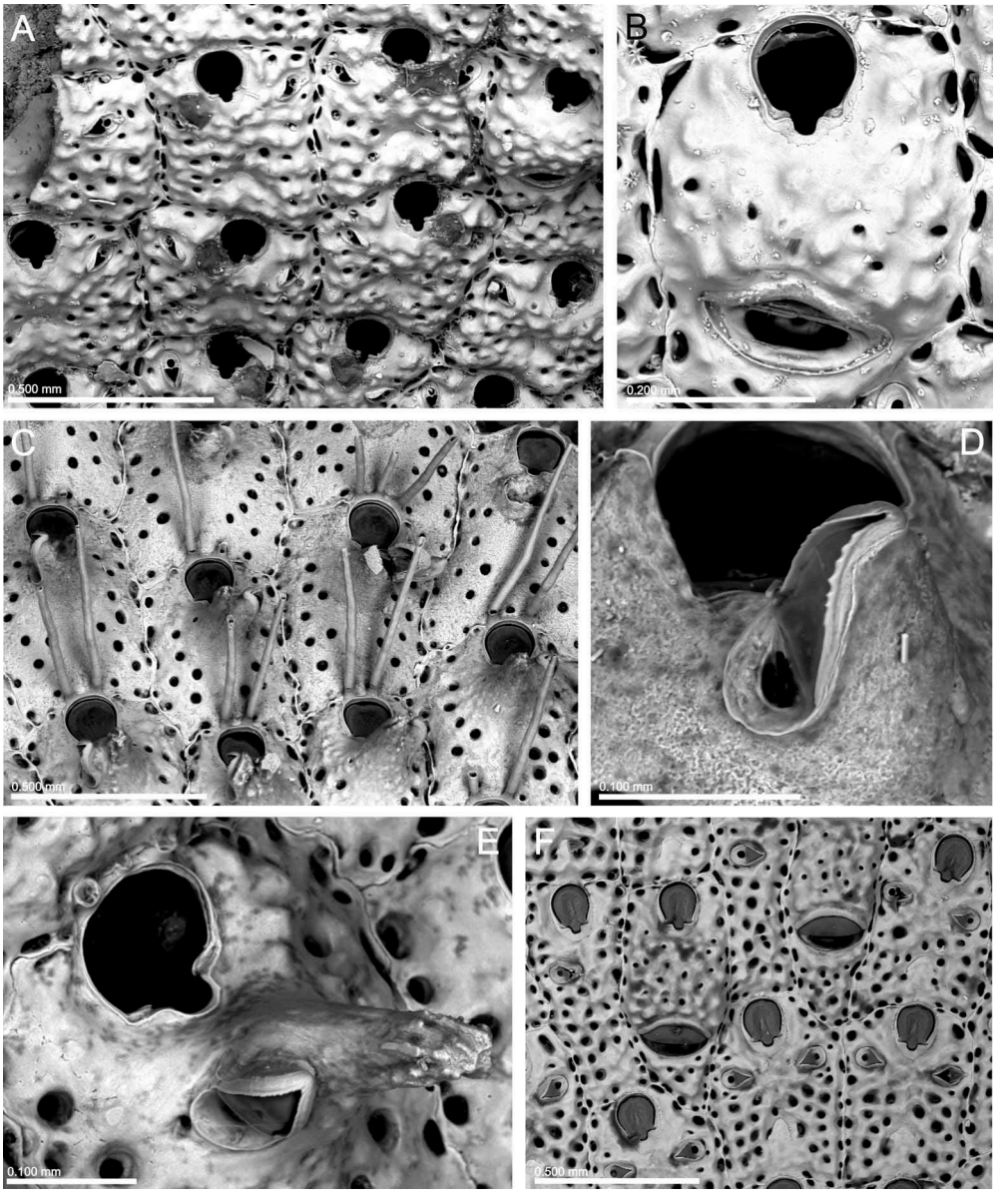


**Figure 11.** *Schizomavella linearis*. (A, B) Typical morphotype (MNCN 25.03/3910, St. 7, Kornati); (C–E) morphotype with a large single suboral avicularium (C and E, MNCN 25.03/3910, St. 12, Vis, Komiža Bay; D, MNCN 25.03/3913, St. 14, Hvar Island); (F) morphotype with larger primary orifice and avicularia (MNCN 25.03/3916, St. 7, Kornati).

3914: St. 16,/3911: St. 12, Vis (Komiža Bay), 43°04.430 N, 16°07.213 E, 1 September 2001, 10–15 m (Figure 11C, E).

3914: St. 16,/3912: St. 14, Hvar Island (Kozja), 43°11.374 N, 17°04.930 E, 2 April 2005, 15–20 m.

3914: St. 16,/3913: St. 14, Hvar Island (Kozja), 43°11.374 N, 17°04.930 E, 2 April 2005, 15–20 m (Figure 11D).

**Table 8.** Measurements (in mm) of *Schizomavella linearis* ('*typical*' morphotype; Kornati).

| | Mean | SD | Minimum | Maximum | N |
|---|---|---|---|---|---|
| Autozooid length | 0.464 | 0.0636 | 0.369 | 0.589 | 24 |
| Autozooid width | 0.378 | 0.0619 | 0.259 | 0.558 | 24 |
| Orifice length | 0.106 | 0.0082 | 0.087 | 0.123 | 24 |
| Orifice width | 0.099 | 0.0072 | 0.086 | 0.113 | 24 |
| Ovicell length | 0.223 | 0.0068 | 0.213 | 0.229 | 7 |
| Ovicell width | 0.251 | 0.0153 | 0.221 | 0.265 | 7 |
| Avicularium length | 0.078 | 0.0070 | 0.068 | 0.089 | 9 |
| Avicularium width | 0.044 | 0.0080 | 0.033 | 0.059 | 9 |

Note: SD, standard deviation; N, number of measurements.

**Table 9.** Measurements (in mm) of *Schizomavella linearis* ('*hastiformis*' morphotype; Komiža Bay and Hvar Island).

| | Mean | SD | Minimum | Maximum | N |
|---|---|---|---|---|---|
| Autozooid length | 0.475 | 0.1169 | 0.400 | 0.583 | 19 |
| Autozooid width | 0.384 | 0.1059 | 0.285 | 0.504 | 19 |
| Orifice length | 0.109 | 0.0339 | 0.095 | 0.122 | 19 |
| Orifice width | 0.126 | 0.0293 | 0.110 | 0.142 | 19 |
| Ovicell length | 0.225 | 0.0800 | 0.218 | 0.239 | 7 |
| Ovicell width | 0.255 | 0.0905 | 0.244 | 0.266 | 7 |
| Avicularium length | 0.147 | 0.0245 | 0.099 | 0.182 | 15 |
| Avicularium width | 0.048 | 0.0097 | 0.033 | 0.063 | 10 |

Note: SD, standard deviation; N, number of measurements.

**Table 10.** Measurements (in mm) of *Schizomavella linearis* ('*pseudolinearis*' morphotype; Kornati and Ždralova Bay).

| | Mean | SD | Minimum | Maximum | N |
|---|---|---|---|---|---|
| Autozooid length | 0.493 | 0.0702 | 0.381 | 0.628 | 21 |
| Autozooid width | 0.362 | 0.0602 | 0.267 | 0.463 | 21 |
| Orifice length | 0.132 | 0.0044 | 0.123 | 0.140 | 21 |
| Orifice width | 0.118 | 0.0079 | 0.104 | 0.133 | 21 |
| Ovicell length | 0.219 | 0.0092 | 0.209 | 0.236 | 6 |
| Ovicell width | 0.226 | 0.0219 | 0.195 | 0.247 | 6 |
| Avicularium length | 0.101 | 0.0076 | 0.089 | 0.116 | 33 |
| Avicularium width | 0.057 | 0.0044 | 0.046 | 0.069 | 33 |
| Globular avic. length | 0.215 | 0.0175 | 0.195 | 0.246 | 6 |
| Globular avic. width | 0.112 | 0.0084 | 0.102 | 0.123 | 6 |

Note: SD, standard deviation; N, number of measurements.

3914: St. 16,/3914: St. 16, Korčula Island (Lucnjak), 42°94.973 N, 17°16.026 E, 2007, 15–20 m.

Morphotype *'pseudolinearis'*:

CNHM Inv. br. 67: St. 2, Ćutin Islet (Cres), 44°72.393 N, 14°49.374 E, 17 October 2001, 12 m.

CNHM Inv. br. 68: St. 6, Dugi otok Vele stijene, 43°54.282 N, 15°07.954 E, 12 July 2003, 20–40 m.

MNCN 25.03/3915: St. 1, Ždralova Bay (Velebit Channel), 44°53.059 N, 14°53.458 E, 27 May 2002, 10–20 m.

MNCN 25.03/3916: St. 7, Kornati (Mala Sestrica), 43°47.922 N, 15°16.452 E, 30–35 m (Figure 11F).

### Remarks

*Schizomavella linearis* was redescribed by Hayward and Thorpe (1995), who selected a neotype. Its supposed distribution ranges from west Norway and Faroe Isles in the north to the western Mediterranean, and into the Adriatic, in the south.

Having examined several specimens from different sampling sites, we have noted some morphological variations within them, and as a result we have outlined these variations in the three 'forms' noted below.

Material coming from Sts. 7, 8 and 11 (Figure 11 A, B) fits the redescription of *S. linearis* by Hayward and Thorpe (1995) (see also Hayward and Ryland 1999; Hayward and McKinney 2002), and is here named the '*typical*' morphotype.

Material coming from Sts. 3, 4, 12, 14, and 16 develops a single suboral avicularium on a large, conical umbo proximal to the sinus, and is here named the '*hastiformis*'morphotype. The extent of this umbo, actually the avicularian cystid, varies in morphology from a low, massive cone, to a long, finger-like projection (Figure 11C–E). The material cited here was previously reported as *S. hastata* by Novosel (2007). The true identity of *S. hastata* was uncertain until its redescription by Hayward and Thorpe (1995). Earlier authors (and even some later ones) based their identifications on the presence of the single, suboral avicularium on a large umbo; however, the character that best defines *S. hastata* is the shape of the orifice, it being rounded, with a broad, shallow sinus occupying its entire proximal border, and flanked by very small condyles. On the contrary, the material here studied has a primary orifice quite similar to the typical material of *S. linearis*, so we think that it does not correspond to *S. hastata*. A similar morphology can be also seen in material identified as *S. hastata* from La Atunara (Strait of Gibraltar; López de la Cuadra 1991: pl. 26, fig. F), Marseille (photos sent by J.G. Harmelin), Algeria (MNHN 11239, Gautier Coll.) and the Balearics (MNHN 11222, Gautier Coll.). The discovery of specimens from the north of the Bay of Biscay with a single suboral avicularium led Hayward and Ryland (1978) to describe the species *Schizomavella hastiformis*, which nevertheless they later considered to be a morphotype of *S. linearis* (see Hayward and Ryland 1999). Something similar may occur with Mediterranean material previously identified as *S. hastata*.

Finally, material coming from Sts 1, 2, 6 and 7, here named the '*pseudolinearis*' morphotype, has a larger primary orifice that is longer than wide, and the avicularia are larger than in the typical form of the species, and frequently distally orientated, instead of medially (Figure 11F). Similar colonies have been observed off Avilés (northwest Spain) at 144 m depth, and off Brittany at 255 m depth (unpublished data). We are unable to discount the possibility that these differences are within the range of variation of the species, and we therefore tentatively include these specimens in *S. linearis*.

These three 'morphotypes' do not seem to follow any pattern of distribution along the Adriatic coast, and no particular abiotic pattern was observed that can explain the morphological variations. Taking into account the high degree of variation observed in material of *S. linearis*, not only in the Adriatic but also in the western Mediterranean, we believe that it is not impossible that we were dealing with several similar species. To corroborate this assumption, however, it will be necessary to undertake a thorough revision of Atlanto–Mediterranean specimens previously identified as *S. linearis* or any of its 'varieties', as well as *S. hastata*, using SEM observations, as well as utilising newly

collected material for molecular work, and previous literature. This huge task is outside the scope of the present paper.

## ***Schizomavella mamillata*** (Hincks, 1880)
(Figure 12; Table 11)

*Schizoporella linearis* var. *mamillata* Hincks, 1880: 248.
*Schizomavella linearis* var. *mamillata*: Gautier 1962: 143.
*Schizomavella mamillata*: Gautier 1958: 199; Hayward and McKinney 2002: 59, fig. 27 A–C; Novosel 2007: 65, fig. 28C, D.

### *Material examined*

CNHM Inv. br. 69: St. 16, Korčula Island (Sika), 42°94.973 N, 17°16.026 E, 22 April 2004, 30–40 m.
MNCN 25.03/3917: St. 16, Korčula Island (Lucnjak), 42°94.973 N, 17°16.026 E, 24 April 2004, 15–20 m (Figure 12B).
MNCN 25.03/3918: St. 17, Pelješac, 42°94.612 N, 17°28.522 E, 23 April 2005, 30–40 m (Figure 12A).

### *Remarks*

The Adriatic material studied here fully matches the description and illustrations of *Schizomavella mamillata* given by Hayward and McKinney (2002), who selected a lectotype for the species. It is noticeable that the autozooidal operculum of the material studied here has a median prominence running proximo-distally, which can be indicative of a strengthening structure, within or below the operculum. This structure has not been observed in other species treated here.

*Schizomavella mamillata* seems to be common throughout the shallow waters of the Mediterranean, but it is also present in several localities along the Portuguese coast (Reverter-Gil et al. 2014). In the Adriatic, it has only been recorded in recent years: in Jabuka Islet (Zavodnik et al. 2000), Rovinj (Hayward and McKinney 2002), Lastovo and

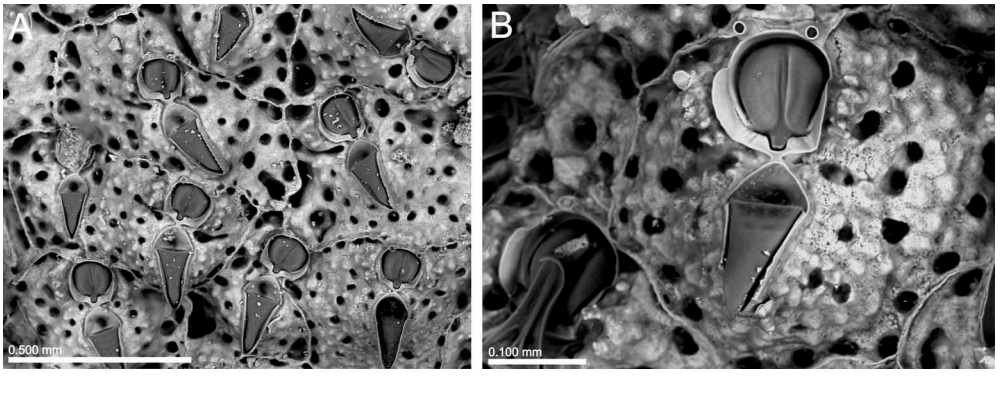


**Figure 12.** *Schizomavella mamillata*. (A) Group of zooids (MNCN 25.03/3918, St. 17, Pelješac); (B) autozooid showing the operculum (MNCN 25.03/3917, St. 16, Korčula Island).

**Table 11.** Measurements (in mm) of *Schizomavella mamillata* (Korčula and Pelješac).

| | Mean | SD | Minimum | Maximum | N |
|---|---|---|---|---|---|
| Autozooid length | 0.494 | 0.0513 | 0.416 | 0.600 | 16 |
| Autozooid width | 0.390 | 0.0651 | 0.300 | 0.502 | 16 |
| Orifice length | 0.122 | 0.0082 | 0.107 | 0.138 | 16 |
| Orifice width | 0.108 | 0.0062 | 0.099 | 0.122 | 16 |
| Avicularium length | 0.202 | 0.0270 | 0.155 | 0.245 | 16 |
| Avicularium width | 0.104 | 0.0082 | 0.086 | 0.115 | 16 |

Note: SD, standard deviation; N, number of measurements.

Prvić Islands (Novosel et al. 2004), and several other localities along the Croatian coast, between 10 and 45 m depth (Novosel 2007).

## ***Schizomavella adriatica*** sp. nov.
(Figure 13; Table 12)

? *Schizoporella auriculata*: Hincks 1886: 270.

? *Schizomavella rudis*: McKinney and Jaklin 2000: 13, 14.

*Schizomavella rudis*: Hayward and McKinney 2002: 61, fig. 27D–H; Novosel 2007: 65, fig. 28E–F.

### *Type material*

***Holotype.*** CNHM Inv. br. 43: St. 16, Korčula Island (Sika), 42°94.973 N, 17°16.026 E, 24 April 2004, 30–40 m depth, one colony on a bivalve shell (Figure 13G).

***Paratypes.*** CNHM Inv. br. 44: St. 2, Ćutin Islet (Cres), 44°72.393 N, 14°49.374 E, 17 October 2001, 12 m depth, one colony on a stone.

CNHM Inv. br. 45: St. 2, Ćutin Islet (Cres), 44°72.393 N, 14°49.374 E, 17 October 2001, 12 m depth, three colonies on a piece of metal.

CNHM Inv. br. 46: St. 2, Ćutin Islet (Cres), 44°72.393 N, 14°49.374 E, 15 June 2000, 11–15 m depth, a colony on a shell.

CNHM Inv. br. 47–51: St. 16, Korčula Island, 42°94.973 N, 17°16.026 E, 24 April 2004, 15–20 m depth.

MNCN 25.03/3919: St. 2, Ćutin Islet (Cres), 44°72.393 N, 14°49.374 E, 15 June 2000, 11–15 m depth, a free fragment.

MNCN 25.03/3920: St. 16, Korčula Island, 42°94.973 N, 17°16.026 E, 24 April 2004, 15–20 m depth, one colony on a gastropod shell (Figure 13A).

MNCN 25.03/3921: St. 16, Korčula Island, 42°94.973 N, 17°16.026 E, 24 April 2004, 15–20 m depth (Figure 13B, D, E, H).

NHMUK 2015.3.4.4: St. 2, Ćutin Islet (Cres), 44°72.393 N, 14°49.374 E, 17 October 2001, 12 m depth, one colony on a stone (Figure 13C, F).

NHMUK 2015.3.4.5: St. 12, Vis (Komiža Bay), 43°04.430 N, 16°07.213 E, 1 September 2001, 12 m.

### *Other material examined*

NHMUK 1899.5.1.459, NHMUK 1899.5.1.468, NHMUK 1899.5.1.989: Adriatic, Hincks coll. as *Schizoporella auriculata*; reidentified by P. Hayward as *Schizomavella* sp. indet.

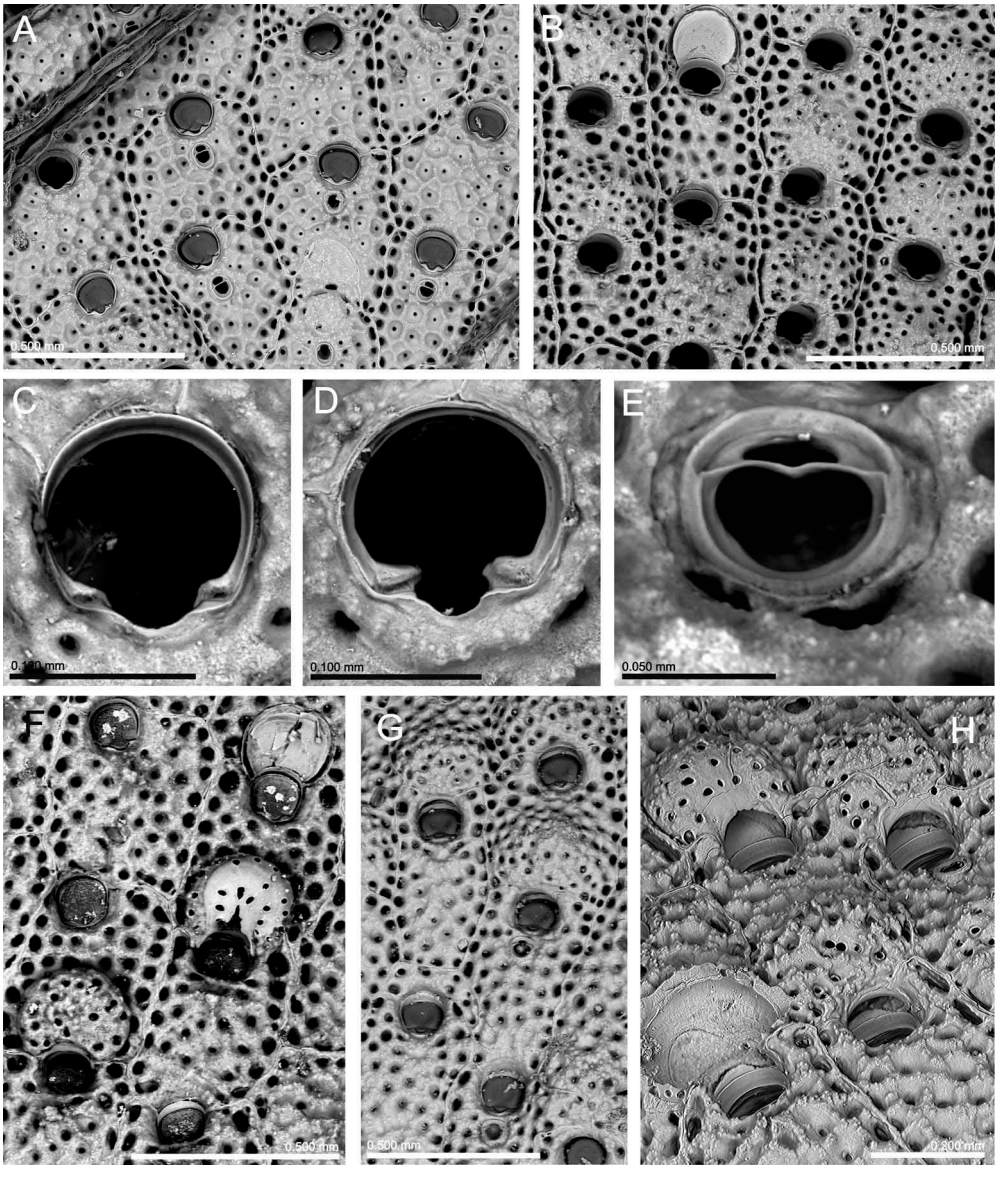


**Figure 13.** *Schizomavella adriatica* sp. nov. (A, B) Groups of zooids with variably calcified frontal wall (A MNCN 25.03/3920, paratype, St. 16, Korčula Island; B MNCN 25.03/3921, paratype, St. 16, Korčula Island); (C, D) primary orifices (C NHMUK 2015.3.4.4, paratype, St. 2, Ćutin Islet; D MNCN 25.03/3921, paratype, St. 16, Korčula Island); (E) suboral avicularium with crossbar forming an open angle (MNCN 25.03/3921, paratype, St. 16, Korčula Island); (F) developing ovicells, from initial stage (up) to completely covered with secondary calcification (down; NHMUK 2015.3.4.4, paratype, St. 2, Ćutin Islet); (G) group of ovicellate zooids (CNHM Inv. br. 43, holotype, St. 16, Korčula Island); (H) group of ovicellate zooids (MNCN 25.03/3921, paratype, St. 16, Korčula Island).

### *Diagnosis*

Frontal shield uniformly perforated by rounded pores, each in a depression. Primary orifice rounded; sinus wide and shallow, flanked by two shoulders; condyles smooth. Suboral avicularium small, oval, distant from the primary orifice – that is, unattached to

**Table 12.** Measurements (in mm) of *Schizomavella adriatica* sp. nov. (paratypes, Korčula Island and Ćutin Islet).

| | Mean | SD | Minimum | Maximum | N |
|---|---|---|---|---|---|
| Autozooid length | 0.458 | 0.0439 | 0.360 | 0.590 | 32 |
| Autozooid width | 0.369 | 0.0551 | 0.217 | 0.488 | 32 |
| Orifice length | 0.106 | 0.0096 | 0.090 | 0.127 | 32 |
| Orifice width | 0.117 | 0.0118 | 0.089 | 0.137 | 32 |
| Ovicell length | 0.210 | 0.0227 | 0.179 | 0.266 | 26 |
| Ovicell width | 0.266 | 0.0268 | 0.203 | 0.307 | 26 |
| Avicularium length | 0.069 | 0.0081 | 0.057 | 0.087 | 25 |
| Avicularium width | 0.052 | 0.0061 | 0.038 | 0.063 | 25 |

Note: SD, standard deviation; N, number of measurements.

the rim – but frequently missing from large areas of the colony. Ovicell evenly perforated, soon covered by granular secondary calcification.

### *Etymology*

Pertaining to its only known occurrence – that is, only found in the Adriatic Sea.

### *Description*

Colony encrusting, multilaminar, forming large, irregular patches.

Autozooids distinct, separated by fine sutures, arranged in radial series in the basal layer, randomly orientated in frontally budded patches. Autozooids in the basal layer rectangular or polygonal in shape, irregularly polygonal in successive layers. Frontal shield flat or slightly convex, uniformly perforated by rounded pores, each in a distinct depression in newly formed individuals. In older zooids, the increase in secondary calcification gives the frontal wall a rough, granular appearance and the pores appear larger (Figure 13B); in heavily calcified zooids, the medial pores may become occluded, with the exception of the row of marginal pores which become elongate (Figure 13A). Zooid lateral walls with small uniporous septula, placed in rows near the basal wall.

Primary orifice rounded, nearly as long as wide. Proximal border with a wide, shallow sinus, occupying half of its width, flanked by two shoulders. Condyles smooth, moderately developed, extending from the edges of the sinus to the lateral edges of the orifice and continuous with it.

Suboral avicularium small, oval, slightly longer than wide, quite distant from the primary orifice and unattached to the rim. Proximally directed, with rostrum almost parallel to frontal plane. Crossbar complete, slender, sometimes forming an open angle in the middle but without columella. Opesia transversely oval or subcircular; palatal foramen large, oval, with semielliptical mandible. However, avicularia are frequently missing from large areas of a colony.

Ovicell acleithral, initially prominent, globose, evenly perforated by several circular pseudopores. Soon covered by granular secondary calcification, that may sporadically occlude the pseudopores.

Ancestrula unknown.

### *Remarks*

*Schizomavella adriatica* sp. nov. was previously reported as *Schizomavella rudis* (Manzoni, 1869) by Hayward and McKinney (2002) from the Northern Adriatic, by

Novosel (2007) from several Croatian localities, and probably by McKinney and Jaklin (2000). Reverter-Gil et al. (2012) recently re-examined many Mediterranean records of *S. rudis* and as a result described a new species, *Stephanotheca watersi*. However, the record of Hayward and McKinney (2002) has been considered to correspond to another, as yet, undescribed species of *Schizomavella*. Among other differences with *S. rudis*, the zooidal orifice of *S. adriatica* sp. nov. has a proximal edge with a shallow sinus flanked by two shoulders and smooth condyles, the ovicell is uniformly perforated and is not closed by the operculum and *S. adriatica* sp. nov. does not exhibit a dimorphic orifice in ovicellate zooids.

*Schizomavella adriatica* sp. nov. shows some similarities with *S. sarniensis* and *S. grandiporosa*, as recently redescribed by Souto et al. (2013); for instance, it has the rounded orifice with a shallow, wide sinus, the frontal shield evenly perforated by large pores and the ovicell immersed by secondary calcification. However, the shape of the condyles is different amongst these three species: in *S. adriatica* sp. nov. they are smooth and continuous with the lateral walls of the orifice; in *S. grandiporosa* they are smooth, oval, with a lateral notch; and finally in *S. sarniensis* they are large, finely toothed and also notched. Differences are also seen in the avicularia amongst these three species. In *S. adriatica* sp. nov. the suboral avicularium is frequently absent from large areas of a colony, but when present it is distant from the primary orifice – that is, unattached to the orificial rim, with the rostrum parallel to frontal plane, the crossbar lacking a columella. In the other two species the avicularia are nearly always present, close to the sinus and continuous with the orificial rim, almost perpendicular to the frontal wall, and their crossbars have a well-developed columella.

Hincks (1886) reported the presence of *S. auriculata* in the Adriatic and defined the new variety *S. auriculata* var. *spathulata*. It is unclear if he considered all his Adriatic material to belong to this variety, or whether part of it represented the 'typical' morphology. We have examined three samples from the Adriatic in the Hincks collection (NHMUK 1899.5.1.459, NHMUK 1899.5.1.468, NHMUK 1899.5.1.989), originaly labeled as *Schizoporella auriculata* (later reassigned as *Schizomavella* sp. indet. by P. Hayward); this material is here assigned to *S. adriatica* sp. nov.

## Other species previously reported from the Adriatic Sea

*Schizomavella asymetrica* (Calvet, 1927)

Hayward and McKinney (2002) upgraded Calvet's (1927) variety *asymetrica* to species status and reported it for the first time in the Adriatic. *Schizomavella asymetrica* was originally recorded from Monaco (Calvet 1927) and subsequently reported by Gautier (1962) from Marseille and Tunis. Novosel's (2007) record corresponds to *S. stanislavi* sp. nov. (see above). *Schizomavella asymetrica* was not found during the present study.

*Schizomavella auriculata* (Hassall, 1842)

Several authors have reported *S. auriculata* from the northern and central Adriatic (see Novosel and Požar-Domac 2001; Novosel 2007). However, it must be stated that *S. auriculata* is an Atlantic species that is absent from the Mediterranean. Its diagnostic

characters, previously confused with those of *S. cuspidata* (= *S. cornuta*) as outlined above, were established by Hayward and Thorpe (1995). Previous records of *S. auriculata* in the Mediterranean correspond to various other species of *Schizomavella*, most often *S. cornuta* (see Reverter-Gil and Fernández-Pulpeiro 1996); however, the revision of all original material is necessary to validate the identifications.

*Schizomavella discoidea* (Busk, 1859)

This species has previously been reported from the northern and central Adriatic (Hincks 1887; McKinney 2000; McKinney and Jaklin 2000; Zavodnik et al. 2000; Novosel 2007). *Lepralia discoidea* was originally described from Madeira. Its type material was not found at the NHMUK, but we have examined Madeiran material in the Norman Collection. Comparison of this Madeiran material with European continental shelf records (from Great Britain to the Iberian Peninsula in the Atlantic, as well as the Western Mediterranean: see Hayward and Ryland 1999; López de la Cuadra and García-Gómez 2001; Reverter-Gil and Fernández-Pulpeiro 2001), strongly suggests that these records actually correspond to at least one new undescribed species, but a thorough revision of the material will be necessary to elucidate this any further. Notwithstanding, *S. discoidea* s. l. and *S. halimedae* (found during the present study) are morphologically similar species that have only recently been clearly separated (see López de la Cuadra and García-Gómez 2001). As stated by these authors, many previous records of *S. discoidea* s. l. in the Mediterranean are probably referable to *S. halimedae*, a species restricted to the inner Mediterranean. In fact Hincks (1887, p. 303), who first reported *S. discoidea* from the Adriatic, stated that 'In specimens from the Adriatic the small avicularium on the front of the cell is sometimes replaced by a long spatulate form. The dependent lateral appendages were not noticed'. This description clearly corresponds to *S. halimedae*. However, *S. discoidea*, or another very similar undescribed species, seems to be present at least in the western Mediterranean. Therefore, the presence of *S. discoidea* in the Adriatic cannot be discounted, but needs further investigation to be confirmed. No colonies of *S. discoidea* were found during the present study.

*Schizomavella gautieri* Reverter-Gil and Fernández-Pulpeiro, 1997

This species was originally described from Algeria, and later found in Isola Vulcano (Italy) (J.-G. Harmelin unpublished data: MNHN 20204). It was wrongly reported from the Adriatic by Novosel (2007); her original material has been re-examined and belongs to *S. cornuta* (see above). *Schizomavella gautieri* was not found during the present study.

*Schizomavella hastata* (Hincks, 1862)

This species was previously reported in the Adriatic by Brusina (1907), Friedl (1918), and Novosel (2007). However, the specific characters of this species were unclear until its redescription by Hayward and Thorpe (1995). Material documented by Novosel (2007) is here reassigned to *S. linearis* (see above). It should be stressed that the most useful character for distinguishing *S. hastata* from other species of *Schizomavella* is the shape of the primary orifice, not the size and position of the suboral avicularium. In a re-examination of reference illustrations and material assigned to *S. hastata* from the Mediterranean, we have noticed that many orifices actually resemble those of *S. linearis*

rather than *S. hastata* – that is, they never show the characteristic shallowly concave proximal border seen in *S. hastata*. In conclusion, *S. hastata* is probably absent from the Adriatic, and perhaps from the whole Mediterranean, although it was previously considered to be present in the area (Reverter-Gil and Fernández-Pulpeiro 1996; Hayward and Ryland 1999). All previous records will need to be reassessed with reference to their original material to ascertain its true distribution.

*Schizomavella ochracea* (Hincks, 1862)
This species was erroneously cited by Novosel and Požar-Domac (2001) when compiling previous records from the Adriatic. Friedl (1918) actually cited '*Smittina auriculata* var. *spathulata* (Hincks, 1886 = var. *ochracea* Hincks)' from near Banjol (Rovinj), around Brijuni islands and near Muggia (Italy); subsequently, Vatova (1928) compiled this record. The variety *spathulata* actually corresponds to *S. cornuta* (see above). *Lepralia ochracea* has been redescribed recently and reassigned to the genus *Stephanotheca*. Irrespective of this, it seems to be absent from the Mediterranean anyway (Reverter-Gil et al. 2012).

*Schizomavella rudis* (Manzoni, 1869)
This species was reported in the Adriatic by McKinney and Jaklin (2000), Hayward and McKinney (2002) and Novosel (2007). As stated above, all of these records probably correspond to *S. adriatica* sp. nov.

*Schizomavella subsolana* Hayward and McKinney, 2002
This species, described by Hayward and McKinney (2002) from the northern Adriatic, was later reported by Novosel (2007). Unfortunately, her original material has been lost, and so was not included in the present study.

*Schizomavella triangularis* Reverter-Gil and Fernández-Pulpeiro, 1997
This species was reported by Chimenz Gusso et al. (2007) from the northern Adriatic, but it was a typographical mistake (Chimenz Gusso pers. comm.); it was deleted from that area in a subsequent paper (Rosso et al. 2010). *Schizomavella triangularis* was not found during the present study.

## Discussion

Among the species described in this paper, three of them have a calcified 'hood' covering the opesia of the suboral avicularium: *S. stanislavi* sp. nov., *S. mystacea* sp. nov. and *S. tubulata* sp. nov. This structure was only recently reported in *Schizomavella*, present in an unknown species from Madeira (Souto et al. 2014), but it is also present in *S. hirsuta* from Marseille (see above). This 'hood' is formed when the peristomial rim surrounds the primary orifice and encloses the avicularium, or at least its distal part. In all cases, the avicularium is close to the proximal border of the orifice and almost perpendicular to the frontal plane. The calcified 'hood' seems to protect the opesia of the avicularium when the zooidal operculum opens, working as a door-stop, a function perhaps similar to the lyrula of other ascophorans (see Berning et al. 2014). However, in other *Schizomavella* species with the avicularium

in a similar position, such as *S. auriculata, S. cristata* (Hincks, 1879) and *S. teresae*, the 'hood' is absent. Further studies will be necessary to understand the development and function of this structure.

In *Schizomavella*, different morphologies of ovicell can be found. In the genotype species, *S. auriculata*, the ovicell is acleithral and the ooecium is covered by an imperforate layer of secondary calcification, but there is a proximal area of exposed pseudoporous ectooecium. This morphology is present in many other species of the genus, with some variation regarding the shape and extension of the pseudoporous area, the number of pores, and their size: *S. cornuta, S. halimedae, S. linearis, S. mamillata, S. mystacea* sp. nov. and *S. tubulata* sp. nov., among the species treated in the present paper; *S. asymetrica, S. cristata, S. fischeri, S. gautieri, S. hastata, S. hondti, S. triangularis* and *S. subsolana*, among other European species.

In several species previously assigned to *Schizomavella*, the ovicell is cleithral. In these species the ovicell opening is formed by the concave proximal margin of the ooecium, which extends to the proximolateral corners of the zooidal orifice; the periphery of the ooecium is covered by a thick layer of imperforate secondary calcification, leaving a central rounded area of exposed pseudoporous ectooecium. These species were recently transferred to the lanceoporid genus *Stephanotheca* (see Reverter-Gil et al. 2012).

In other European *Schizomavella* species, such as *S. discoidea* s. l., *S. neptuni* (Jullien, 1882) and *S. noronhai* (Norman, 1909), the globular ovicell is also acleithral. In these species the ooecium only has a basal, peripheral rim of imperforate secondary calcification and a large area of exposed pseudoporous ectooecium which may be covered by a thin layer of secondary calcification that does not occlude the pseudopores (Reverter-Gil et al. forthcoming).

*Schizomavella stanislavi* sp. nov., together with other European species *S. grandiporosa, S. hirsuta, S. sarniensis* and *S. teresae*, has a slightly different ovicell morphology: the ooecium is initially smooth, randomly perforated by pseudopores, but later covered by a thick, nodular secondary calcification that does not occlude the pseudopores. However, in these species there is always a small, uncovered vertical portion of the pseudoporous area just distal to the primary orifice (see Reverter-Gil and Fernández-Pulpeiro 1996; Souto et al. 2013; present paper), not too dissimilar to the type species of the genus. In all these species, both the frontal shield and the ovicell become heavily calcified and covered by minute, pointed processes, which makes it difficult to differentiate them without SEM imagery. This perhaps indicates that these species are closely allied, but probably they do not constitute a separate clade. Two of them, *S. sarniensis* and *S. teresae*, seem to be present only in the European Atlantic. *Schizomavella grandiporosa* is present from the northwest of the Iberian Peninsula down to North Morocco and Algeria. Finally, *S. hirsuta* and *S. stanislavi* sp. nov. are probably endemic Mediterranean species; both species share the distal calcified 'hood' on the suboral avicularium and perhaps both are derived from a '*S. grandiporosa*-like' ancestor. If this is the case, *S. mystacea* sp. nov. and *S. tubulata* sp. nov., with their distinct morphologies, perhaps developed the calcified 'hood' independently, making it a functional, analogous struture. *Schizomavella mystacea* sp. nov. may be derived from a '*S. cornuta*-like' ancestor, as this species has a similar ovicell, with *S. tubulata* sp. nov. deriving from a '*S. halimeade*-like' ancestor, both sharing the same ovicell.

Finally, *S. adriatica* sp. nov. also has an ovicell covered by perforated secondary calcification, but in this case there is no remnant of the pseudoporous ectooecium proximally. Also, the shape of the primary orifice in *S. adriatica* sp. nov. differs from other species treated here, and its avicularium, when present, is placed far from the orifice. As such, *S. adriatica* sp. nov. does not have a close morphological relationship with the other species treated in the present paper.

## Conclusions: updated list of Adriatic *Schizomavella* species

As a result of the revision of material in the present work, as well as the available literature, we can conclude that 11 species of *Schizomavella* are presently known in the Adriatic Sea. The presence of two other species is here considered uncertain (see below).

The most diverse locality in the Adriatic is Jabuka Shoal, where eight *Schizomavella* species were recorded. Rovinj and Vis (Komiža Bay) both have six species, while Jabuka Islet, Biševo and Korčula and Lastovo Islands have five species each.

*Schizomavella adriatica* sp. nov.
Unrecorded Adriatic locality (?Hincks 1886, as *S. auriculata*; present paper).
Rovinj (?McKinney and Jaklin 2000, as *S. rudis*; Hayward and McKinney 2002, as *S. rudis*).
Ćutin Islet (Cres), Vis (Komiža Bay) and Korčula Island, between 10 and 40 m (Novosel 2007, as *S. rudis*; present paper).
*Schizomavella asymetrica* (Calvet, 1927)
Rovinj (Hayward and McKinney 2002).

*Schizomavella cornuta* (Heller, 1867)
Kvarner region (Heller 1867, as *Lepralia cornuta*).
Unrecorded locality (Hincks 1886, as *Schizoporella auriculata* var. *spathulata*).
?Rovinj, Brijuni islands and near Muggia (Italy; Friedl 1918; Vatova 1928, both as *Smittina auriculata* var. *spathulata*).
?Jabuka Island (Zavodnik et al. 2000, as *Schizomavella cuspidata*).
Rovinj (Hayward and McKinney 2002).
?Lastovo and Prvić Islands (Novosel et al. 2004, as *S. cuspidata*).
Mlj Island, between 35 and 38 m (Novosel 2007, as *S. gautieri*; present paper).
Ždralova Bay, Ćutin Islet (Cres), Dugi otok, Iž Island, Kornati, Jabuka Shoal, Jabuka Islet, Brusnik, Biševo, Vis, Sušac, Lastovo Island and Korčula Island, between 1 and 40 m depth (Novosel 2007, in part; present paper).
Brindisi (Chimenz Gusso, pers. comm.)

*Schizomavella halimedae* (Gautier, 1955)
Unrecorded locality (Hincks 1887, as *Schizoporella discoidea*).
Lastovo and Prvić Islands (Novosel et al. 2004).
Kornati, Jabuka Shoal, Jabuka Islet, Biševo, Vis (Komiža Bay), Hvar Island and Lastovo Island, between 5 and 50 m depth (Novosel 2007, as *S. discoidea* and *S. halimedae*; present paper).

*Schizomavella linearis* (Hassall, 1841)
Hvar Island (Heller 1867, as *Lepralia linearis*).
Gulf of Trieste (Gräffe 1884, as *Schizoporella linearis*).
Unrecorded locality (Hincks 1887, as *Schizoporella linearis*).
Dugi otok Island (Brusina 1907, as *Schizoporella linearis*).
Silba Channel and Rovinj (Friedl 1918, as *Smittina linearis*).
Unrecorded locality (Kolosváry 1943, as *Schizoporella linearis*).
Rovinj (McKinney and Jaklin 2000; Hayward and McKinney 2002).
Jabuka Island (Zavodnik et al. 2000).
Lastovo and Prvić Islands (Novosel et al. 2004).
Ždralova Bay, Ćutin Islet (Cres), Dugi otok Island, Kornati, Silba, Jabuka Shoal, Jabuka Islet, Biševo, Vis (Komiža), Hvar Island (Kozja), Lastovo, Pelješac, and the islands of Korčula and Mljet, between 5 and 50 m depth (Novosel 2007, as *S. linearis* and *S. hastata*; present paper).

*Schizomavella mamillata* (Hincks, 1880)
Jabuka Island (Zavodnik et al. 2000).
Rovinj (Hayward and McKinney 2002).
Lastovo and Prvić Islands (Novosel et al. 2004).
Ždralova Bay, Jabuka Shoal, Jabuka Islet, Lastovo Island, Pelješac Peninsula and Korčula Island, between 10 and 45 m (Novosel 2007; present paper).

*Schizomavella mystacea* sp. nov.
? Rovinj (? Hayward and McKinney 2002, in part, as *S. cornuta*).
Jabuka Shoal and Biševo, between 30 and 32 m depth (Novosel 2007, in part, as *S. cornuta*; present paper).

*Schizomavella rosae* sp. nov.
Jabuka Shoal, at 34 m depth (Novosel 2007, in part, as *S. cornuta*; present paper).

*Schizomavella stanislavi* sp. nov.
Jabuka Shoal, Jabuka Islet, Lastovo Island, Biševo, Vis Island (Komiža) and Lastovo Island, between 5 and 105 m depth (Novosel 2007, as *S. asymetrica, S. auriculata*, and *S. cornuta*, in part; present paper).

*Schizomavella subsolana* Hayward and McKinney, 2002
Rovinj (Hayward and McKinney 2002).
Jabuka Shoal and Vis Island (Komiža), between 12 and 52 m depth (Novosel 2007).

*Schizomavella tubulata* sp. nov.
Korčula Island, between 30 and 40 m depth (present paper).
Uncertain records:

*Schizomavella discoidea* (Busk, 1859)
This species needs confirmation. Previous Adriatic records may correspond to *S. halimedae* or to a new species.

Rovinj (McKinney 2000; McKinney and Jaklin 2000).
Jabuka Island (Zavodnik et al. 2000).

*Schizomavella hastata* (Hincks, 1862)
This species needs confirmation. Previous Adriatic records may correspond to a morphotype of *S. linearis* or to a new species.
Dugi otok Island (Brusina 1907, as *Schizoporella linearis hastata*).
Unrecorded locality (Friedl 1918, as *Smittina linearis* var. *hastata*).

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## Geolocation information

| Locality No | Locality name | Coordinates |
|---|---|---|
| 1 | Ždralova Bay (Velebit Channel) | 44.884317ºN, 14.890967ºE |
| 2 | Ćutin Islet (Cres) | 44.723930ºN, 14.493740ºE |
| 3 | Silba | 44.381567ºN, 14.663233ºE |
| 4 | Dugi otok (North) | 44.170417ºN, 14.805117ºE |
| 5 | Iž Island | 44.030780ºN, 15.111860ºE |
| 6 | Dugi otok Vele stijene | 43.904700ºN, 15.132567ºE |
| 7 | Kornati | 43.798700ºN, 15.274200ºE |
| 8 | Jabuka Shoal | 43.101000ºN, 15.436833ºE |
| 9 | Jabuka Islet | 43.091667ºN, 15.460000ºE |
| 10 | Brusnik | 43.004333ºN, 15.792667ºE |
| 11 | Biševo | 42.955200ºN, 16.004350ºE |
| 12 | Vis (Komiža) | 43.044300ºN, 16.072130ºE |
| 13 | Sušac | 42.766783ºN, 16.508833ºE |
| 14 | Hvar (Kozja) | 43.113740ºN, 17.049300ºE |
| 15 | Lastovo | 42.723780ºN, 16.884290ºE |
| 16 | Korčula | 42.949730ºN, 17.160260ºE |
| 17 | Pelješac | 42.946120ºN, 17.285220ºE |
| 18 | Mljet | 42.756400ºN, 17.383890ºE |

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