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Serpulidae (Annelida) of Lizard Island, Great Barrier Reef, Australia

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Abstract

Serpulidae are obligatory sedentary polychaetes inhabiting calcareous tubes that are most common in subtropical and tropical areas of the world. This paper describes serpulid polychaetes collected from Lizard Island, Great Barrier Reef, Australia in 1983–2013 and deposited in Australian museums and overseas. In total, 17 serpulid genera were recorded, but although the study deals with 44 nominal taxa, the exact number of species remains unclear because a number of genera (i.e., *Salmacina*, *Protula*, *Serpula*, *Spirobranchus*, and *Vermiliopsis*) need world-wide revisions. Some species described herein are commonly found in the waters around Lizard Island, but had not previously been formally reported. A new species of *Hydroides* (*H. lirs*) and two new species of *Semivermilia* (*S. annehoggettae* and *S. lylevaili*) are described. A taxonomic key to all taxa found at Lizard Island is provided.

Key words: Serpulidae, taxonomy, new records, new species

Introduction

The annelid family Serpulidae *sensu lato* is large, currently comprising 70 valid genera and over 500 species (ten Hove & Kupriyanova 2009; Rzhavsky *et al.* 2013). Traditionally the family was divided into the subfamilies Spirorbinae, Serpulinae, and Filograninae (e.g., Rioja 1923; Fauvel 1927). Pillai (1970) elevated the Spirorbinae to family status, but a number of later phylogenetic studies (e.g., ten Hove 1984; Smith 1991; Kupriyanova 2003; Kupriyanova *et al*. 2006) showed that spirorbins are monophyletic and are nested within the Serpulidae. Moreover, the results of analyses of both molecular (Lehrke *et al.* 2007; Kupriyanova *et al.* 2009) and combined morphological and molecular data (Kupriyanova *et al.* 2006) indicate that neither Serpulinae nor Filograninae is monophyletic and that Spirorbinae is a sister group to a clade containing mostly "filogranins" and some "serpulins". Therefore, currently the spirorbids are lowered to subfamily rank (Rzhavsky *et al*. 2013) and the traditional subfamilies Serpulinae and Filograninae have been abandoned pending revision and re-formulation.

Studies of serpulids in Australia are scarce. Haswell (1883, 1885) was the first zoologist who described 11 Australian serpulid species from the British Museum collections. Early studies of Australian serpulids were published by Bush (1905), Augener (1914), Benham (1916), Fauvel (1917, 1922), Johansson (1918), Bretnall (1921), and Monro (1938). Among those, only Bretnall (1921) mentions a serpulid (*Ditrupa*) from Queensland. Dew (1959) and Straughan (1967a, b) were the first authors dealing exclusively with serpulid polychaetes, together mentioning over 50 taxa from Thursday Island in North Queensland to Cape Jarvis in Southern New South Wales. Between 1979 and 1991 Hartmann-Schröder published 11 papers on polychaetes (including some serpulid records)

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all around Australia (Hartmann-Schröder 1979, 1980, 1981, 1983, 1984, 1985, 1986, 1987, 1989, 1990, 1991), however, not from Lizard Island. Information on serpulids from Lizard Island has been scattered in a number of more recent publications. Bioerosion and recruitment studies at Lizard Island by Hutchings & Murray (1982) and Hutchings (1984) mentioned two serpulid species. Imajima & ten Hove (1984) examined some serpulids from Australia, among which 7 are from Lizard Island. Fiege & ten Hove (1999) redescribed *Spirobranchus gaymardi* (Quatrefages, 1866), while Pillai & ten Hove (1994) described two new species of *Spiraserpula* collected from Lizard Island. Kupriyanova *et al.* (2006), the first combined morphological and molecular phylogeny of the family, and the study of Kupriyanova *et al.* (2008) included 7 species collected from Lizard Island. Ten Hove & Kupriyanova (2009) mentioned and illustrated a number of serpulid taxa collected at Lizard Island in their taxonomic review of the family Serpulidae. Most recently Sun *et al.* (2015) revised the genus *Hydroides* in Australia. The present study is the first to systematically describe serpulid polychaetes (excluding spirorbins) from Lizard Island.

Material and methods

The present work is based on the serpulid material collected at Lizard Island by Harry ten Hove in 1983 and 1986, Richard Smith (James Cook University, Australia) in 1984–1986, Elena Kupriyanova and Greg Rouse in 2005, Charlotte Watson and Chris Glasby (both MAGNT, CReefs surveys http://www.aims.gov.au/creefs/field-program.html) in 2008 and 2009, and Yanan Sun, Elena Kupriyanova, and Pat Hutchings (Lizard Island Polychaete Workshop) in 2013. Locality data for material collected in 2013 during the Lizard Island Polychaete Workshop (MI QLD xxxx) are provided in the Appendix of Ribas & Hutchings (2015, *Zootaxa* 4019) together with maps showing sites.

The specimens are deposited in the following museum collections: **AM**—Australian Museum, Sydney, Australia, **BM(NH)**—British Museum (Natural History), nowadays Natural History Museum, London, UK, **MAGNT**—Museum and Art Gallery of Northern Territory, Darwin, Australia, **MBMCAS**—Marine Biological Museum of the Chinese Academy of Sciences, Qingdao, China, **SAM**—South Australian Museum, Adelaide, Australia (some material lacks registration numbers), **SMF**—Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt, Germany, and **ZMA**—Zoological Museum of Amsterdam, nowadays incorporated in the Naturalis Biodiversity Center, Leiden, the Netherlands. Other abbreviations used: NSW—New South Wales, NT—Northern Territory, Qld—Queensland, WA—Western Australia.

Live specimens were examined in the laboratory of Lizard Island Research Station (**LIRS**) and were photographed by G. Rouse in 2005 and by A. Semenov in 2013. Fixed specimens were completely or partially removed from their tubes, stained with methyl blue to increase contrast, and were viewed under a dissecting microscope Leica MZ8. Selected fixed specimens were photographed by Eunice Wong with Spot Flex CCD 15.2 camera fitted on a Leica MZ16 dissection microscope at the **AM**. Helicon Focus 5.3 Pro software was used to create a sharply focussed photomontage, using the layers of partially focused images captured. Number of specimens listed under each registration number is one unless otherwise specified.

Taxonomic account

Genus *Crucigera* Benedict, 1887

Type-species. *Crucigera websteri* Benedict, 1887

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube white or yellowish, opaque, circular to semi-circular in cross-section, with or without longitudinal keels and/or peristomes; tabulae may be present. Granular overlay absent, but outer layer may be shiningly hyaline. Operculum soft, funnel shaped, formed of fused radii. Base of funnel with 2–4 finger-like bosses. Peduncle smooth, cylindrical, without wings, separated from operculum by constriction; inserted proximal from first and/or second dorsal radiole on one side. Pseudoperculum present. Arrangement of radioles in two half to complete circles, up to 50 radioles per lobe in larger taxa. Inter-radiolar

membrane present. Branchial eyes may be present. Stylodes absent. Mouth palps absent. Seven thoracic chaetigerous segments. Collar trilobed, tonguelets between ventral and lateral collar lobes absent. Thoracic membranes long, forming apron. Collar chaetae bayonet-shaped and limbate. Thoracic chaetae limbate, *Apomatus* chaetae absent. Thoracic uncini saw-shaped with 5–7 teeth, including simple pointed anterior fang. Triangular depression present. Abdominal chaetae flat trumpet-shaped, with denticulate edge. Abdominal uncini saw-shaped with 4–6 teeth anteriorly; rasp-shaped with 2–4 rows, 7–8 teeth in profile posteriorly. Long posterior capillary chaetae present. Achaetous anterior abdominal zone absent. Posterior glandular pad absent.

Remarks. The genus, with five species, was thoroughly revised by ten Hove & Jansen-Jacobs (1984). It is most similar to the nominal genus *Serpula*, the only difference being the finger-like bosses below the opercular funnel. However, a molecular phylogenetic study by Kupriyanova *et al*. (2008) demonstrated that both traditional genera *Crucigera* and *Serpula* most probably are paraphyletic.

Crucigera tricornis Gravier, 1906

(Fig. 1A, B)

Serpula (*Crucigera*) *websteri* var. *tricornis* Gravier, 1906a: 111–112 [Red Sea; description].—1906b: pl. 8, fig. 289; 1908: 117–119, figs 473–475 [same].

Serpula websteri tricornis.—Solis-Weiss *et al*. 2004: 18 [Gulf of Tadjoura, Gulf of Aden, holotype, MNHN POLY TYPE 734].

Crucigera tricornis.—Imajima 1977: 92–94, fig. 3 [Ogasawara Islands, Southern Japan; description]; ten Hove & Jansen-Jacobs 1984: 161–162 [detailed description as a part of revision]; Imajima & ten Hove 1984: 42–43, fig. 3a, b [Ponape Island, Majuro Atoll; Lizard Island]; Vine & Bailey-Brock 1984: 139 [Red Sea]; Vine 1986: 89–90 [Red Sea; figure]; Imajima & ten Hove 1986: 3 [Solomon Islands]; Bailey-Brock 1987: 282 [Tonga]; ten Hove 1993: 83 [Seychelles, name only]; 1994: 114 [same]; Hassan 1998: 51 [Red Sea; diagnosis]; Fiege & Sun 1999: 111 [Hainan Island, China]; Sun & Yang 2001b: 210–211, fig. 1A–F [Hainan Island]; Wehe & Fiege 2002: 124 [synonomy]; Kupriyanova *et al.* 2008: 426, 428, 430–43, fig. 1D [Lizard Island; DNA data]; ten Hove & Kupriyanova 2009: 36, fig. 3D [Lizard Island]; Bailey-Brock *et al*. 2012: 969 [Marshall Islands].

Material examined. AM W.28308 (2), Turtle Beach, 14°40'S, 145°27'E, undersides of dead and living corals, coll. H. ten Hove, 22 Jun 1983; **AM** W.28344, stn.21, south of South Island, 14°42'S, 145°28'E, sloping silty reef, little coral cover, 20 m, coll. H. ten Hove & P. Hutchings, 6 Mar 1986; **AM** W.43970, MI QLD 2354; **AM** W.47309, Day Reef, outer Fore Reef, 14°28'30"S, 145°32'12"E, coral rubble, 30 m, coll. S. Smith; **AM** W.47313, Day Reef, mid-shelf of Fore Reef, 14°28'18"S, 145°31'48"E, coral rubble, 10 m, coll. M. Blazewicz-Paskowycz, 13 Feb 2009; **AM** W.47345, Hicks Reef outer Barrier, 14°28'48"S, 145°29'18"E, coral rubble, 2–18 m, coll. C. Watson & K. Mills, 14 Feb 2009; **AM** W.47351, inter-reef sand, 14°23'24"S, 145°31'48"E, artificial substrate, 10 m, coll. M. Timmers, 9 Feb 2009; **AM** W.47354, same, 10 Feb 2009; **AM** W.47450, stn.G238, east lagoon near Bird Islet, 10 m, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **MAGNT** W025495, North Point, Fore Reef, 14°39'S, 145°27'E, coral rubble, 2 m, coll. C. Watson, 12 Apr 2008; **MAGNT** W025496, Big Vicky Reef, northwest of Palfrey Island, 14°0'S, 145°0'E, coral rubble, 3 m, coll. K. Mills, 12 Apr 2008; **MAGNT** W025498, off Granite Bluff, Fore Reef, 14°0'S, 145°0'E, coral rubble, 15 m, coll. M. Blazewicz-Paskowycz, 17 Apr 2008; **MAGNT** W025501, Yonge Reef, 14°34'30"S, 145°36'18"E, coll. C. Glasby, 20 Apr 2008; **SAM** E3587, stn.G231, off Coconut Beach, 14°41'S, 145°28'E, G. Rouse & E. Kupriyanova, 26 Oct 2005; **ZMA** V.Pol. 4578 (4), stn.18, lagoon near east entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, 3 Mar 1986; **ZMA** V.Pol. 4579, stn.17, Palfrey Island, south of lighthouse, 14°40'S, 145°28'E, coral heads on sandy bottom, 7 m, coll. H. ten Hove, P. Hutchings & M. Reid, 2 Mar 1986.

Diagnosis. Operculum a shallow funnel with three large elongated proximal processes; tube with 6–9 longitudinal keels (Fig. 1A, B).

Remarks. According to descriptions and illustrations of Imajima (1977) and Imajima & ten Hove (1984), the tube of this species is white with 7–9 sinuous longitudinal keels, with a row of pits between the keels. However, at least one speciemen from Lizard Island (Fig. 1B) had a yellowish tube with straight longitudinal keels and numerous transverse ridges.

Distribution. Red Sea, Japan, Australia; widely distributed in the Indo-West Pacific.

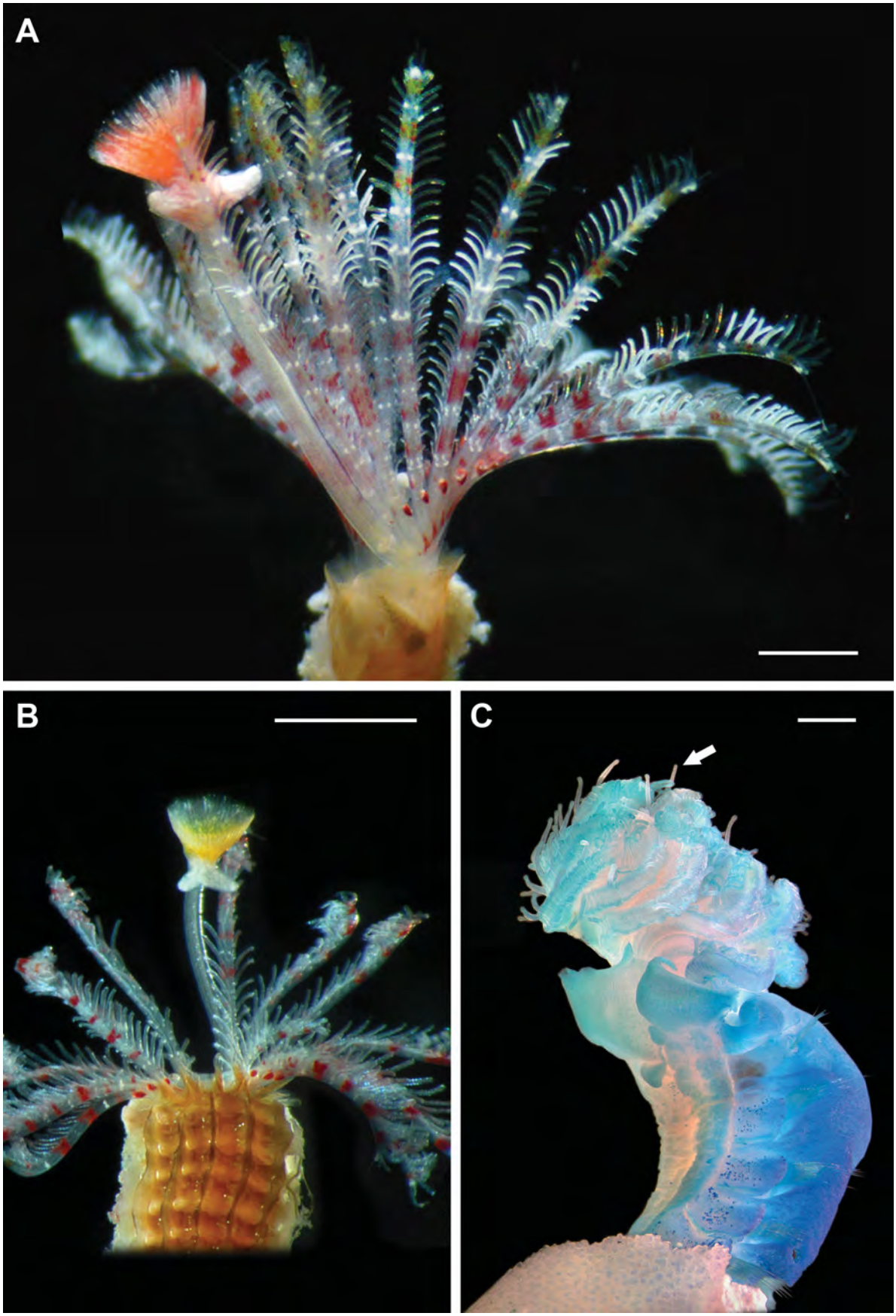

FIGURE 1. A. *Crucigera tricornis,* live animal, stn.G231, **SAM** E3587; B. Live animal, stn.G238, **AM** W.47450; C. *Dasynema chrysogyrus*, anterior lateral view of fixed specimen (stained with methylene blue), operculum missing, **AM** W.45087, arrow indicates radiolar stylodes. Photo: A, B—G. Rouse, C—E. Wong. Scale bars: A = 1 mm, B = 1 mm, C = 0.5 mm.

Genus *Dasynema* Saint-Joseph, 1894

Type-species. *Serpula chrysogyrus* Grube, 1876

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube white, opaque, with some orange, semi-circular in cross-section, with peristomes and (5) irregular longitudinal keels. Hyaline granular overlay of the tube absent. Operculum with fleshy globular ampulla proximally, calcium carbonate infiltrated chitinous cone distally. Peduncle smooth, without pinnules, broadly flattened, with unpaired basal wing for 2/3rd of its length and paired small distal wings, separated from ampulla by constriction; inserted at the base of radiolar crown below and between 1st and 2nd radioles. Pseudoperculum absent. Radioles arranged in two semi-circles and connected by short inter-radiolar membrane. Radioles with ocellar clusters and unpaired outwardly directed stylodes, up to 15 radioles per lobe. Mouth palps not observed. Seven thoracic chaetigerous segments. Collar trilobed, tonguelets absent. Thoracic membranes ending at 5th chaetiger, no apron. Collar chaetae limbate. *Apomatus* chaetae present. Thoracic uncini saw-shaped, with numerous (approximately 17) teeth, anterior peg blunt (not gouged or pointed). Triangular depression present. Abdominal chaetae flat narrow geniculate with blunt teeth along blade (*Vermiliopsis* type). Abdominal uncini saw-shaped anteriorly, with 11–12 teeth, posteriorly rasp-shaped with 2–4 rows of teeth, 14–15 teeth in profile. Achaetous anterior abdominal zone absent. Posterior capillary chaetae present, very long. Posterior glandular pad present.

Remarks. This poorly known monotypic genus is easily recognizable because of its characteristic feature, outwardly directed stylodes on the radioles, which is unique for serpulids. For a detailed differential diagnosis see Imajima & ten Hove (1984: 55).

Dasynema chrysogyrus (Grube, 1876)

(Fig. 1C)

Serpula chrysogyrus Grube, 1876: 73 [Philippines].

Serpula chrysogyrus.—Grube 1878: 276–278, pl. 15, fig. 8 [Philippines]; Andrews 1891: 289 [same]; McIntosh 1926: 412 [same].

Dasynema chrysogyrus.—Saint-Joseph 1894: 262, 264 [species placed in new genus]; Imajima & ten Hove 1984: 56–58, fig. 6 a–t [Ponape Island; detailed description]; ten Hove & Kupriyanova 2009: 38–39, fig. 14 [SEM of chaetae and radiolar crown]; Bailey-Brock *et al.* 2012: 968–970, fig. 2 [Marshall Islands].

Not *Dasynema chrysogyrus.*—Nishi 1993c: 145–146, figs 1, 2 [Okinawa, Japan; see Remarks].

Material examined. AM W.45087, MI QLD 2424; **ZMA** V.Pol. 4539 (2), stn.18, lagoon near East entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, 3 Mar 1986; **ZMA** V.Pol. 4540, stn.20, reef front north of South Island, sloping reef outside lagoon & sandy bottom below, 10–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 5 Mar 1986.

Diagnosis. Tubes elaborate with five longitudinal ridges of tubercles; pale dull yellow with white ridges. Radioles with slender external stylodes in a single row; paired eyespots at the base of stylodes. Operculum with light-brown chitinous cap.

Remarks. The preserved material of *Dasynema* could be mistaken for species of *Vermiliopsis glandigera/pygidialis*-complex based on tube and opercular characters since stylodes have to be teased carefully away from the radiole to be seen in some specimens. The record of *Dasynema* in Okinawa (Nishi 1993c) is based on a mis-identification because the reported specimen lacks stylodes and thus, does not belong to this genus (Nishi pers. comm.), but probably belongs to the *Vermiliopsis glandigera/pygidialis*-complex.

Distribution. Philippines: Ponape Island, Eastern Caroline Islands; Okinawa, Japan; Qld, Australia; Marshall Islands. First record for Lizard Island.

Genus *Hydroides* Gunnerus, 1768

Type-species. *Hydroides norvegica* Gunnerus, 1768

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube white (sometimes bluish), more or less circular to trapezoidal (with flattened upper surface) in cross-section, peristomes and shallow longitudinal ridges may be present, no distinct keels. A granular overlay may be present. Operculum two-tiered, composed of basal funnel of fused radii and distal verticil (crown) of chitinized spines. Peduncle cylindrical, smooth, without wings, separated or not from opercular funnel by a constriction; formed from second dorsal radiole on one side. Pseudoperculum present. Arrangement of radioles in semi-circles, up to 33 per lobe. Branchial eyes absent. Inter-radiolar membrane generally absent, rarely present. Stylodes absent. Mouth palps absent. Seven thoracic chaetigerous segments, exceptionally more (9 in *H. bisecta* Imajima & ten Hove, 1989 and *Hydroides* sp. 2 Bastida-Zavala & ten Hove 2002; 7–9 in *H. bannerorum* Bailey-Brock, 1991). Collar trilobed, tonguelets absent. Thoracic membranes long, forming ventral apron. Collar chaetae bayonet-type and limbate. *Apomatus* chaetae absent. All uncini saw-shaped with up to 7 teeth; anterior fang simple pointed. Triangular depression present. Abdominal chaetae flat trumpet-shaped with denticulate edge. Achaetous anterior abdominal zone absent. Posterior capillary chaetae present. Posterior glandular pad absent.

Remarks. The genus in Australia was recently revised by Sun *et al.* (2015) to include 26 taxa, 9 of which were found off Lizard Island.

Hydroides albiceps (Grube, 1870)

(Fig. 2)

Serpula (*Eupomatus*) *albiceps* Grube, 1870: 520–521 [Red Sea].

Eupomatus albiceps.—Willey 1905: 312, pl. 7, fig. 180A [Sri Lanka]; Hartman 1954: fig. 641 [Marshall Islands]; Reish 1968: 228 [Marshall Islands].

Hydroides albiceps.—Fauvel 1953: 460, fig. 241d, e [Sri Lanka]; Pillai 1960: 12 [Sri Lanka]; 1971: 112–113 [same]; Straughan 1967b: 220, fig. 8m [Qld, Australia]; Imajima 1976a: 234–235 [diagnosis, Japan]; 1976b: 133–135, fig. 8a–v [Tanegashima, Japan]; 1978: 53–54 [Izu Islands, Japan]; 1979: 168 [Honshu, Japan]; 1982: 44 [Micronesia]; Mak 1982: 601–602 [Hong Kong]; Day & Hutchings 1979: 143 [Qld; name in checklist]; Imajima & ten Hove 1984: 43–44 [Truk Islands, Ponape and Majuro Atoll; Shark Bay, WA, Australia; Gulf of Thailand, Indonesia, Samoa]; 1986: 5 [Solomon Islands]; Vine & Bailey-Brock 1984: 139, fig. 2K [Sudan, Red Sea]; Yang & Sun 1988: 311, fig. 150 F–G [South China Sea]; Nishi 1993a: 12, table 1 [Ryukyu Islands; reproduction]; Meng *et al.* 1994: 47 [Hainan, South China Sea]; Wang & Huang 1993: 7 [Hong Kong; fouling]; Ishaq & Mustaquim 1996: 164–166, fig. 2 [Pakistan]; Hassan 1998: 50 [Red Sea, figure]; Mohan *et al.* 1997: 351, 354–355, fig. 10 [India; fouling]; Fiege & Sun 1999: 112–114 [Hainan Island, China]; Sun & Yang 2000: 117–118, fig. 1A–G [same]; ten Hove & Ben-Eliahu 2005: 129–132, 134, 135, 137, 143–145 [opercular development; Seychelles, Red Sea, Philippines, Samoa, Qld, Australia]; ten Hove & Kupriyanova 2009: 52 [name only]; Sun *et al.* 2012a: 7, figs 3A–B, 4A–H [Hong Kong]; Bailey-Brock *et al*. 2012: 969 [Enewetak, Marshall Islands]; Sun *et al.* 2015: 10–14, fig. 2 [WA, NT, Qld, Australia].

Hydroides minax (not Grube).—Gibbs 1971: 203 [Solomon Islands].

Hydroides spiratubus Pillai, 2009: 128–131 [Kimberley, WA].

Material examined. AM W.20155 (2), Turtle Beach, lagoon, 14°40'S, 145°28'E, coll. G. Anderson, 22 Jun 1982; **MAGNT** W025510, off Casuarina Beach, lagoon of Patch Reef, 14°40'48"S, 145°26'42"E, coral rubble, 2 m, coll. N. Bruce, 15 Apr 2008.

Diagnosis. Opercular verticil with 6–13 spines, curved outward, with rectangular to clavate tips, without any accessory spinules. Dorsal verticil spine vesicular, consisting of a bulbous median part, and two latero-dorsal more or less triangular (seen from the dorsal side) outpockets; the three parts vary considerably in relative size. Funnel with 14–31 clavate to bottle-shaped chitinized radii, bluntly rounded in juveniles, base of funnel not chitinized. Grooves separating radii extending 1/2 of funnel length (Fig. 2).

Remarks. The species is most similar to *Hydroides trivesiculosa* Straughan, 1967b. According to Sun *et al.* 2015, *H. albiceps* differs from *H. trivesiculosa* in the size and shape of the dorsal verticil spine. *H. trivesiculosa* has an exceptionally large vesicular dorsal verticil spine which is more than 5 times longer than the smaller verticil spines. The lateral outpockets of the dorsal verticil spine are straight in *H. albiceps*, while those of *H. trivesiculosa* are larger and curved ventrally.

Distribution. Red Sea, widely distributed in the Indo-West Pacific.

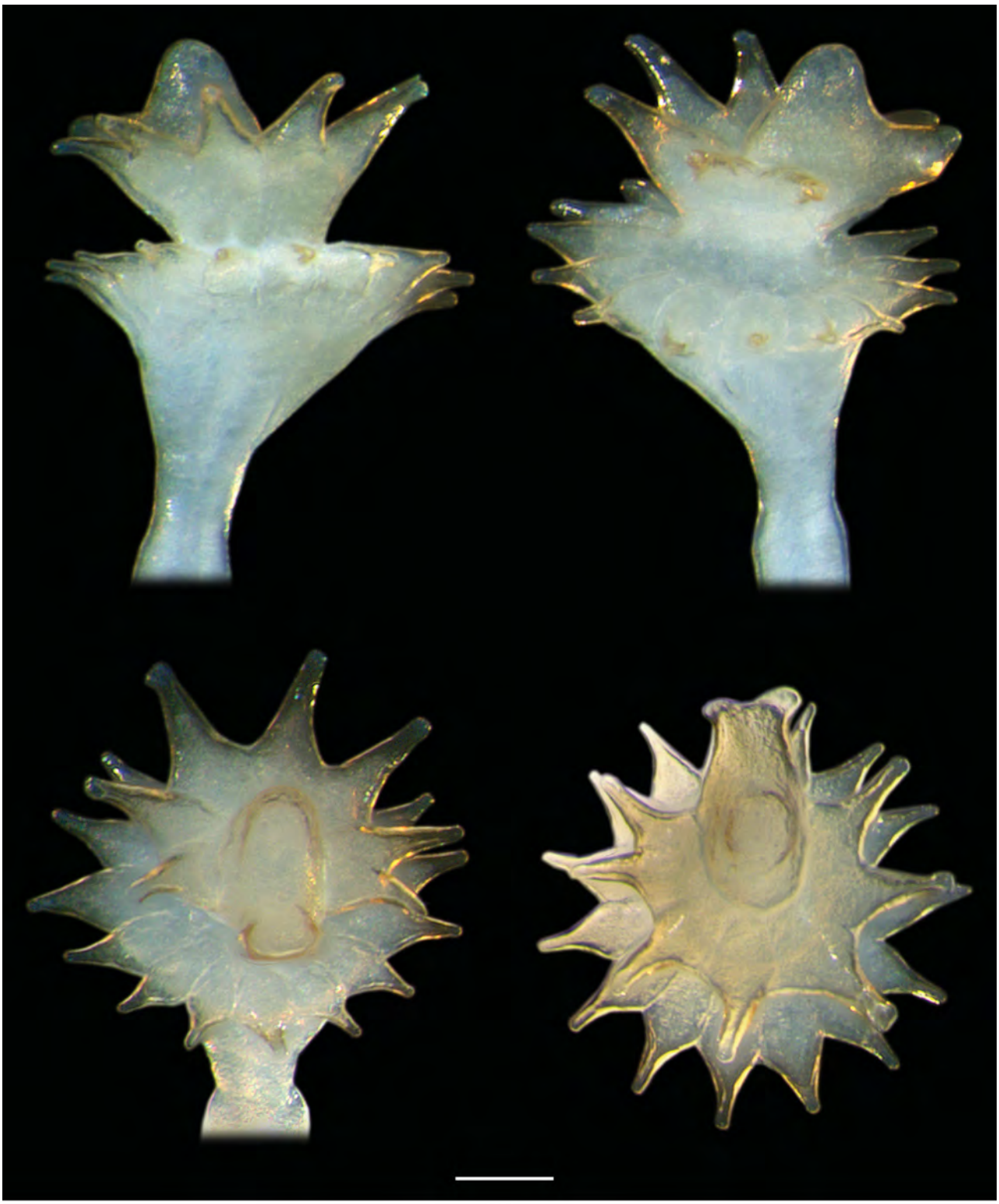

FIGURE 2. *Hydroides albiceps*, fixed specimen, various views of the same operculum, **AM** W.20155. Photo: E. Wong. Scale bars = 0.1 mm.

Hydroides externispina Straughan, 1967b

(Fig. 3)

Hydroides externispina Straughan, 1967b: 31–33, fig. 3 [Heron Island, Qld; material studied].
Hydroides externispina.—Imajima 1976a: 232 [diagnosis; Japan]; 1976b: 126–127, fig. 3a–k [South-Western Japan; description]; ten Hove & Kupriyanova 2009: 53 [name only]; Sun *et al.* 2015: 32–34, fig 8 [WA, Qld, Australia].
Hydroides externispinosa [in error].—Day & Hutchings 1979: 144 [Qld; name in checklist].

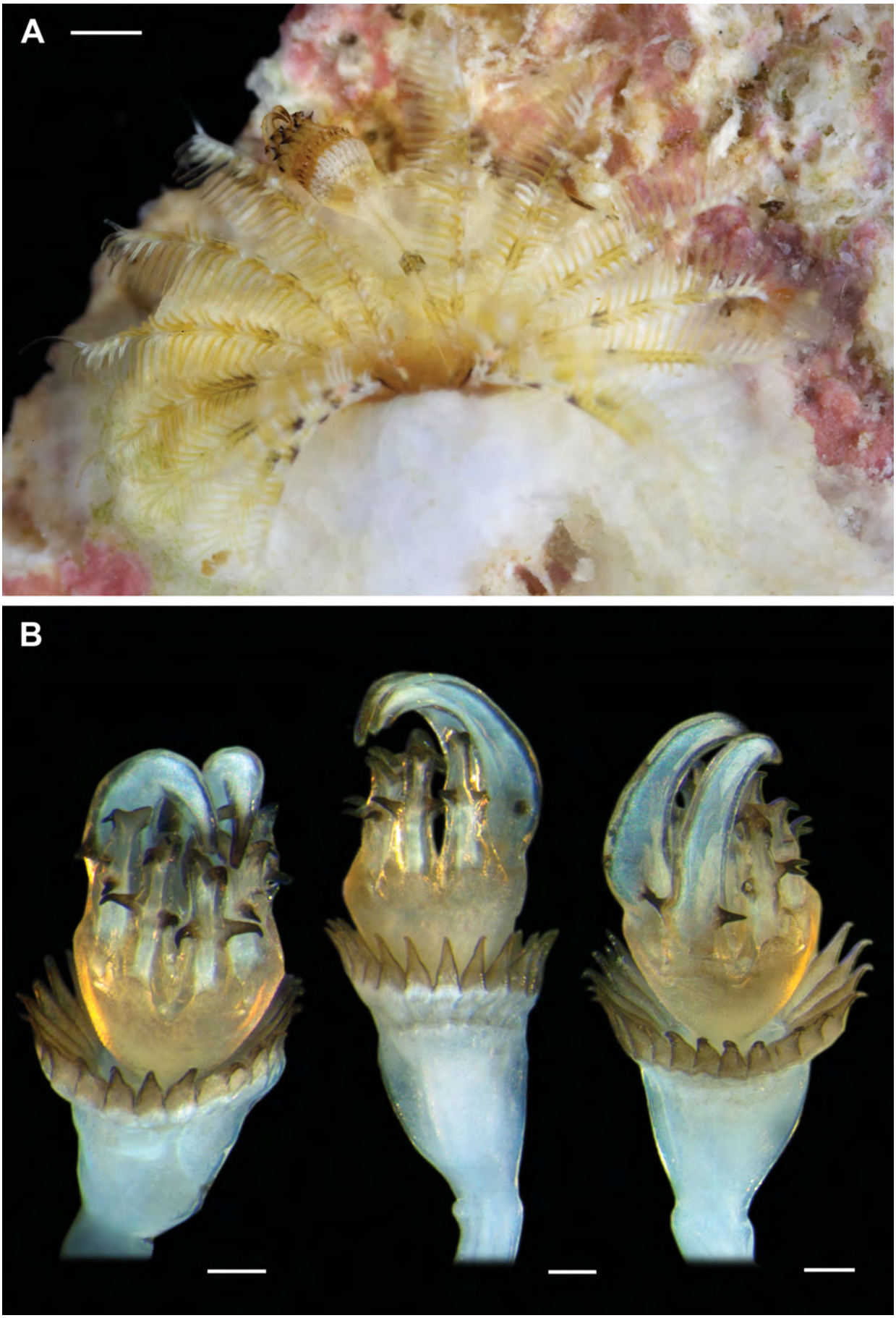

FIGURE 3. *Hydroides externispina.* A. Live animal in tube, **AM** W.45056; B. Fixed specimen, various views of the same operculum. Photo: A—A. Semenov, B—E. Wong. Scale bars: A = 1 mm, B = 0.1 mm.

Material examined. AM W.45056, MI QLD 2406; **AM** W.45086, MI QLD 2424; **MAGNT** W025511, southwest of Palfrey Island, lagoon, 14°41'42"S, 145°26'50"E, coral rubble, 4 m, coll. M. Ekins, 13 Apr 2008; **MAGNT** W025514, lagoon southwest of Palfrey Island, 14°41'42"S, 145°26'30"E, coral rubble, 4 m, coll. M. Ekins, 15 Apr 2008.

Diagnosis. Opercular verticil with 8–10 spines, ending into sharply pointed tips, curved inwards. Two dorsal verticil spines long and curved inwards, with pair of proximal lateral spinules. Dorsal spines covering other verticil spines, the latter with one curved external spinule on 1/3 of the incurving sharp tip, with a pair of lateral spinules curving outward and a small basal spinule. Funnel with 24–36 pointed chitinized tips, base of funnel not chitinized. Grooves separating radii extending 1/3 of funnel length (Fig. 3).

Remarks. *Hydroides externispina* is easily recognisable because of its two large, strongly curved inwards dorsal verticil spines as well as dark curved outwards lateral and external spinules. This species can be confused with *H. tambalagamensis* Pillai, 1961 because of similar dark curved outwards lateral spinules on the verticil spines in both species. *H. externispina* differs from *H. tambalagamensis* by the presence of two enlarged curved inwards dorsal verticil spines, whereas in *H. tambalagamensis* all verticil spines are of the same size. The presence of these two large inwards-curved dorsal verticil spines makes *H. externispina* similar to *H. glasbyi* Sun *et al*., 2015, however, the latter species lacks conspicuous externally curved lateral spinules on smaller verticil spines.

Distribution. Indo-West Pacific: Southwestern Japan, Indonesia, New Caledonia; Qld, WA, Australia.

***Hydroides lirs* n. sp.**
(Figs 4, 5)

Material examined. Holotype: **AM** W.43967, MI QLD 2354. Paratypes: **AM** W.41749, Yonge Reef, 14°35'S, 145°37'E, coll. R. Smith, 5 Nov 1985; **AM** W.42357, Yonge Reef, back reef bommie, 14°36'S, 145°37'E, coll. R. Smith, 7 Nov 1985; **AM** W.42358, same; **ZMA** V. Pol.5035, stn.21, south Lizard Island, 14°42'S, 145°28'E, sloping silty reef, little coral cover, 20 m, coll. H. ten Hove & P. Hutchings, 6 Mar 1986.

Other material examined. AM W.42366, Palm Group, Orpheus Island, Pioneer Bay, 18°37'S, 146°30'E, coll. R. Smith, Oct 1984.

Diagnosis. Opercular verticil with a basal column and 11–12 spines (Figs 4A, 5A). All verticil spines with pointed tips and one pointed internal spinule each at mid-length. Dorsal verticil spine large hook, strongly curved inward and bearing a pair of lateral spinules distally; other spines similar in size and shape, curved outwards. Central tooth absent. Funnel with 20–30 chitinized radii ending in long pointed tips; radii each bearing a minute internal spinule basally; base of funnel elongated, chitinized. Grooves separating radii extending 1/2 of funnel length.

Description. TUBE: white, width 3.86 mm (4.24 ± 0.92 mm, n = 3, 3.57–4.24 mm), with lumen of 3.14 mm (2.76 ± 0.66 mm, n = 3, 2–3.14 mm). Circular in cross section, without longitudinal ridges.

BRANCHIAE: with 20 radioles on left lobe, 24 radioles on right lobe (21.2 ± 1.3 left radioles, n = 5, 20–23; 22.6 ± 1.95 right radioles, n = 5, 20–25), arranged in semicircles, not connected by inter-radiolar membrane (Fig. 4B). Branchial eyes absent.

PEDUNCLE: smooth, circular in cross section, inserted just below first and second normal radioles; with clear chitinized constriction at the base of the funnel (Fig. 4A). Pseudoperculum present.

OPERCULUM: with distal verticil inserted on short stalk into proximal oblique radially symmetrical funnel. Verticil with 11 spines (11.4 ± 0.55, n = 5, 11–12), with pointed tip; one dorsal hook stout, elongated, curved inward, with a pair of subterminal lateral spinules; other verticil spines curved outwards, with one inner spinule at about half of their length (Figs 4A, 5A). Basal spinule absent. Funnel with 34 (50 ± 10.3, n = 5, 34–62) sharp chitinized radii, each radius with one curved basal tooth. Grooves separating radii extending 1/3 to 1/2 of funnel length. Length of operculum 2.33 mm (3.27 ± 0.64 mm, n = 5, 2.33–4 mm), width 1.37 mm (1.93 ± 0.48 mm, n = 5, 1.37–2.67 mm).

COLLAR AND THORACIC MEMBRANES: collar low, continuous with thoracic membranes, forming apron across anterior abdominal chaetigers.

THORAX: with collar chaetiger and 6 uncinigerous chaetigers. Collar chaetae of two types: bayonet with two short conical teeth (Fig. 5B) and limbate. Subsequent chaetae limbate, of two sizes. Uncini along entire thorax saw-shaped with 6–7 teeth (Fig. 5C).

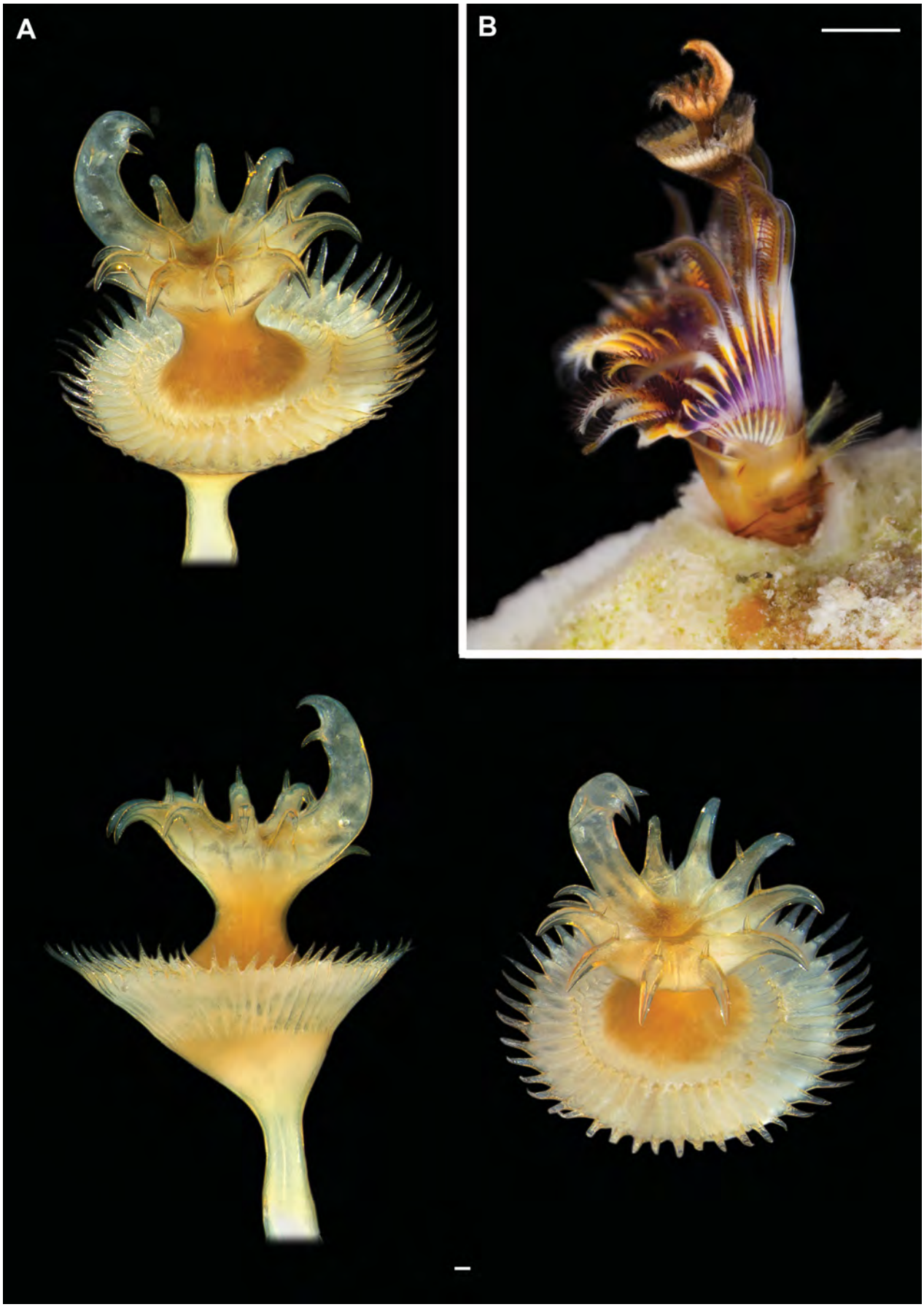

FIGURE 4. *Hydroides lirs* n. sp. A. Fixed specimen, various views of the same operculum, **AM** W.41749; B. Live animal in tube, **AM** W.43967. Photo: A—E. Wong, B—A. Semenov. Scale bars: A = 0.1 mm, B = 1 mm.

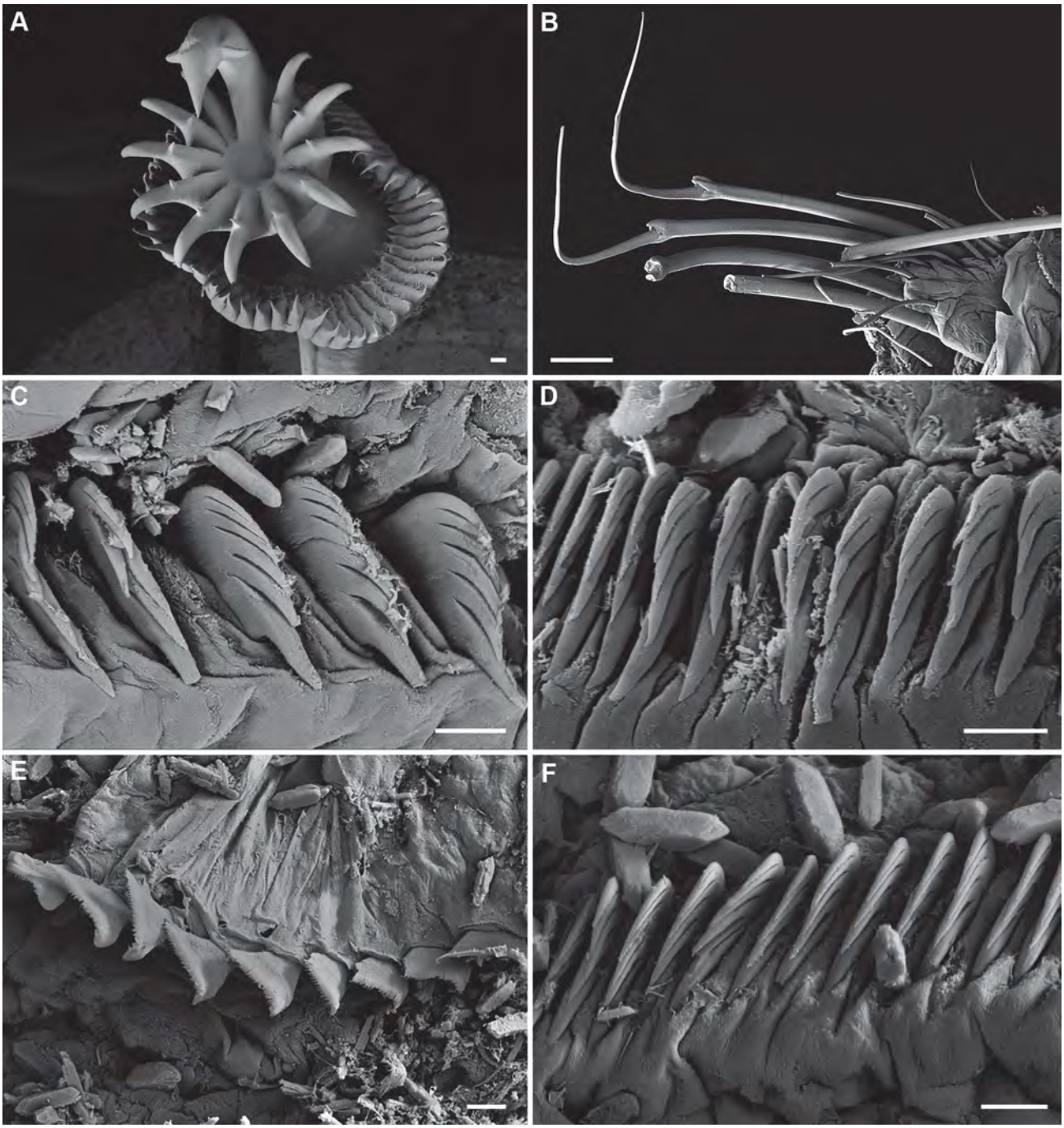

FIGURE 5. *Hydroides lirs* n. sp., **AM** W.42366, SEM images. A. Operculum, top view; B. Collar chaetae; C. Uncini of thoracic chaetiger; D. Uncini of anterior abdominal chaetiger; E. Flat trumpet-shaped chaetae of mid-abdominal chaetiger; F. Uncini of mid-abdominal chaetiger. Photo: A–F—Y. Sun & S. Lindsay. Scales: A, B = 0.1 mm, C–F = 0.01 mm.

ABDOMEN: abdominal chaetigers 140 (131 ± 10.3, n = 3, 120–140 mm). Chaetae flat trumpet-shaped (Fig. 5E), uncini saw-shaped anteriorly (Fig. 5D, F), with pointed fang and 4–5 teeth; rasp-shaped with 2–5 rows of teeth and fang and up to 4–5 teeth in profile view posteriorly. Simple capillaries present posteriorly.

SIZE: length 16.7 mm (24.6 ± 8.26 mm, n = 5, 16.7–34.3 mm). Width of thorax 2.57 mm (2.46 ± 0.23 mm, n = 5, 2.14–2.71 mm). Branchiae and operculum accounting for 1/5 of entire length.

COLOUR: verticil spines and tips of funnel radii yellow. Base of branchial crown purple, brown, yellow bands present above the purple base, the middle region of branchial crown with white bands, terminal brown to yellow (Fig. 4B).

ECOLOGY: found from subtidal, 10–20 m, embedded in corals.

Etymology. The species name honours Australian Museum's Lizard Island Research Station **(LIRS)**, recognised as one of the best field stations in the world for tropical marine research and a world-leading supplier of on-reef facilities for coral reef research and education.

Remarks. The new species was originally labelled as *H. exaltata* (Marenzeller, 1885) or *H. minax* (Grube, 1878) in the **AM** collections because it resembles *H. exaltata* in having a large smoothly incurved dorsal spine and verticil spines with an internal spinule each, and also resembles *H. minax* in the presence of a pair of distal lateral spinules on the incurved dorsal spine. *Hydroides lirs* n. sp. differs from *H. exaltata* in having a pair of lateral spinules on the incurved dorsal spine, which is absent in *H. exaltata*. From *H. minax* the new species can be distinguished by the following characters: dorsal hook is smoothly curved in *H. lirs* n. sp., but strongly curved in *H. minax*; verticil spines in *H. minax* are short and lack internal spinules that are present in *H. minax.* The basal teeth typical for of the funnel radii in *H. lirs* n. sp. were not observed either in *H. exaltata* or in *H. minax*. *Hydroides lirs* n. sp. also resembles *H. pseudexaltata* Pillai, 2009, but can be distinguished from latter by the presence of lateral spinules in its dorsal spine, internal spinules in the verticil spines (as opposed to the absence of lateral and internal spinules in *H. pseudexaltata*) and its sharp-tipped funnel radii (as opposed to almost T-shaped tips in *H. pseudexaltata*).

Type locality. Lizard Island, Qld, Australia.

Distribution. Lizard Island, Orpheus Island, Qld, Australia.

Hydroides longispinosa Imajima, 1976a

(Fig. 6)

Hydroides longispinosa Imajima, 1976a: 240–246, fig. 5 [Ogasawara Islands, Southern Japan].

Hydroides centrospina Wu & Chen, 1981a: 354–355 [South China Sea; description].

Hydroides centrospina.— Meng *et al.* 1994: 46, figs 3, 1–9 [Hainan Island, South China Sea]; Sun & Yang 2000: 119 [South China Sea]; Sun *et al*. 2015: 46–50, Fig. 14 [Qld, NSW, Australia].

Hydroides longispinosa.—Imajima 1977: 95 [Ogasawara Islands, South Japan, fouling buoy]; 1982: 46 [Palau Islands, fouling boat]; 1987: 78 [Okinawa, Japan]; Hutchings & Murray 1982: 1031, 1034, 1035 [Lizard Island, experimental settling on dead coral substrate]; Imajima & ten Hove 1984: 48 [Ponape Island; Lizard Island, Qld, material of Hutchings & Murray; discussion]; 1986: [Gilbert Islands, Solomon Islands]; Hutchings 1984: 232–233 [Lizard Island, Qld; settling]; 1985: 246–247 [same]; Meng *et al.* 1994: 46 [Hainan Island, South China Sea; name]; Sun & Yang 2000: 124, figs G–K [Yellow Sea].

Hydroides longispinosus.—Bailey-Brock 1987: 282 [Tonga]; Fiege & Sun 1999: 116–118 [Hainan Island, South China Sea]; ten Hove & Kupriyanova 2009: 53 [name]; Bailey-Brock *et al*. 2012: 969, 972, fig. 4D [Enewetak, Rongelap, Marshall Islands].

Material examined. AM W.201323, between Yonge and Lizard Island, 14°40'S, 145°28'E, 15 m, coll. P. Hutchings, Jan 1983; **AM** W.16981, near Bird Islet, 14°40'S, 145°28'E, 7 m, coll. P. Hutchings & P. Weate, det. H. ten Hove; **AM** W.16986, near Bird Islet, 14°40'S, 145°28'E, 7 m, coll. P. Hutchings & P. Weate, det. H. ten Hove; **AM** W.16987, near Bird Islet, 14°40'S, 145°28'E, 7 m, coll. P. Hutchings & P. Weate, det. H. ten Hove; **AM** W.20155 (2), Turtle Beach, lagoon, 14°40'S, 145°28'E, coll. G. Anderson, 22 Jun 1982, det. C.J. Watson; **AM** W.27388, lagoon between Bird and South Island, 14°41'S, 145°28'E, 15 m, coll. C. Watson & P. Hutchings, 12 Mar 1986, det. H. ten Hove; **AM** W.41749, Yonge Reef, 14°35'S, 145°37'E, coll. R. Smith, 5 Nov 1985; **AM** W.41968, lagoon, 14°40'S, 145°27'E, coll. P. Hutchings & P. Weate; **AM** W.41969, coll. P. Hutchings & P. Weate, 16 Jan 1976; **AM** W.41970, lagoon, 14°40'S, 145°27'E, coll. P. Hutchings, Jan 1982; **AM** W.41971, same, coll. P. Hutchings, Jan 1982; **AM** W.41972, same, coll. P. Hutchings, Jan 1982; **AM** W.41973, lagoon, 14°40'S, 145°27'E, coll. P. Hutchings & P. Weate; **AM** W.42328 (2), off Chinamans Head, 14°40'S, 145°27'E, 7 m, coll. P. Hutchings, 28 Jul 1977; **AM** W.42059, off South Island, stn.G244, coll. E. Kupriyanova & G. Rouse, 2 Nov 2005; **AM** W.42327, lagoon, 14°40'S, 145°27'E, coll. P. Hutchings & P. Weate, 1976, det. E. Kupriyanova; **AM** W.42329, lagoon drop-off, 14°42'S, 145°28'E, 7.7 m, coll. P. Hutchings & P. Weate, 6 Nov 1976, det. E. Kupriyanova; **AM** W.42330, off Chinamans Head, 14°40'S, 145°27'E, 7 m, coll. P. Hutchings & P. Weate, 8 Jan 1977, det. E. Kupriyanova; **AM** W.42331, lagoon, 14°40'S, 145°27'E, coll. P. Hutchings & P. Weate, 1 Aug 1977, det. E. Kupriyanova; **AM** W.42332 (2), fringing reef between Bird Islet and South Island, 14°40'S, 145°28'E, 12 m, coll. P. Hutchings & P. Weate, 11 Jan 1977, det. E. Kupriyanova; **AM** W.42333, near Bird Islet, 14°40'S, 145°28'E, 12 m, coll. P. Berents & P. Hutchings, Sep 1976, det. E. Kupriyanova; **AM** W.44224, MI QLD 2368; **AM** W.44226, MI

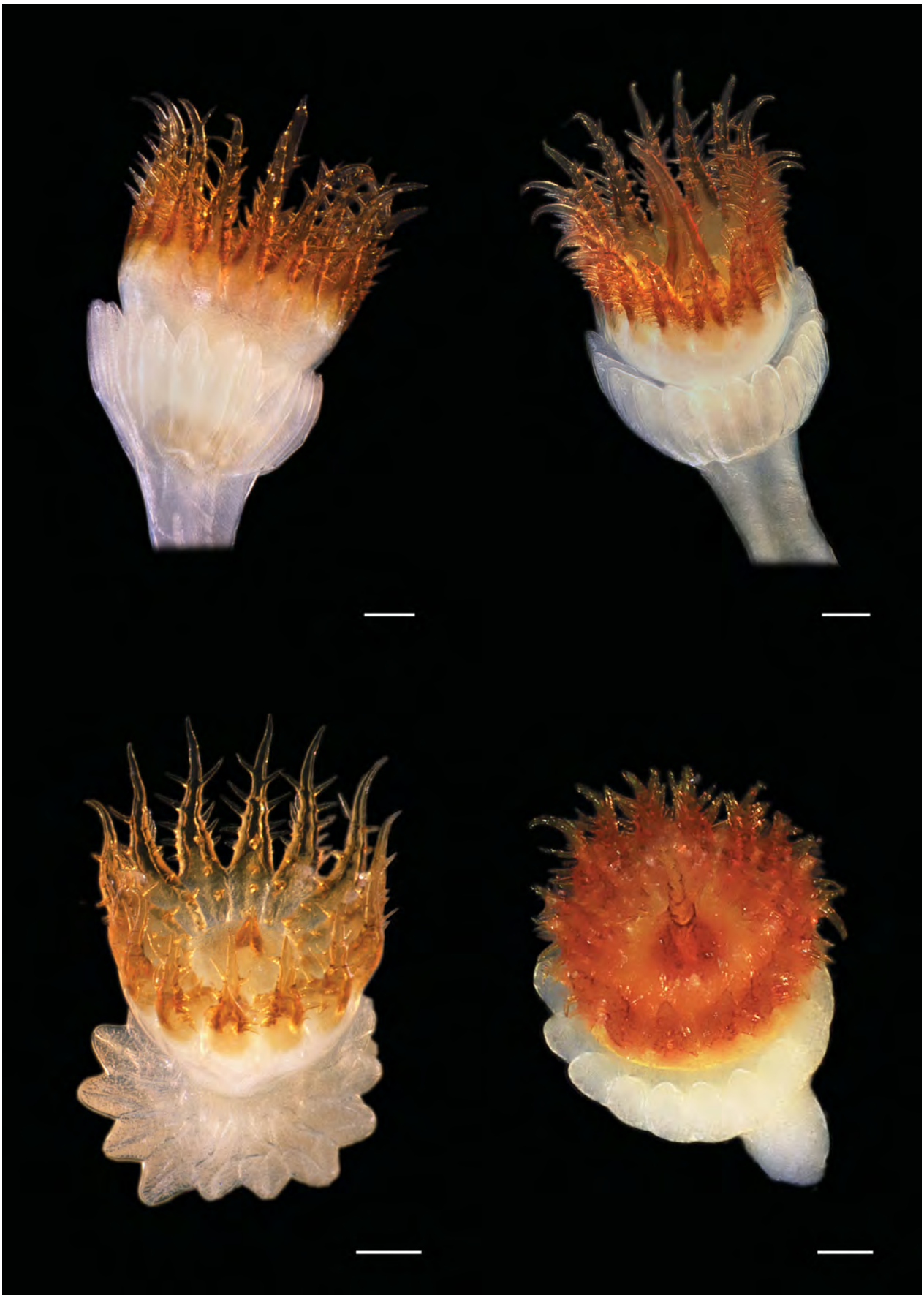

FIGURE 6. *Hydroides longispinosa,* opercula of fixed specimens, **AM** W.42327 (bottom right), **AM** W.42333 (the rest). Photo: E. Wong. Scale bars = 0.1 mm.

QLD 2367 (6); **AM** W.45085, MI QLD 2424 (50); **AM** W.45096, MI QLD 2435 (50); **AM** W.45424, MI QLD 2447 (6); **AM** W.46531, Bird Islet, front reef, Fore Reef, 14°41'48"S, 145°27'54"E, coral rubble, 3 m, coll. C. Watson, 8 Feb 2009; **AM** W.46532, same; **MAGNT** W025500 (many), North Point, mid shelf of Fore Reef, 14°38'42"S, 145°27'12"E, coral rubble, 2 m, coll. C. Watson, 12 Apr 2008; **MAGNT** W025509, Yonge Reef, 14°34'30"S, 145°36'18"E, coll. C. Glasby, 20 Apr 2008; **MAGNT** W025512 (2), North Point, mid shelf of Fore Reef, 14°38'42"S, 145°27'12"E, coral rubble, 2 m, coll. C. Watson, 12 Apr 2008; **MAGNT** W025513 (10), Palfrey Island, Fore Reef, 14°41'36"S, 145°26'24"E, dead *Pocillopora* sp. head, 10 m, coll. S. Smith, 15 Apr 2008; **MAGNT** W025515, North Point, mid shelf of Fore Reef, 14°38'42"S, 145°27'12"E, coral rubble, 2 m, coll. C. Watson, 12 Apr 2008; **SAM** E3600, stn.G238, east lagoon near Bird Islet, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **ZMA** V.Pol. 3446 (20), near Bird Islet, grid C, experimental fouling panels, coll. P. Hutchings & P. Weate, det H. ten Hove 1981, retained from AM W.16984–6; **ZMA** V.Pol. 4962 (2), stn.20, reef front North of South Island, sloping reef outside lagoon & sandy bottom below, 10–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 5 Mar 1986; **ZMA** V.Pol. 4965 (10), stn.17, Palfrey Island, south of lighthouse, 14°40'S, 145°28'E, coral heads on sandy bottom, 7 m, coll. H. ten Hove, P. Hutchings & M. Reid, 2 Mar 1986; **ZMA** V.Pol. 4966 (10), stn.18, lagoon near East entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, 3 Mar 1986.

Diagnosis. Opercular verticil with 13–15 spines equal in size (no larger dorsal spine) curved outward, with pointed tips, each verticil spine with 4–6 pairs of lateral spinules directed obliquely outwards. All verticil spines also with 4–6 accessory teeth arranged in a single row on inner side. Central tooth longer than verticil spines, may be smooth, but mostly bearing numerous randomly placed small teeth distally. Funnel not chitinized, with 15–20 blunt-tipped radii. Grooves separating radii extending 1/3 of funnel length (Fig. 6).

Remarks. The species can be distinquished from *H. elegans* by the distinctly shorter central verticil spine. Material of Fiege & Sun (1999) included specimens with smooth central spines in the verticil, but one specimen with two opercula showed one smooth central spine and one with lateral pinnules. Because the smooth central spine, the main distinctive character of *H. centrospina* Wu & Chen, 1981a, clearly shows intraspecific variability, Fiege & Sun (1999: 118) synonymised *Hydroides centrospina* with *H. longispinosa*.

Distribution. Indo-West Pacific, from Qld, Australia to South Japan and Micronesia, South China, Ponape Island, Tonga.

Hydroides minax (Grube, 1878)

(Fig. 7)

Serpula minax Grube, 1878: 269–271, pl. 15, fig. 5 [Philippines; original description].

Eupomatus minax.—Willey 1905: 314 [Sri Lanka].

Serpula (*Hydroides*) *monoceros.*—Gravier 1906a: 110–111 [Red Sea; description]; 1906b pl. 8 fig. 288 [same]; 1908: 115–117, figs 467–472 [same].

Hydroides monoceros.—Pixell 1913: 76–77 [Zanzibar, Red Sea; diagnosis]; Fauvel 1919: 342 [Gambier Islands]; 1923: 48 [same]; 1930: 63 [Sri Lanka]; 1947: 95–96, fig. 89e [Gambier Islands]; 1953: 460 [Sri Lanka]; Day 1957: 118 [Inhaca Island, Mozambique]; 1967: 808, fig. 38.4o–p [same]; Hartman 1959: 453 [synonymy]; Straughan 1967a: 31 [Heron Island, Qld]; 1967b: 221 [Havannah Island, Qld]; Gibbs 1969: 446 [Solomon Islands]; Kumaraswamy Achari 1969: 40 [Sri Lanka]; Pillai 1971: 71 [Sri Lanka]; Amoureux *et al*. 1978: 145, fig. 12 [Gulf of Eilat]; Lewis 1979: 7 [Qld; fouling]; Vine & Bailey-Brock 1984: 141 [Sudanese Red Sea]; Chandra Mohan & Aruna 1994: 60 [India; shipfouling].

Hydroides minax.—Fauvel 1939: 361–362 [Vietnam]; 1953: 460 [Sri Lanka]; Pillai 1960: 8–10, fig. 3a–e [Sri Lanka]; 1971: 110 [Sri Lanka]; Wu 1968: 45 [Taiwan]; Kumaraswamy Achari 1969: 40 [Sri Lanka]; Imajima 1976a: 234–235 [diagnosis; Japan]; 1976b: 129–130, fig. 5 [Tanega-Shima, South Japan; description]; 1982: 42 [Micronesia]; 1987: 77 [Okinawa, Japan]; Zibrowius 1979: 133–134 [ship's hull in Toulon, France]; Zibrowius & Bitar 1981: 160 [ship-transported to Mediterranean]; Imajima & ten Hove 1984: 48 [Majuro; Lizard Island, Qld; synonymy]; 1986: 3 [Solomon Islands]; Vine & Bailey-Brock 1984: 141 [Sudanese Red Sea]; Vine 1986: 90 [Sudanese Red Sea; figure]; Bailey-Brock 1987: 282 [Tonga]; Ben-Eliahu & ten Hove 1992: 40–43, 45, 47, 52–53 [Red Sea, Lessepsian migrant to the Levantine Mediterranean]; ten Hove 1994: 108 [Seychelles]; Fosså & Nilsen 1996: 139 [Indo-Pacific; symbiotic in corals]; 2000: 141 [same]; Hassan 1998: 50, figure [Red Sea; diagnosis]; Fiege & Sun 1999: 119, fig. 9A–C [South China Sea]; Sun & Yang 2000: 126, fig. 5G–J [South China Sea]; ten Hove & Ben-Eliahu 2005: fig. 1h [Red Sea, Indonesia]; Kupriyanova *et al.* 2008: 428, 430–431 [Lizard Island; DNA data]; ten Hove & Kupriyanova 2009: 53 [name only]; Pillai 2009: 120, figs 15A–G, 16A–F [Kimberley, WA]; Bailey-Brock *et al.* 2012: 969, 972 [Enewetak, Majuro, Marshall Islands]; Sun *et al.* 2015: 53–56, fig. 16 [WA, NT, Qld, Australia].

Not *Hydroides minax*.—Gibbs 1971: 203 [Solomon Islands; see *H. albiceps*].

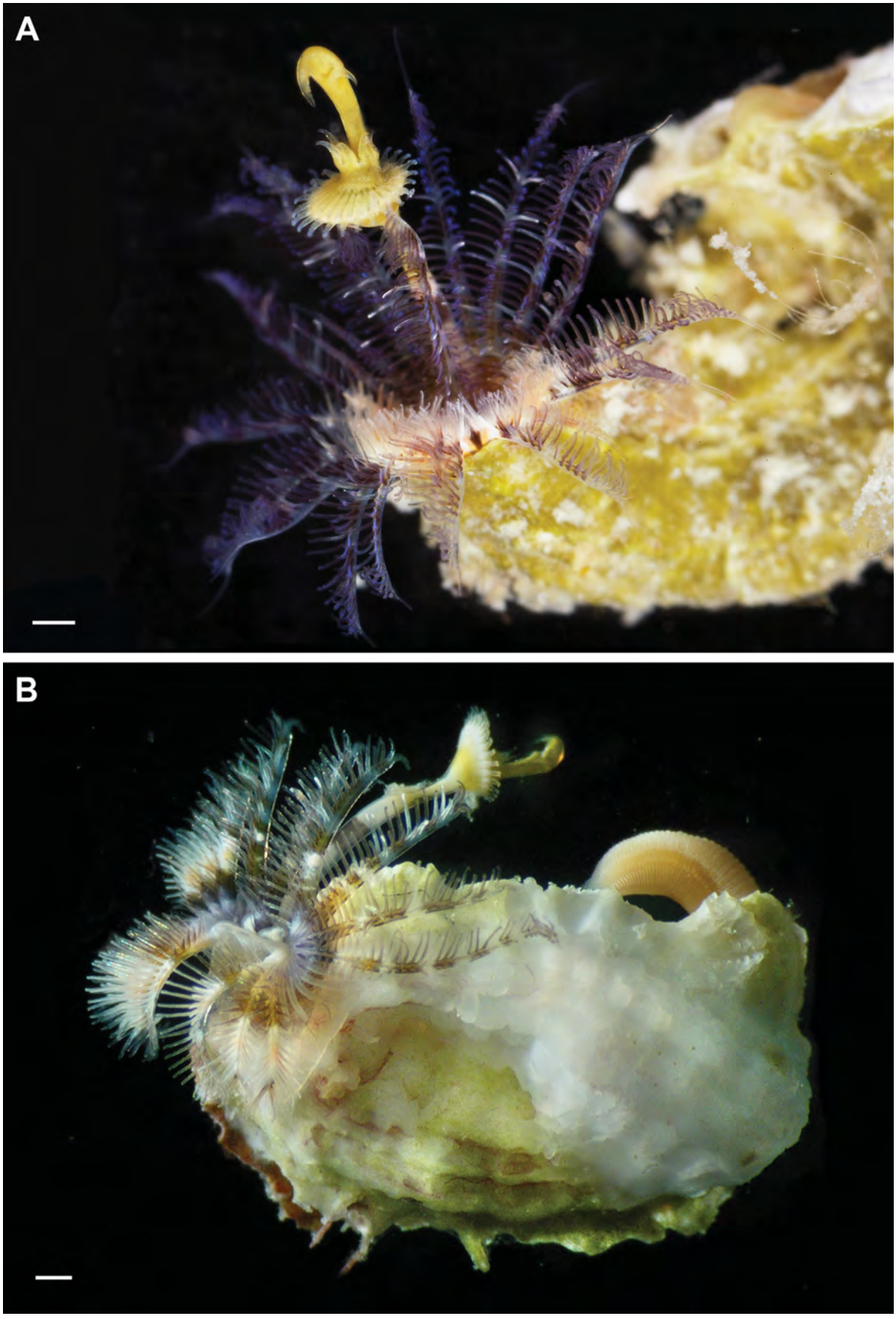

FIGURE 7. *Hydroides minax*, live animals in tubes. A. **AM** W.44056; B. stn.G229, **SAM** E3597. Photo: A—A. Semenov, B—G. Rouse. Scale bars: A, B = 1 mm.

Material examined. AM W.16982, near Bird Islet, 14°40'S, 145°28'E, experimental fouling grid C, 7 m, coll. P. Hutchings & P. Weate, 1979, det. H. ten Hove; **AM** W.42357, Yonge Reef, back reef, 14°36'S, 145°37'E, in cave, coll. R. Smith, Nov 1985, det. E. Kupriyanova; **AM** W.42358, Yonge Reef, back reef bommie, 14°36'S, 145°37'E, on ledge, 5 m, coll. R. Smith, 7 Nov 1985, det. E. Kupriyanova; **AM** W.42359, Yonge Reef, 14°36'S, 145°37'E, coll. R. Smith, det. E. Kupriyanova; **AM** W.46530, inter-reef sand, 14°23'24"S, 145°16'24"E, artificial substrate, 10 m, coll. M. Timmers, 10 Feb 2009; **SAM** E3597, stn.G229, near Bird Islet, 7–8 m, coll. G. Rouse & E. Kupriyanova, 24 Oct 2005; **ZMA** V.Pol. 3447, near Bird Islet, grid C, experimental fouling panels, coll. P. Hutchings & P. Weate, det. H. ten Hove 1981, retained from **AM** W.16984–6; **ZMA** V.Pol. 5035, stn.21, south of South Island, 14°42'S, 145°28'E, sloping silty reef, little coral cover, 18–20 m, coll. H. ten Hove & P. Hutchings, 6 Mar 1986.

Diagnosis. Opercular verticil with 7–11 spines, dorsal one stout, elongated, terminating in three sharply pointed ventrally curving hooks that may be of similar size, but generally one large terminally and two smaller ones laterally; other verticil spines short, curved outwards, with pointed tips. Spinules and central tooth absent. Funnel with 22–26 chitinized radii ending in swollen or sharp tips, base of funnel elongated, chitinized, merging into constriction. Grooves separating radii extending 1/2 of funnel length (Fig. 7).

Remarks. *Hydroides minax* can be easily confused with *H. lirs* n. sp. (see Remarks after description of *H. lirs* n. sp.). In addition to morphological differences, the two species appear to differ ecologically: specimens of *H. minax* were collected from coral rubble or rocks, while those of *H. lirs* n. sp. were found embedded in living corals.

Distribution. Widely distributed in the Indo-West Pacific, Lessepsian migrant to the Levant Mediterranean.

Hydroides cf. *recta* Straughan, 1967

(Fig. 8)

Hydroides novaepommeraniae (not Augener, 1925).—Kupriyanova *et al.* 2008: 428–430 [Lizard Island, Qld; DNA data].
Hydroides cf. *recta.*—Sun *et al.* 2015: 71–74, fig. 23 [Lizard Island, Qld, Australia].

Material examined. AM W.44229, MI QLD 2367; **AM** W.45071, MI QLD 2417; **SAM** E3599, stn. G238, east lagoon near Bird Islet, 14°46'59"S, 145°05'23"E, coral rubble, 10 m, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **MAGNT** W025508, Yonge Reef, 14°34'28"S, 145°36'19"E, coll. C. Glasby, 20 Apr 2008.

Diagnosis. Opercular verticil small, with 7–11 straight spines, ending in pointed tips (Fig. 8). **AM** W.44229 and **AM** W.45071 with all verticil spines smooth, similar in size and shape, spinules absent. **SAM** E3599 with one dorsal verticil spine slightly larger than others with subterminal inner spinule, a tiny inner basal spinule present on each spine. Funnel hardly chitinized, with 14–21 radii ending with pointed to swollen tips. Grooves separating radii extending 1/3 of length of wide part of funnel; funnel extending down to constriction for a length equalling 1/2 of that of the peduncle.

Remarks. Although Sun *et al.* (2015) re-examined a paratype of *H. longistylaris* (**MBMCAS** MBM40) and the holotype and paratypes of *H. recta*, they could not attribute the specimens from Lizard Island to either of these two nominal taxa. A similar specimen has been recorded from the Solomon Islands under the name *Hydroides* (aff.) *recta* (**BMNH** 1970: 829, identifications by H. Zibrowius 1972, H. ten Hove 1986). Because we do not have any additional data on these forms other than the slightly ambiguous data in Sun *et al*. (2015), we refrain from describing this material as a new species.

Distribution. Lizard Island, Qld, Solomon Islands.

Hydroides tambalagamensis Pillai, 1961

(Fig. 9)

Hydroides tambalagamensis Pillai, 1961: 36–38, fig. 12 [Tambalagam Lake, Sri Lanka].
Hydroides tambalagamensis.—Straughan 1967b: 33, fig. 3g [Heron Island, Qld; diagnosis]; Imajima 1976a: 231–132 [diagnosis, Japan]; Imajima 1976b: 123–126, fig. 2a–j [Tanega-Shima, Japan]; Imajima 1979: 167 [Kii Peninsula, Japan]; Imajima & ten Hove 1984: 49 [Majuro, Marshall Islands, Lizard Island, Qld; synonymy]; ten Hove & Kupriyanova 2009: 54 [name only]; Sun *et al.* 2012a: 21 [Hong Kong, description]; Sun *et al.* 2015: 82–85, fig. 27 [WA, NT, Qld, Australia].
Hydroides spiculitubus Pillai, 2009: 125–128 [Kimberley, WA].

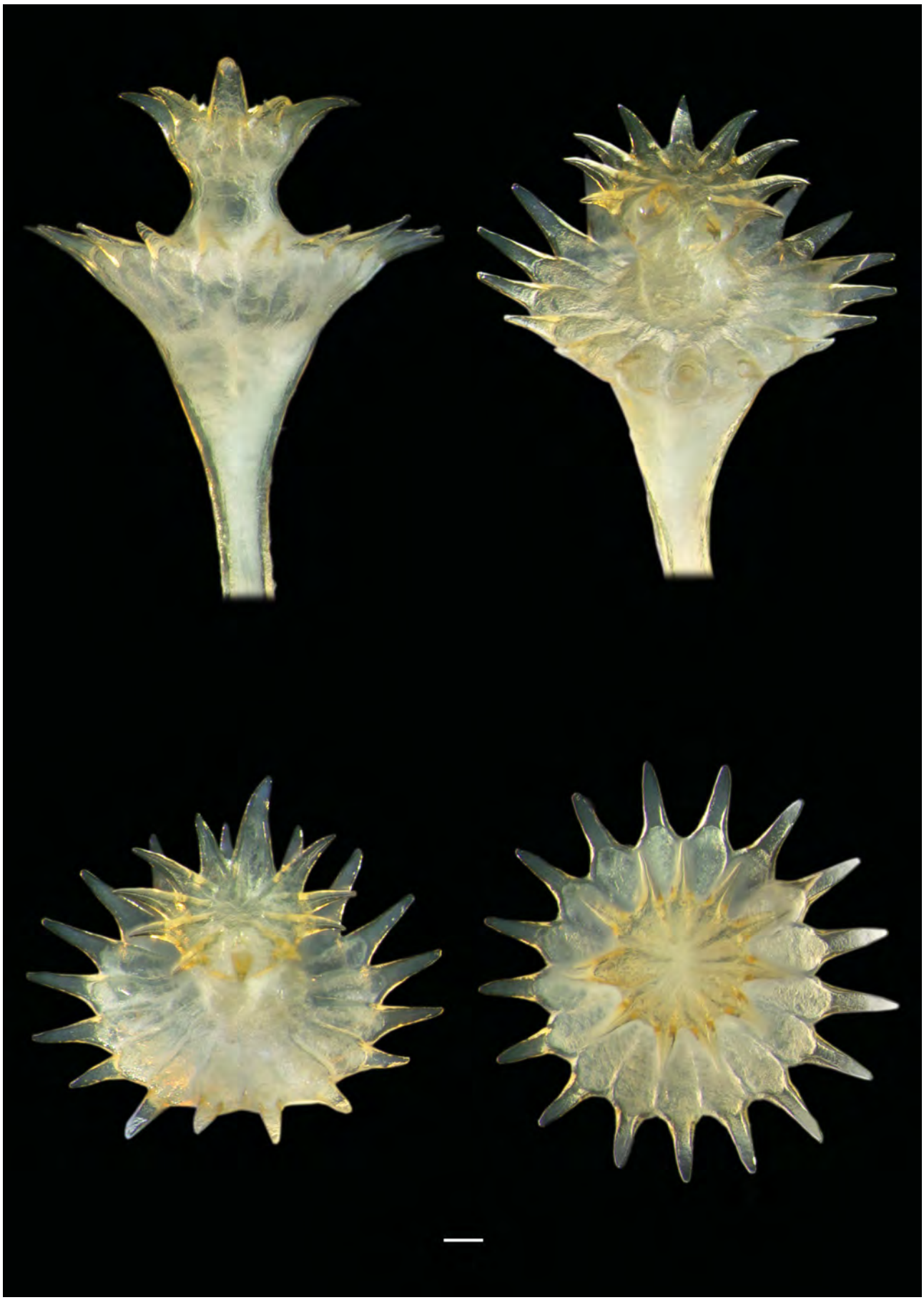

FIGURE 8. *Hydroides* cf. *recta,* various views of the same operculum, stn.G238, **SAM** E3599. Photo: E. Wong. Scale bar = 0.1 mm.

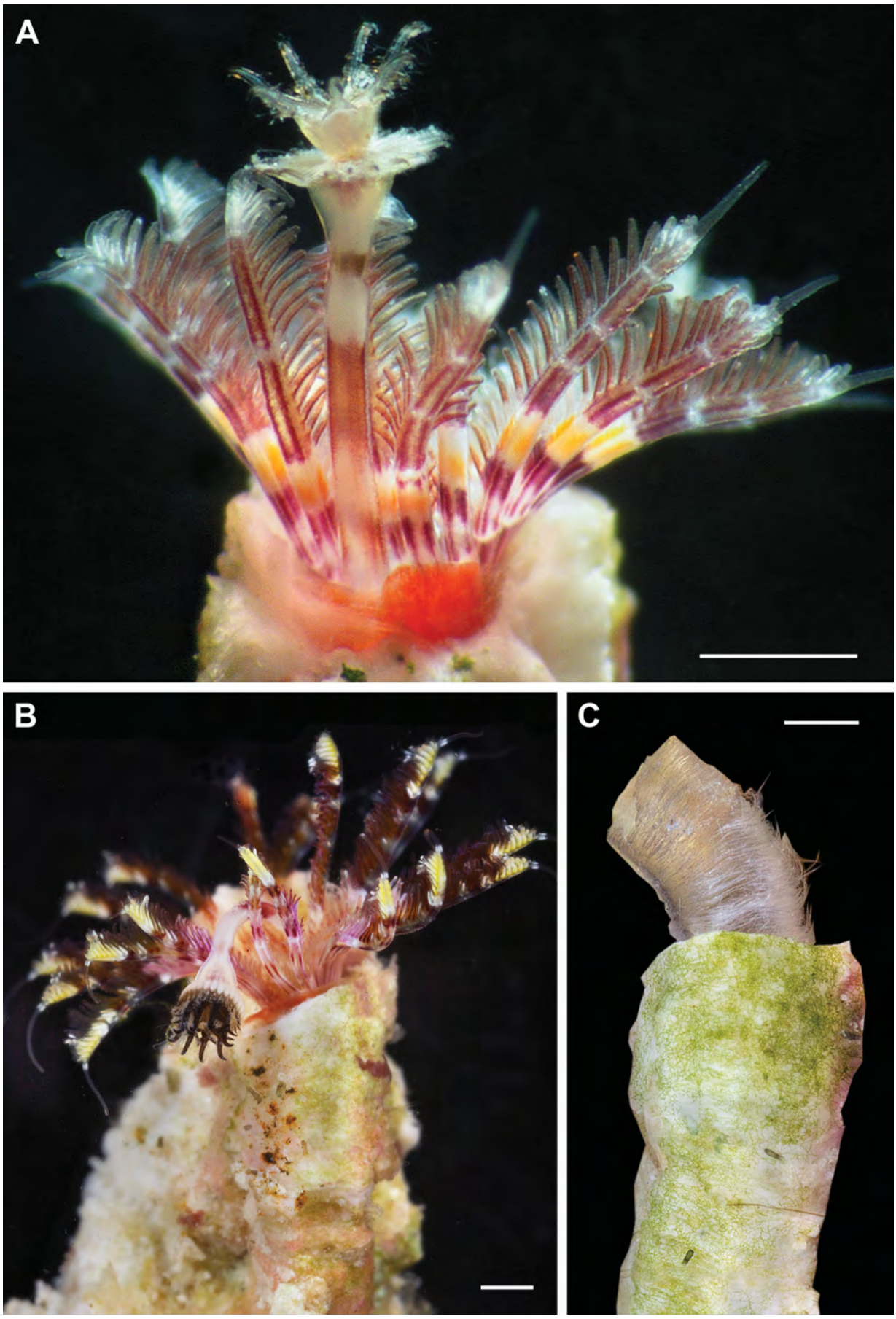

FIGURE 9. *Hydroides tambalagamensis*. A. Live animal in tube, stn.G232, **SAM** E3598; B. Live animal in tube, **AM** W.45058; C. Tube fragment showing typical internal layer made of spicules, **AM** W.45050. Photo: A—G. Rouse, B, C—A. Semenov. Scale bars: A–C = 1 mm.

Hydroides spiculitubus.— Bailey-Brock *et al.* 2012: 969, 973 [Marshall Islands].

Material examined. AM W.38609, North Point, 14°40'S, 145°28'E, 20 m, coll. P. Hutchings, 9 Mar 1986; **AM** W.45050, MI QLD 2406 (5); **AM** W.45058, MI QLD 2406; **AM** W.45064, MI QLD 2413; **AM** W.45417, MI QLD 2446 (2); **AM** W.45418, MI QLD 2446; **AM** W.46430, Hicks Reef Outer Barrier, Fore Reef, 14°28'48"S, 145°29'12"E, coral rubble, 2–18 m, coll. C. Watson & K. Mills, 14 Feb 2009; **AM** W.46431, Day Reef, Fore Reef, 14°28'18"S, 145°31'48"E, coral rubble, 10 m, coll. M. Blazewicz-Paskowycz, 13 Feb 2009; **SAM** E3598 (2), stn.G232, between First Beach and Osprey Island, 1 m, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005.

Diagnosis. Verticil with 7–8 sub-equal spines (no larger dorsal spine). Each verticil spine curved outwards and ending in pointed tip, bearing a pair of outwardly curved lateral spinules at about half of its length, an inwardly curved radial spinule at the same level or slightly above, and a small basal radial spinule. Funnel with 24–39 sharply pointed dark-brown chitinized radii, base of funnel not chitinized. Grooves separating radii extending 1/3 of funnel length (Fig. 9).

Remarks. Pillai (2009) described specimens with *H. tambalagamensis*-type operculum and a detachable inner tube as *Hydroides spicilituba* n. sp. However, Sun *et al.* (2015) synonymized *H. spicilituba* with *H. tambalagamensis* based on the identical 18S sequences of specimens with and without inner tubes. Here we follow the synonymy of Sun *et al*. (2015).

Distribution. Indo-West Pacific.

Hydroides trivesiculosa Straughan, 1967b

(Fig. 10)

Hydroides trivesiculosa Straughan, 1967b: 33–34, fig. 3h–j [Heron Island, Qld; material studied].
Hydroides trivesiculosa.—Sun *et al*. 2015: 85–87, fig. 28 [WA, NT, Qld, Australia].
Hydroides trivesiculosus.—ten Hove 1990: 119 [Discussion]; ten Hove 1994: 108 [Seychelles]; Kupriyanova *et al.* 2008: 428, 430–431, fig. 1A [Lizard Island, Qld; DNA data]; ten Hove & Kupriyanova 2009: 53 [name only]; Bailey-Brock *et al.* 2012: 969, 973, fig. 4A [Enewetak, Rongelap, Marshall Islands], Sun *et al.* 2012b: 540–545 [DNA data].

Material examined. AM W.16983 (3), near Bird Islet, 14°40'S, 145°28'E, exposed, 7 m, coll. P. Hutchings & P. Weate; **AM** W.16984 (2), near Bird Islet, grid C, from experimental fouling panels, coll. P. Hutchings & P. Weate, Jul 1978, det H. ten Hove 1981; **AM** W.16985 (2), near Bird Islet, 14°40'S, 145°28'E, experimental fouling grid C, near Bird Islet, C-15-18-3, coll. P. Hutchings & P. Weate, det. H. ten Hove 1981; **AM** W.40553 (2), stn.G236, east lagoon near Bird Islet, 9 m, coll. G. Rouse & E. Kupriyanova, 29 Oct 2005; **AM** W.42057, stn.G232, between First Beach & Osprey Island, coral rubble, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005; **AM** W.42334, Lagoon, 14°40'S, 145°27'E, 10 m, coll. P. Hutchings & P. Weate, Jun 1982, det. E. Kupriyanova; **AM** W.43909, MI QLD 2335; **AM** W.43964, MI QLD 2337; **AM** W.43968, MI QLD 2348 (2); **AM** W.44061, MI QLD 2356; **AM** W.44227, MI QLD 2367 (15); **AM** W.44233, MI QLD 2373; **AM** W.44234, MI QLD 2373; **AM** W.44534, MI QLD 2375; **AM** W.44541, MI QLD 2390 (7); **AM** W.45065, MI QLD 2413 (2); **AM** W.45068, MI QLD 2413 (2); **AM** W.45078, MI QLD 2417 (5); **AM** W.45083, MI QLD 2423; **AM** W.45090, MI QLD 2435 (20); **AM** W.45415, MI QLD 2446; **AM** W.45423, MI QLD 2447; **AM** W.46428, Coconut Beach, 14°40'54"S, 145°28'24"E, *Halimeda* sp. and rubble, 2 m, coll. C. Watson, 7 Feb 2009; **AM** W.46432, inter-reef sand, 14°23'24"S, 145°16'24"E, artificial substrate, 10 m, coll. M. Timmers, 9 Feb 2009; **AM** W.46529, same, 10 Feb 2009; **AM** W.46534, Yonge Reef, Deep Reef slope, 14°36'54"S, 145°37'11"E, coral rubble, 4–8 m, coll. M. Blazewicz-Paskowycz, 18 Feb 2009; **AM** W.46535, Hicks Reef Outer Barrier, Fore Reef, 14°28'48"S, 145°29'12"E, coral rubble, 2–18 m, coll. C. Watson & K. Mills, 14 Feb 2009; **AM** W.46536, same; **AM** W.47454, stn.G247, channel near Bird Islet, coll. G. Rouse & E. Kupriyanova, 3 Oct 2005; **SAM** E3601, stn.G229, Lagoon near Bird Islet, 7–8 m, coll. G. Rouse & E. Kupriyanova, 24 Oct 2005; **ZMA** V.Pol. 3448 (2), near Bird Islet, grid C, from experimental fouling panels, coll. P. Hutchings & P. Weate, det. H. ten Hove 1981, retained from **AM** W.16984–6.

Diagnosis. Opercular verticil inserted on a short stalk into proximal funnel. Verticil with 5–8 spines, one very large dorsal spine made of a bulbous median part and two latero-dorsal extensions and 4–7 small outwardly curved spines positioned at the base of dorsal verticil spine, each ending in T-shaped tip, without accessory spinules. Funnel with 18–25 chitinized radii tips, base of funnel slightly chinitized. Grooves separating radii extending 1/3 of funnel length (Fig. 10).

Remarks. *Hydroides trivesiculosa* can usually be distinguished from *H. albiceps* by the exceptionally large size of the dorsal bulbous verticil spine, and the lower number of verticil spines, but there are (few) transitional forms. Additionally, molecular studies are needed to determine whether *H. trivesiculosa* and *H. albiceps* are separate species.

Distribution. Qld, tropical Australia, Tanzania, Red Sea, Seychelles, Indonesia.

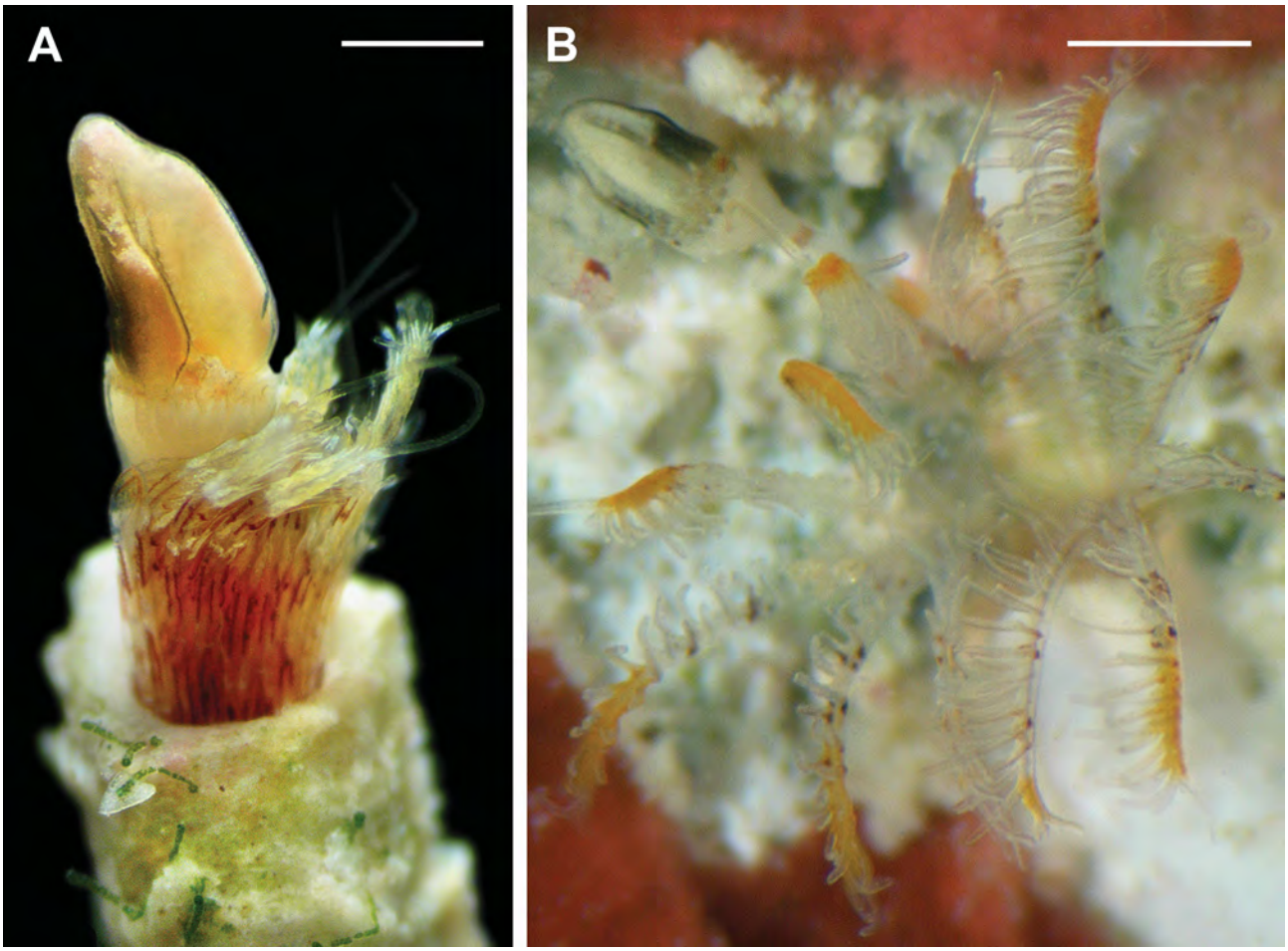

FIGURE 10. *Hydroides trivesiculosa,* live animals in tubes. A. Stn.G229, **SAM** E3601; B. Stn.G236, **AM** W.40553. Photo: A, B—G. Rouse. Scale bars: A–B = 0.5 mm.

Hydroides tuberculata Imajima, 1976

(Fig. 11)

Hydroides tuberculata Imajima, 1976a: 132–133, fig. 7a–j [SW Japan; description].

Hydroides tuberculata.—Imajima 1978: 53 [Izu Islands, Japan]; 1982: 44 [Palau and Yap Islands, Micronesia]; Imajima & ten Hove 1984: 44–45 [Truk, Ponape Island; Okinawa, experimental fouling; Lizard Island, experimental fouling, Noosa Head, Heron Island; synonymy, extensive discussion]; Bailey-Brock 1985: 210 [Fiji]; Sun *et al.* 2015: 88–91, Fig. 29 [WA, NT, Qld, Australia].

Hydroides perezi not Fauvel, 1918.—Straughan 1967a: 219–220, Fig. 6o [Havannah Island, Qld, see Imajima & ten Hove 1984: 44].

Hydroides brachyacantha not Rioja, 1941.—Dew 1959: 28–29 [in part, see Imajima & ten Hove 1984: 44].

Hydroides tuberculatus.—ten Hove 1994: 108 [SW Japan]; Fiege & Sun 1999: 121–123, fig. 11A–C [South China Sea]; Kupriyanova *et al.* 2008: 428, 430–431, fig. 1B [Lizard Island, Qld; DNA data]; ten Hove & Kupriyanova 2009: 54 [name only]; Bailey-Brock *et al.* 2012: 969, 973–974, fig. 4B, C [Rongelap, Utirik, Marshall Islands]; Sun *et al.* 2012a [Discussion].

Material examined. AM W.198890, near Bird Islet, 14°40'S, 145°28'E, experimental fouling grid C, 7 months exposed near Bird Islet, C-15-18-3, coll. P. Hutchings & P. Weate, det. H. ten Hove, 1981; **AM** W.198919 (2),

lagoon drop-off between Bird Islet and South Island, stn.77 LIZ C15-18-3, 14°42'S, 145°28'E, Jul 1978; **AM** W.198920, near Bird Islet, 14°40'S, 145°28'E, experimental fouling grid C, 7 months exposed near Bird Islet, C-15-18-3, coll. P. Hutchings & P. Weate, det. H. ten Hove, 1981; **AM** W.16980, near Bird Islet, 14°40'S, 145°28'E, experimental fouling grid C, 7 months exposed near Bird Islet, C-15-18-3, coll. P. Hutchings & P. Weate, det. H. ten Hove, 1981; **AM** W.45055, MI QLD 2406 (3); **AM** W.45074, MI QLD 2417; **AM** W.45079, MI QLD 2417 (2); **AM** W.45092, MI QLD 2435; **AM** W.45414, MI QLD 2446; **AM** W.45419, MI QLD 2446 (2); **AM** W45425, MI QLD 2447; **AM** W.46429, Day Reef, mid shelf of Fore Reef, 14°28'18"S, 145°31'48"E, coral rubble, 10 m, coll. M. Blazewicz-Paskowycz, 13 Feb 2009; **AM** W.46527, North Direction Island, Deep Reef slope, 14°44'36"S, 145°30'54"E, coral rubble, 2 m, coll. C. Watson; **AM** W.46528, North Direction Island, Deep Reef slope, 14°44'36"S, 145°30'54"E, coral rubble, 2 m, coll. C. Watson; **AM** W.46533, Coconut Beach, inter-reef sand, 14°40'54"S, 145°28'24"E, *Halimeda* and rubble, 2 m, coll. C. Watson, 7 Feb 2009; **AM** W.47451 stn. G241, Osprey Island, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **SAM** E3596, stn.G236, east lagoon near Bird Islet, 9 m, coll. G. Rouse & E. Kupriyanova, 29 Oct 2005; **ZMA** V.Pol. 3449, near Bird Islet, grid C, from experimental fouling panels, coll. P. Hutchings & P. Weate, det H. ten Hove 1981, retained from **AM** W.16984 and **AM** W.16986 (2).

Diagnosis. Opercular verticil consists of 5–6 triangular spines curved inward, with a small external knob. Dorsal verticil spine larger than others, with elongated sharp tip, curved inward. Funnel radii with 18–25 chitinized pointed tips, base of funnel half chitinized (Fig. 11). Tube often (but not always) bluish, dark brown or black inside.

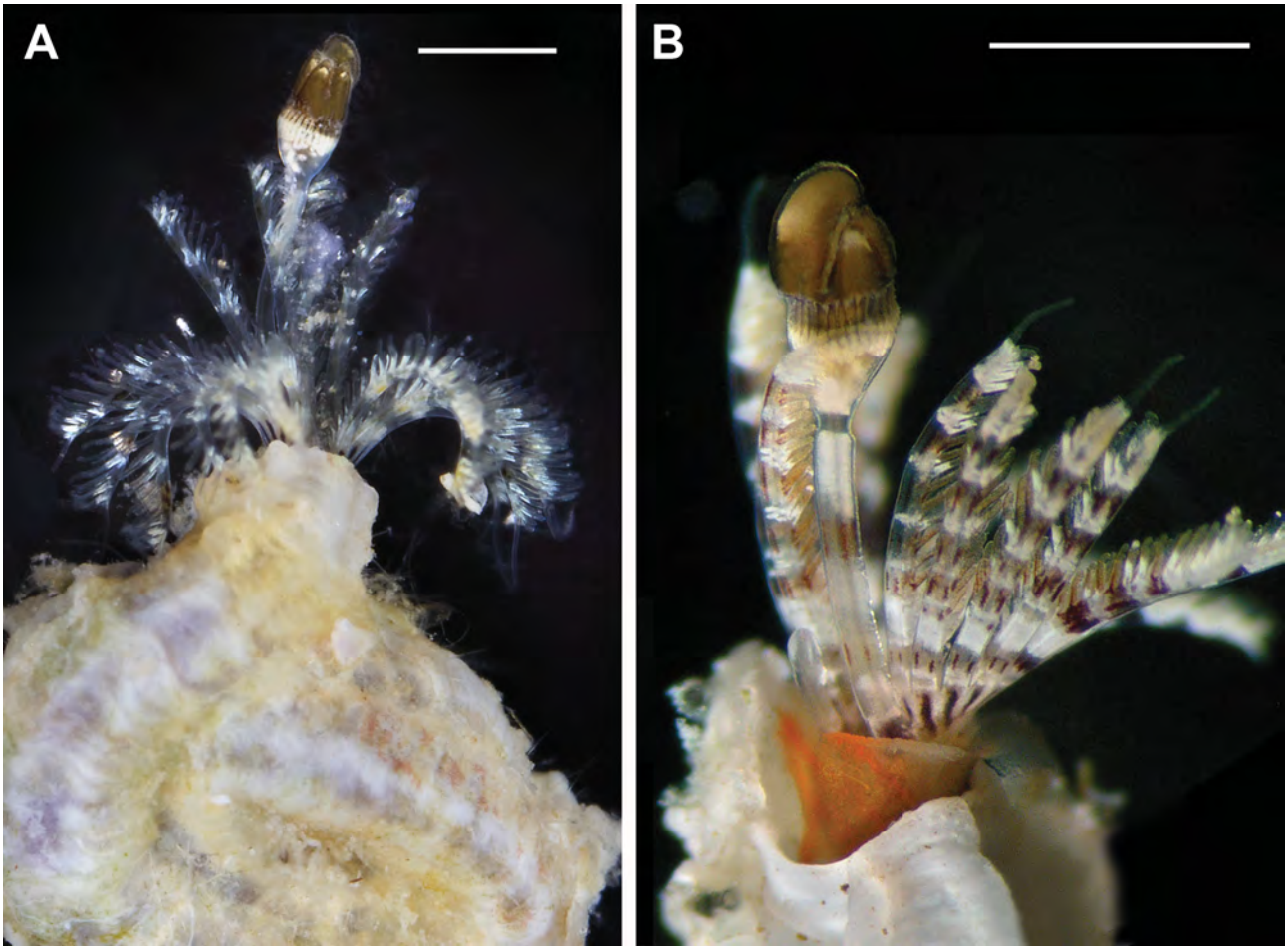

FIGURE 11. *Hydroides tuberculata*, live animals in tubes. A. **AM** W.45055; B. Stn.G236, **SAM** E3596. Photo: A—A. Semenov, B—G. Rouse. Scale bars: A = 1 mm, B = 1 mm.

Remarks. Specimens from Lizard Island (**AM** W.45474, **AM** W.45414, and **AM** W.45419) show more slender verticil spines than specimens from other localities. Lizard Island specimens have dark brown verticil spines and funnel radii tips, a large inward curved hook and sub-triangular ventral verticil spines. The external knob, which

was considered to be one of the most important taxonomic characters (Imajima & ten Hove 1984) is not obvious in **AM** W.45474, **AM** W.45414, **AM** W.45419. However, our molecular data (Sun *et al.* unpubl.) show that these specimens belong to the same species as other specimens that have typical *Hydroides tuberculata* opercula.

Many Indo-West Pacific *Hydroides* nominal species are characterized by a low number of rather valvular verticil spines: *H. adamaformis* Pillai, 2009, *H. kimberleyensis* Pillai, 2009, *H. perezi* Fauvel, 1918, *H. rhombobula* Chen & Wu, 1980, *H. tuberculata* Imajima, 1976a, *H. uniformis* Imajima & ten Hove, 1986 and *H. xishaensis* Chen & Wu, 1978. *Hydroides tuberculata* can be distinguished from *H. kimberleyensis*, *H. rhombobula*, *H. uniformis* and *H. xishaensis* by the presence of an enlarged dorsal verticil spine with external knob, while all verticil spines are equally sized and apparently smooth in the other nominal taxa. *Hydroides tuberculata* differs from *H. perezi* by the shape of the verticil spines, subtriangular in cross-section in *H. tuberculata,* but flat in *H. perezi* (ten Hove 1970; Imajima & ten Hove 1984). Additional studies are needed to determine whether *H. perezi* and *H. tuberculata* are separate species.

Distribution. Indo-West Pacific (Micronesia, Melanesia, Southern Japan; NT, Qld, WA, Australia).

Genus *Josephella* Caullery & Mesnil, 1896

Type-species. *Josephella marenzelleri* Caullery & Mesnil, 1896

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube white, opaque, circular in cross-section, with small peristomes; tube diameter approximately 0.1 mm. Granular overlay absent. Operculum delicate membranous cup with a flat distal surface surmounted by a marginal crown of fine teeth joined by a transparent membrane. Peduncle second non-modified pinnulate radiole. Pseudoperculum absent. Radioles arranged in semi-circles, up to 3 per lobe. Inter-radiolar membrane absent. Branchial eyes absent, a pair of red ocellar clusters at the base of collar. Stylodes absent. Mouth palps absent. 5 thoracic chaetigerous segments. Collar non-lobed. Tonguelets absent. Thoracic membranes short, ending at first chaetiger. Collar chaetae limbate. *Apomatus* chaetae present. Uncini rasp-shaped, with 10–12 teeth seen in profile, 4 teeth in a row distally to 7 above peg. Anterior peg gouged, widened into a rectangular to trapezoid base, flat, but with sharp angles that sometimes curve underneath (thus giving a bifurcate appearance under compound microscope). Triangular depression absent. Abdominal chaetae flat narrow geniculate with pointed denticulate edge. Abdominal uncini with 9–10 teeth in a row. Achaetous anterior abdominal zone long. Posterior capillary chaetae absent. Posterior glandular pad absent.

Remarks. This tiny serpulid is known from numerous circum(sub)tropical, temperate locations around the world. The species was confused with *Rhodopsis* by Straughan (1967a, fig. 5i).

Josephella marenzelleri Caullery & Mesnil, 1896
(Fig. 12)

Josephella marenzelleri Caullery & Mesnil, 1896: 484–486, figs 4–6 [Cap de la Hague, France; original description].

Josephella marenzelleri.—Dew 1959: 52–53, fig. 21 [Aquarium at Taronga Zoo, NSW, Australia]; Straughan 1967b: 252–253 [NSW, Australia]; Uchida 1978: 34–36, 74 [Sabiura, Japan]; Imajima 1979: 181 [Honshu, Japan]; Bianchi 1981: 134–135, fig. 30a, b [Italy; diagnosis]; Bailey-Brock 1991: 200–201, fig. 2 [Hawaii]; Ben-Eliahu & Payiatas 1999: 108–113, figs 2–4 [Cyprus; SEM of chaetae]; Ben-Eliahu & Safriel 1982: 378, 387, 389 [comparison diversity Mediterranean and Red Sea; cryptic]; Nishi 1992b: 12, table 1 [reproduction; Okinawa, Japan]; 1993a: 12 [Okinawa, Japan]; 1993b: 17–19, table 1 [tube ultrastructure, Okinawa, Japan]; 1993d: 7 [Okinawa, Japan; tube diameter]; 1996: 308–309 [on living coral; Okinawa, Japan]; Nishi & Nishihara 1997: 109 [Aquarium Sesoko, Okinawa, Japan].

not *Josephella marenzelleri.*—Straughan 1967a: 42–43, fig. 5i [Heron Island, Qld; see *Rhodopsis pusilla*].

Material examined. AM W.47449, stn.G236, east lagoon near Bird Islet, 9 m, coll. G. Rouse & E. Kupriyanova, 29 Oct 2005; **AM** W.47452, stn.G240, Osprey Island, intertidal rubble zone, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **AM** W.47453, stn.G246, off Granite Bluff, 17 m, coll. G. Rouse & E. Kupriyanova, 3 Nov 2005; **SAM** E3592, stn.G232, between First Beach and Osprey Island, 14°42'S, 145°30'E, coll. E. Kupriyanova & G. Rouse, 26 Oct 2005; **SAM** E3620, Ser53, stn.G240, Coconut Beach 14°41'S, 145°28'E, scuba, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005.

Diagnosis. Tube white, about 0.1 mm in diameter. Operculum delicate membranous cup with a flat distal

surface surmounted by a marginal crown of fine teeth joined by a transparent membrane; borne on normal pinnulated radiole (Fig. 12).

Remarks. This tiny serpulid has been reported from numerous circum(sub)tropical to temperate locations around the world: Australia (Dew 1959), Japan (Uchida 1978, Imajima 1979), Hawaii (Bailey-Brock 1991), Israel (Ben-Eliahu 1976), Italy (Bianchi 1981), Cyprus (Ben-Eliahu & Payiatas 1999), Germany (Hartmann-Schröder 1971), France (Fauvel 1927; Zibrowius 1968), west coast of Africa (Zibrowius 1973), north coast of Tunis (Zibrowius 1979). It remains to be seen if this wide distribution will stand up against the scrutiny of DNA. The species has the same body size as *Rhodopsis pusilla* and was confused with *Rhodopsis* (by Straughan 1967a, fig. 5i).

Distribution. Questionably circum(sub)tropical, temperate.

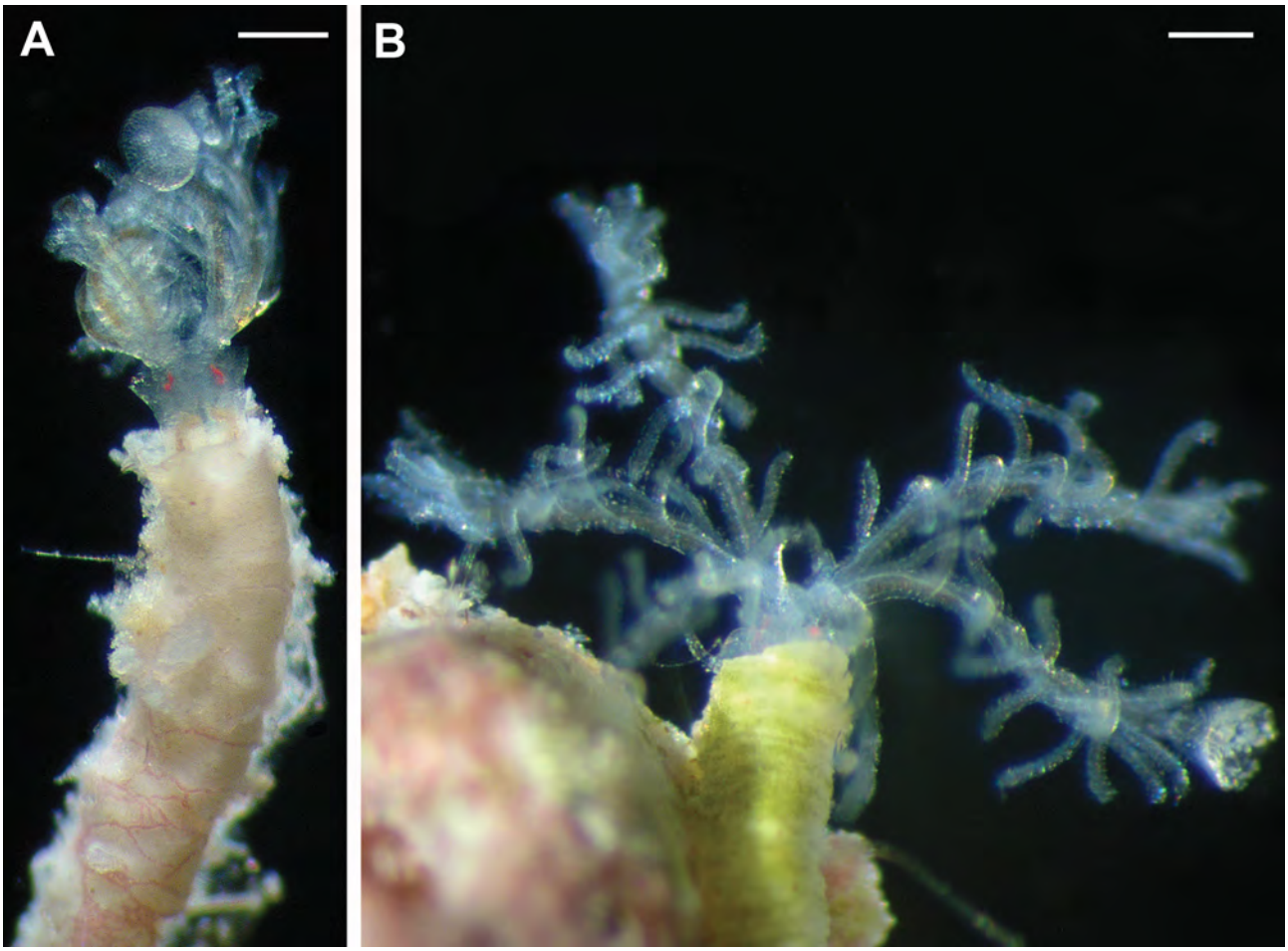

FIGURE 12. *Josephella marenzelleri,* live animals in tubes. A. Stn.G232, **SAM** E3592; B. Pinnulated peduncle is clearly seen, stn.G240, **AM** W.47452. Photo: A, B—G. Rouse. Scale bars: A–B = 0.1 mm.

Genus *Metavermilia* Bush, 1905 *sensu* Zibrowius, 1971

Type-species. *Vermilia multicristata* Philippi, 1844

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube white, opaque, peristomes may be present, as well as several longitudinal keels, sometimes denticulate. Granular overlay generally absent. Operculum with chitinous, non-calcified endplate, sometimes with complex multi-tiered structures, or endplate may be absent. Peduncle flattened, ribbon-like, without distal wings; formed from second dorsal radiole on one side. Constriction may be present. Pseudoperculum may be present. Radioles arranged in semi-circles to short pectinate, up to 18 per lobe. Inter-radiolar membrane and stylodes absent. Branchial eyes may be present. Mouth palps absent. Seven thoracic chaetigerous segments. Collar trilobed, tonguelets between ventral and lateral collar lobes absent. Length of

thoracic membranes variable, ending at thoracic segments 3–7, sometimes forming ventral apron on anterior abdominal segments. Collar chaetae limbate. *Apomatus* chaetae present. Thoracic uncini saw-shaped with up to 15 teeth, anterior tooth blunt, rounded. Triangular depression absent. Abdominal chaetae with flat narrow geniculate blade with rounded teeth; uncini saw- or rasp-shaped. Achaetous anterior abdominal zone absent. Posterior capillary chaetae and glandular pad present.

Metavermilia acanthophora (Augener, 1914)

(Fig. 13A, B)

Vermiliopsis acanthophora Augener, 1914: 155–158, pl. 1, figs 21–24 [WA, Australia].

Vermiliopsis acanthophora.—Dew 1959: 32, fig. 9, A–E [NSW, Australia]; Straughan 1967b: 234 [Qld, Australia]; Knox & Cameron 1971: 40 [Vic, Australia].

Not *Vermiliopsis acanthophora.*—*sensu* Fauvel 1919: 343 [Gambier Islands]; 1923: 53 [Gambier Islands; = *V. glandigera/pygidialis*-complex]; Monro 1937: 318 [Arabian Seas; = *V. glandigera/pygidialis*-complex]; *sensu* Day 1962: 654 [Indian Ocean]; 1967: 814 [Kenia; = *Vermiliopsis* undescribed species *fide* ten Hove 1975: 59].

Metavermilia acanthophora.—ten Hove 1975: 57 [recombination, name in list]; Imaijma 1976b: 138–139, fig. 10a–k [Tanega-Shima, Japan]; 1977: 97 [Ogasawara Islands, Japan]; 1978: 61–62 [Izu Islands, Japan]; 1979: 171 [Kii Peninsula, Japan]; 1982: 51 [Palau Islands]; 1987: 80 [Okinawa, Japan]; Stull 1979: 38 [East off North Island, New Zealand; 26–170 m]; Wu *et al.* 1980: 125 [Xisha Islands, China]; Mak 1982: 606–607 [Hong Kong]; Imajima & ten Hove 1986: 9 [Solomon Islands]; Kupriyanova *et al.* 2006: 423–433, fig. 2 [DNA data]; ten Hove & Kupriyanova 2009: 18, fig. 4c, 62–63, fig. 28 [SEM of chaetae].

Metavermilia ?acanthophora.—Fiege & Sun 1999: 133, fig. 20 [Hainan Island, China].

Metavermilia cf. *acanthophora.*—Sun & Yang 2001b: 212–213, fig. 1G–K [Hainan Island, China].

Material examined. AM W.28417, stn.20, 14°42'S, 145°27'E, reef front north of South Island, sloping reef outside lagoon & sandy bottom below, 10–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 5 Mar 1986; **AM** W.28423, south of lighthouse, Palfrey Island, 14°40'S, 145°28'E, coll. H. ten Hove, 2 Mar 1986, det. H. ten Hove (as *Metavermilia* sp.), det. E. Kupriyanova; **AM** W.42054 (2), stn.G246, Granite Bluff, coll. G. Rouse & E. Kupriyanova, 3 Nov 2005; **AM** W.44050, MI QLD 2350; **AM** W.47300, mid shelf of Fore Reef, 14°36'54"S, 145°37'12"E, *Halimeda* and rubble, 12 m, coll. M. Blazewicz-Paskowycz, 12 Feb 2009; **AM** W.47455, stn.244, off South Island, coll. G. Rouse & E. Kupriyanova, 2 Nov 2005; **ZMA** V.Pol. 4694, stn.19, Turtle Beach, intertidal boulders & cobbles in coarse sand, coll. H. ten Hove, 5 Mar 1986; **ZMA** V.Pol. 4695, stn.16, North Point, sloping reef, dead, slightly silted corals, 3–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986; **ZMA** V.Pol. 4703, stn.22, between Osprey Island & beach of Resort, intertidal at low tide, from below large boulders on rocky bottom, coll. H. ten Hove & P. Hutchings, 6 Mar 1986; **ZMA** V.Pol. 4706 (3), between Research Point & Freshwater Beach, in lagoon, subtidally, from dead coral cobbles on sand, 1 m, coll. H. ten Hove, 16 Jun 1983; **ZMA** V.Pol. 4742, stn.16, North Point, sloping reef, mainly dead, slightly silted corals, 3–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986.

Diagnosis. Distal part of the operculum composed of 4–10 parallel tiers and terminating with a single distal spine or hook (Fig. 13); tube with one or three irregular, rounded longitudinal keels. Thoracic membranes reaching to the end of thorax, but no apron.

Remarks. Literature records need to be checked since some are misidentified (some examples from the Indo-Pacific have been given in the synonymy, above). Besides, there are doubts if this essentially temperate/subtropical species can occur in the tropics. There are two major types, one is large animals with opercula having only 2–3 "disks", the top one is wide and nearly flat, with a distinct hook in the centre, probably *M. acanthophora sensu stricto*; another is much smaller, with opercula reminding pine cones, made of many (up to 20) "disks" or flanges, tapering to the top, with more or less developed hook on the top or without the hook altogether, the latter form attributed to *M. nates* here.

Distribution. Indo-West Pacific, South Japan to Australia.

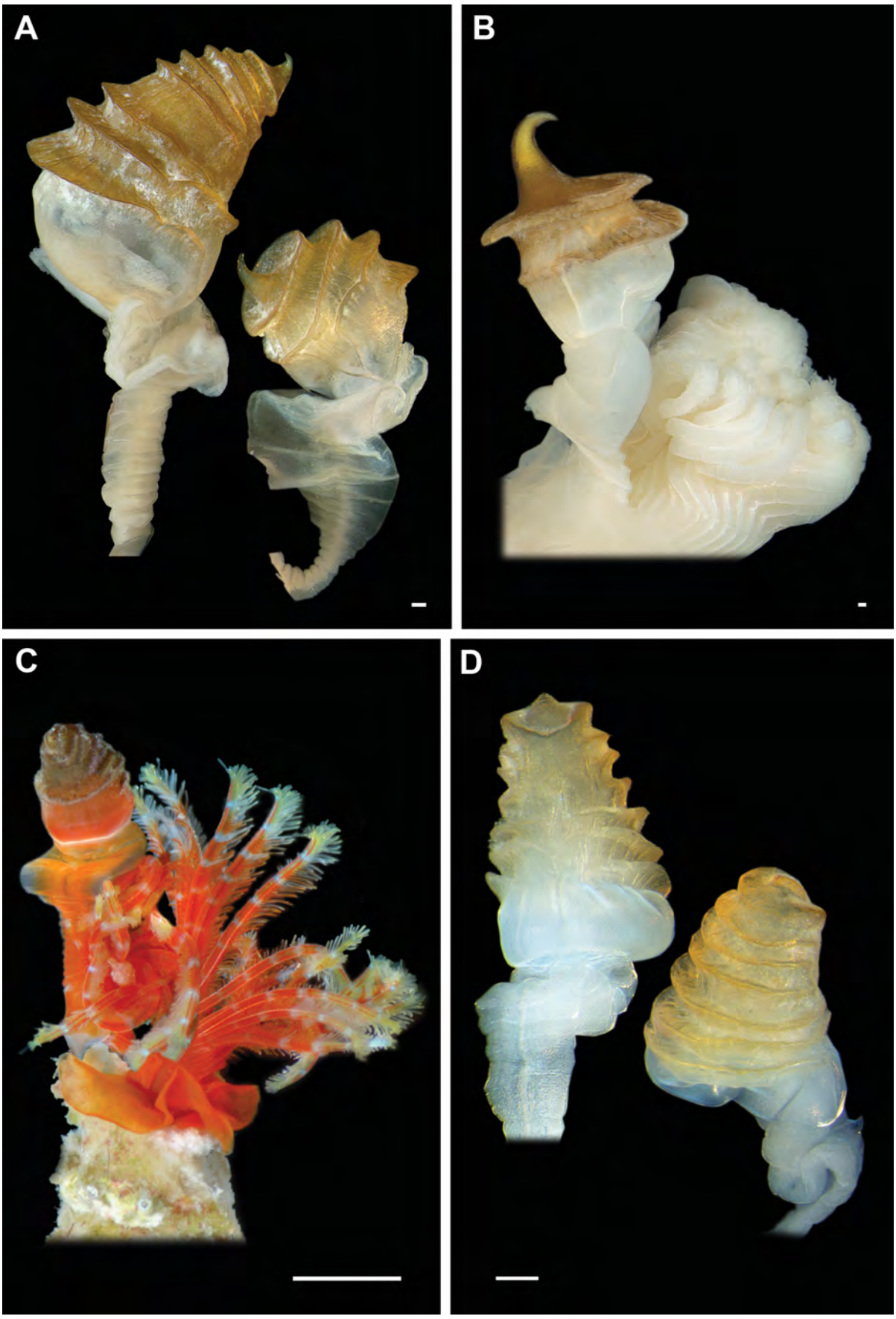

FIGURE 13. *Metavermilia acanthophora.* A. Opercula, stn.G246, **AM** W.42054; B. Operculum, **AM** W.47300. *Metavermilia nates*, C. Live animal in tube, **SAM** stn.G246; D. Opercula, stn.G242, **AM** W.47589. Photo: A, B, D—E. Wong, C—G. Rouse. Scale bars: A, B, D = 0.1 mm, C = 0.5 mm.

Metavermilia multicristata (Philippi, 1844)

Vermilia multicristata Philippi, 1844: 193, pl. 6, fig. K [Southern Italy].
Vermiliopsis multicristata.—Fauvel 1909: 60–61 [Azores; diagnosis]; 1914: 344 [same]; Southward 1963 [continental slope off Brittany]; Zibrowius 1968: 128–130, pl. 3, figs 25–43, pl. 14, fig. g [Northwest Mediterranean]; Bailey-Brock 1976: 77 [Hawaii; name].
Metavermilia multicristata.—Zibrowius 1971: 1375–1377, fig. 1 [Mediterranean/Atlantic; revision, description]; Thorp *et al.* 1986: 884 [British harbours]; ten Hove 1993: 83 [Seychelles, deeper water (150–600 m)]; 1994: 109 [same]; Sun & Yang 2001b: 213, fig. 1L–Q [Xisha Islands, South China Sea]; Nishi *et al.* 2007: 49 [name in key]; Vinn *et al.* 2008: 634, 635 [Seychelles]; ten Hove & Kupriyanova 2009: 63 [name only].

Material examined. ZMA V.Pol. 4696, stn.16, North Point, sloping reef, mainly dead, slightly silted corals, 3–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986; **ZMA** V.Pol. 4741 (2), stn.22, between Osprey Island & beach of Resort, intertidal at low tide, from below large boulders on rocky bottom, coll. H. ten Hove & P. Hutchings, 6 Mar 1986; **ZMA** V.Pol. 4881, Granite Head, 14°39'S, 145°27'E, from underside of boulders on rock, little sand, subtidally, coll. H. ten Hove, 18 Jun 1983 (id as *Spirobranchus* cf. *polytrema*).

Diagnosis. Opercular ampulla globular, covered with simple chitinous, convex distal cap; tube with 5–7 longitudinal keels and some transverse ridges between, giving the tube a porose appearance.

Remarks. The tube and operculum of the specimen from North Point are indistinguishable from Mediterranean material (**ZMA** V.Pol. 3130) when compared under the stereomicroscope and very similar to Sun & Yang (2001b: 213, fig. 1L–M). The two specimens from Osprey Island are the same, including tubes, but for the fact that their opercula (similar to that figured by Bianchi 1981: fig. 29e) appear to have a thin veneer or incrustation of calcareous matter in the opercular cap, just as in the operculum on half branchial crown from Granite Head. Notwithstanding the fact that an essentially temperate-subtropical Mediterranean species of deeper waters is unlikely to occur in tropical waters from the Indo-Pacific, for the time being we regard the material to be conspecific.

Distribution. Subtropical to temperate Atlantic, Mediterranean, West Indian Ocean, South China Sea. New record for Australia.

Metavermilia nates Zibrowius, 1971
(Fig. 13C, D)

Mevermilia (sic!) *nates* Zibrowius, 1971: 1380–1381, fig. 4 [Europa Island, Mozambique Channel, Tanzania Coast].
?*Vermiliopsis multicristata.* —Monro 1937: 319 [Tanzania; *fide* Zibrowius 1971: 1380].
Metavermilia nates.—Imajima 1979: 171–173, fig. 5 [Southern tip of Honshu, Japan]; Imajima & ten Hove 1984: 54 [Ponape Island]; ten Hove & Kupriyanova 2009: 63 [name only].

Material examined. AM W.47588, stn.G239, Reef crest to south of Bird Islet, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **AM** W.47589, stn.G242, east lagoon near Bird Islet, 1 Nov 2005 (1, branchia with operculum); **SAM** stn.G246, off Granite Bluff, coll. G. Rouse & E. Kupriyanova, 3 Nov 2005; **ZMA** V.Pol. 4694, stn.19, Turtle Beach, intertidal boulders & cobbles in coarse sand, coll. H. ten Hove, 5 Mar 1986.

Diagnosis. Operculum complex, consisting of basal ampulla, often with mid-dorsal groove, distal part composed of 4–10 parallel tiers with dorsal indent and terminating with flat disk; tube with 5–9 longitudinal teethed keels (Fig. 13).

Remarks. Zibrowius (1971) also mentioned enlarged tips of branchial radioles in *M. nates* as a specific character.

Distribution. Europa Island, Tanzania; Red Sea; Ponape Island; Honshu, Japan. New record for Australia.

Genus *Paraprotis* Uchida, 1978

Type-species. *Paraprotis dendrova* Uchida, 1978

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube white, opaque, circular in cross-section, without longitudinal keels. Granular overlay not observed. Operculum and pseudoperculum absent (or soft globular operculum may be present on second unmodified radiole in *P. pulchra*). Arrangement of radioles semi-circular or short pectinate, up to 6 per lobe (up to 32 per lobe in *P. pulchra*). Inter-radiolar membrane absent. Branchial eyes (ocellar clusters) present. Stylodes absent. Mouth palps absent, but a spiral projection for brood attachment originates from the right side of the mouth. Collar non-lobed, tonguelets absent. Thoracic membranes narrowing at third chaetiger but continuing to 7th thoracic chaetiger, a narrow apron is probably present. Seven thoracic chaetigerous segments. Collar chaetae limbate. *Apomatus* chaetae absent. Thoracic uncini of *Protis* type, saw-shaped with about 10 teeth, anterior fang with pointed tip. Thoracic triangular depression not observed. Anterior abdominal chaetae flat narrow geniculate with a row of sharp teeth along its free margin. Abdominal uncini similar to thoracic ones but rasp-shaped. Achaetous anterior abdominal zone present, short (2–4 segments). Long posterior capillary chaetae present. Posterior glandular pad not observed.

Remarks. The genus currently includes two species *P. dendrova* and *P. pulchra* (the latter generic attribution questionable), however, our preliminary molecular data (Kupriyanova *et al.* unpubl.) indicate that these two species are not closely related, thus, *P. pulchra* should be transferred to another genus.

Paraprotis dendrova Uchida, 1978
(Fig. 14A)

Paraprotis dendrova Uchida, 1978: 16–17, plas 3, 4 [Sabiura, Japan].
Paraprotis dendrova.—Nishi 1992a: 18–19, fig. 3A–D [Okinawa, Japan]; 1996: 309, fig. 4e [Okinawa, Japan]; Nishi & Yamasu 1992a: 85 [Ryukyu Islands, Japan; brooding]; Rouse 2005: 168, 173, 175, fig. 3B [Okinawa, Japan].

Material examined. SAM E3591, G243, Patch Reef on the way to Palfrey Island, coll. G. Rouse & E. Kupriyanova, 1 Nov 2005; **ZMA** V.Pol. 4538, Granite Head, 14°39'S, 145°27'E, from underside of boulders on rock, little sand, subtidally, coll. H. ten Hove, 18 Jun 1983 (3, carrying eggs/embryos).

Diagnosis. Operculum absent. Ocellar clusters (2–3 per radiole) present. A spiral projection for brood attachment originates from the right side of the mouth, carrying up to 50 embryos (Fig. 14A). Collar non-lobed.

Remarks. This small (tube about 1 mm wide) cryptic species lacks an operculum and is easily recognizable only when the brooding appendage is present.

Distribution. Okinawa, Japan, Qld, Australia. New record for Australia.

Genus Placostegus Philippi, 1844

Type-species. *Serpula tridentata* Fabricius, 1799

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube triangular in cross-section, with denticulate keels, transparent or semi-transparent, often only attached to substratum at the base, collar-like rings absent. Granular overlay absent. Operculum inverse conical, with chitinous cup-shaped endplate. Peduncle cylindrical, smooth, without wings, gradually merging into operculum, at most with shallow constriction; inserted at base of radioles on one side between first and second normal radiole and maximally covering base of first three radioles. Pseudoperculum absent. Radioles arranged in semi-circles, up to 24 per lobe; inter-radiolar membrane, branchial eyes, and stylodes absent. Mouth palps present. Six thoracic chaetigerous segments. Collar tri- to penta-lobed, collar edge may be almost laciniate; tonguelets between ventral and lateral collar lobes present. Thoracic membranes long, forming ventral apron across anterior abdominal segment. Collar chaetae absent; collar region with girdle of reddish ocelli. *Apomatus* chaetae absent. All uncini sub-rectangular, rasp-shaped with > 20 teeth in profile, and up to 8 small teeth in a row; anterior peg wide, flat, bluntly truncate, almost rectangular. Thoracic triangular depression absent. Abdominal chaetae true trumpet-shaped, with distal hollow triangular blade, abruptly bent. Achaetous anterior abdominal zone present. Long posterior capillary chaetae may be present. Posterior glandular pad absent.

Remarks. The genus is poorly known from areas other than the Atlantic/Mediterranean.

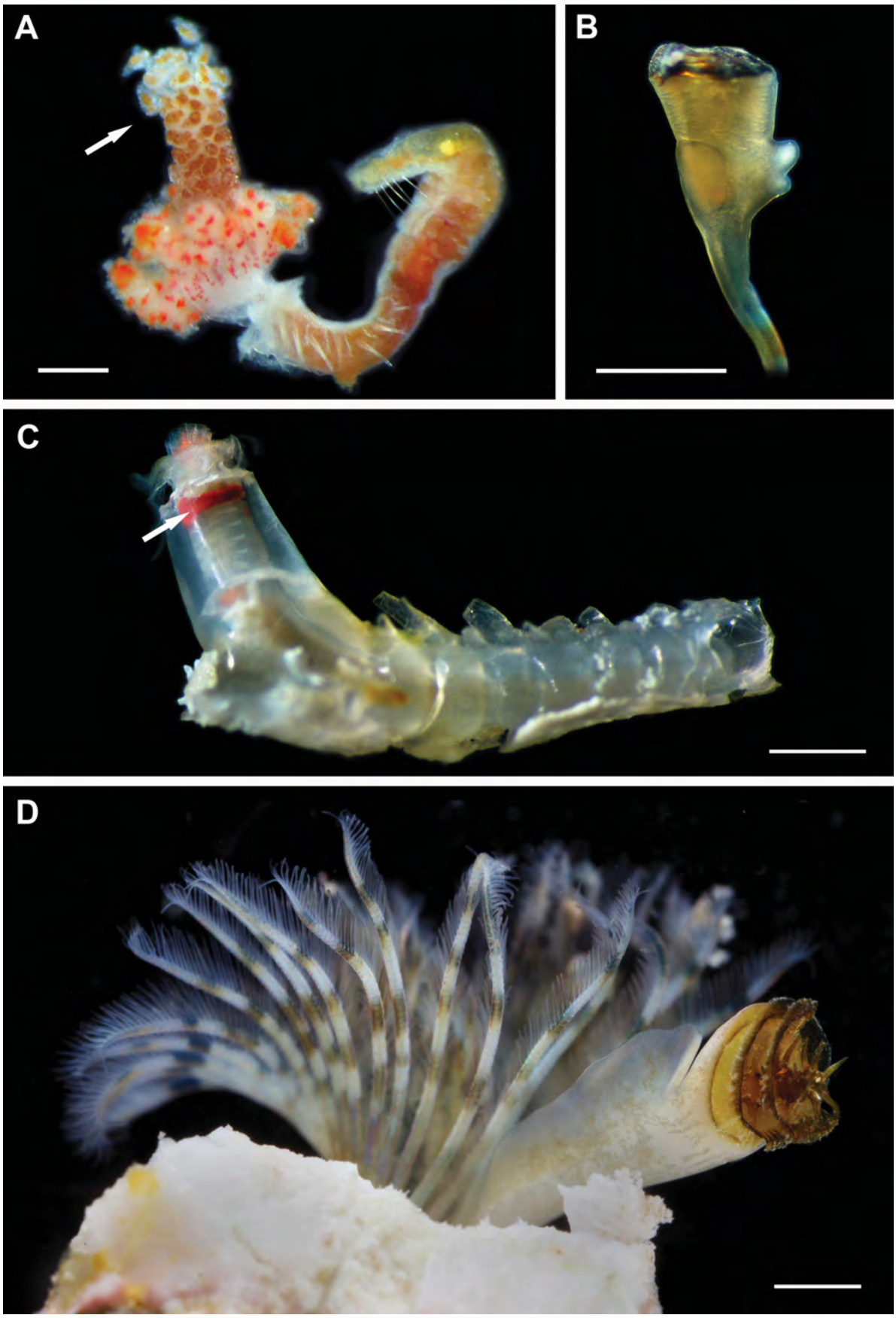

FIGURE 14. A. *Paraprotis dendrova,* live animal removed from the tube, with typical brooding appendage bearing developing larvae (arrow), stn.G243, **SAM** E3591; B. *Placostegus* sp., operculum covered with brown distal plate, stn. G231, **SAM** E3589; C. Same, live animal in transparent tube, radiolar crown and operculum missing, bright orange belt of thoracic eyes (arrow) is seen through tube, stn.G231, **SAM** E3589; D. *Pomatostegus actinoceras,* live animal in tube, **AM** W.44540. Photo: A–C—G. Rouse, D—A. Semenov. Scale bars: A = 0.5 mm, B–D = 1 mm.

***Placostegus* sp.**
(Fig. 14B, C)

? *Placostegus tridentatus* not (Fabricius, 1779) Imajima 1978: 67–69, fig. 9 [Izu Islands, Japan]; 1979: 179 [Kii Peninsula, Japan; see Remarks].

Material examined. SAM E3589, stn.G231, Coconut Beach, 14°41'S, 145°28'E, scuba, G. Rouse & E. Kupriyanova, 26 Oct 2005**; ZMA** V.Pol. 4649, Carter Reef, reef front, 20–30 m, coll. P. Hutchings, 10 Mar 1986 (tube only).

Diagnosis. Tube transparent, with three longitudinal rows of blunt teeth (Fig. 14C); collar region with a band of reddish ocelli, operculum asymetrical, with dark brown distal plate (Fig. 14B).

Remarks. We have refrained from giving a list of synonyms for this taxon and the reference to Imajima (1978) is tentative only, mainly meant as an illustration of the genus. Unpublished notes of one of us (HtH) mention two types of opercula for material from all around Australia, one with an almost circular endplate (like figured by Imajima 1978 fig. 9a–c for ? *P. tridentatus*), the other with a zygomorphic endplate (*cf.* Hartman 1969: 763 for *P. californicus*). The operculum of our present specimen does not entirely fit one of these types, especially with regard to the two ventral bumps of the ampulla, not known from any other *Placostegus* spec. *Placostegus tridentatus* (Fabricius, 1799) is listed by ten Hove & Kupriyanova (2009) as a widely distributed species found in the Atlantic, Mediterranean, and Indo-West Pacific, including Zanzibar, Amirantes Islands, Indonesia, Western Australia and Japan (ten Hove 1994: 109). However, Imajima (1978: 69) already doubted whether or not his Japanese material was identical with the Atlantic specimens on a number of differences, a doubt also expressed by ten Hove (1994: 109) for his material from the Seychelles. Such a wide distribution is questionable in itself, and both unpublished morphological and molecular data indicate that *Placostegus* from Lizard Island is distinct from *P. tridentatus* from Northern Europe. *Placostegus* spp. from the Indo-Pacific Region, including Lizard Island, most likely belong to several undescribed species.

Distribution. Currently unknown.

Genus *Pomatostegus* Schmarda, 1861

Type-species. *Pomatostegus macrosoma* Schmarda, 1861, junior synonym of *Terebella stellata* Abildgaard, 1789.

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube white, opaque, semi-circular to roughly triangular in cross-section, with up to 5 longitudinal keels; granular overlay absent. Operculum a very flat ampulla covered with chitinous disk bearing a column with several serrated disks alternating with circlets of spines proximally and closely applied to each disk. Peduncle flatly triangular in cross-section with broad latero-distal wings along its entire length; inserted to the left or right at the basis of the branchial lobe; from the fact that the first and second radiole separated by the base of the peduncle, it is inferred that it is derived from the second normal radiole. Constriction absent. Pseudoperculum absent. Arrangement of radioles in (semi-)circles, up to 90 per lobe. Interradiolar membrane present. Branchial eyes present. Stylodes absent. Mouth palps absent. Seven thoracic chaetigerous segments. Collar tri- to penta-lobed, well developed with an entire smooth margin. Tonguelets absent. Thoracic membranes short, ending just posterior to the second row of uncini (segment 3). Collar chaetae *Spirobranchus*-type, with basal pilose fin and distal blade, and limbate. *Apomatus* chaetae present. Thoracic uncini saw-shaped, with 9–13 teeth, anterior peg blunt. Thoracic tori meet ventrally in larger specimens; in juveniles the ventral space between thoracic tori narrowing towards last rows that almost fused, leaving a triangular depression. Abdominal chaetae flat narrow geniculate, with long blade. Abdominal uncini smaller than thoracic ones, with about 8 teeth in profile, 3 teeth in a row. Achaetous anterior abdominal zone absent. Long posterior capillary chaetae absent, but posterior chaetae longer. Posterior glandular pad absent.

Remarks. For a couple of decades, the genus was thought to be monotypic, with *Pomatostegus stellatus* (Abildgaard, 1789) as single representative, occurring circumtropically. Instigated by P. Valentijn (personal communication from unpublished student's research), ten Hove & Kupriyanova (2009: 78) restricted the nominal taxon *P. stellatus* to the tropical Atlantic Region, and the previously synonymized *P. actinoceras* Mörch, 1863, from the Indo-West Pacific Region and *P. krøyeri* Mörch, 1863, from tropical Pacific America, were elevated to full species again.

***Pomatostegus actinoceras* Mörch, 1863**
(Fig. 14D)

Pomatostegus actinoceras Mörch, 1863: 400, figs 16–17 [Philippines; original description].
Pomatostegus actinoceras.—Willey 1905: 314, pl. 8, figs 3–4 [Sri Lanka]; Augener 1914: 152–155 [as *actinoceros*; Australia, Shark Bay]; Pillai 2009: 109–112, figs 9a–e & 10a–e [as *actinoceros*; Kimberley, WA]; Humann & Deloach 2010: 71 [Indo-West Pacific; colour photograph]; Bailey-Brock *et al.* 2012: 975, fig. 5A–K [Marshall Islands].
Pomatostegus stellatus not (Abildgaard, 1789).—Dew 1959: 41–42, fig. 14A–G [Qld, Australia; Solomon Islands]; Johanssson 1918: 10–12 [Australia, WA]; Pillai 1960: 23–25, fig. 9a–d [Sri Lanka]; 1971: 94 [same]; Straughan 1967a: 38 [Qld, Australia]; Straughan 1967b: 237 [same]; Straughan 1967c: 224 [NT, Australia]; Imajima 1977: 101–102, fig. 7a–k [Ogasawara Islands, Japan]; 1982: 51 [Palau and Yap Islands]; 1987: 80 [Okinawa, Japan]; Mak 1982: 608 [Hong Kong]; Imajima & ten Hove 1984: 54 [Truk Islands, Ponape and Majuro Atoll]; 1986: 9 [Gilbert Islands (Kiribati) and the Solomon Islands]; Stock 1988: 217 [Lizard Island, Qld, Australia; parasitized]; Nishi 1993a: 12, table 1 [Okinawa, Japan]; 1993b: 19, table 1 [same]; 1995: 29–31, fig. 1h [same]; 1996: 312 [same]; Fiege & Sun 1999: 131–133, fig. 19a–f [Hainan Island, China].

Material examined. AM W.28348, Carter Reef, 14°40'S, 145°28'E, coll. P. Hutchings, 10 Mar 1986, det. H. ten Hove; **AM** W.44540, MI QLD 2390; **AM** W.47311, Day Reef, Fore Reef, 14°28'18"S, 145°31'48"E, coral rubble, 10 m, coll. M. Blazewicz-Paskowycz, 13 Feb 2009; **ZMA** V.Pol. 4754, stn.22, between Osprey Island & beach of Resort, intertidal at low tide, from below large boulders on rocky bottom, coll. H. ten Hove & P. Hutchings, 6 Mar 1986; **ZMA** V.Pol. 4755, Palfrey Island, SE point, sandy beach, intertidal, small cobble, 0.5 m above ebb tide level, probably cast ashore, coll. H. ten Hove, 19 Jun 1983.

Diagnosis. Tube thick, opaque, white, triangular in cross-section; a strong median keel with blunt teeth and two or more lateral rows of well-defined teeth. Peduncle broad with lateral wings terminating in pointed tips. Operculum a column with 2–6 chitinous plates with frilled margins stacked one above the other; diameter of plates decreases upwards (distally). Circlets of 10–12 spines present at the basis of each disk, except for the first chitinous plate (Fig. 14D).

Remarks. There tend to be more of "free" circlets of spines, without accompanying wide plates in the Indo-Pacific *P. actinoceras* as opposed to the Caribbean *P. stellatus*. Figure 14D suggests 3 discs surmounted by 2 or 3 starlets of spines, also compare Rullier 1974 (Cuba) *versus* Fiege & Sun 1999: 132, fig. 19 (China) and Imajima 1977: 101, fig. 7 (Japan); it seems to be one of the morphological differences between these two species.

Distribution. Indo-West Pacific distribution, including Southern Japan, Micronesia and Australia, China, Sri Lanka.

Genus *Protula* Risso, 1826

Type-species. *Protula rudolphi* Risso, 1826, junior synonym of *Serpula tubularia* Montagu, 1803.

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube white, opaque, may be up to 2 cm across and 40 cm long, (semi-)circular in cross-section, longitudinal keels and flaring peristomes absent. Operculum and pseudoperculum absent. Radioles arranged in two semicircles to a spire of up to 6 whorls, up to 320 per lobe (*P. superba* Moore, 1909). Inter-radiolar membrane present. Branchial eyes may be present. Stylodes absent. Mouth palps present. Seven thoracic chaetigerous segments. Collar trilobed, tonguelets absent. Thoracic membranes long and wide, with undulating edge, forming ventral apron across anterior abdominal segments. Collar chaetae limbate. *Apomatus* chaetae present. Thoracic and abdominal uncini rasp-shaped with approximately 30 teeth in profile, up to 6 rows of teeth above and continuing onto elongated rounded peg. Thoracic triangular depression absent. Abdominal chaetae sickle-shaped, with finely denticulate blades, may be retro-geniculate in some taxa. Achaetous anterior abdominal zone absent. Long posterior capillary chaetae present. Posterior glandular pad present.

Remarks. In their recent review of the taxonomy of serpulid genera, ten Hove & Kupriyanova (2009: 81) called *Protula* the most problematic serpulid taxon. Often authors do not even try to identify specimens to species level as evidenced by over 60 literature records of *Protula* spec. in ten Hove's literature database. The phylogenetic basis for this genus is ill-defined and based on negative characters, such as lack of an operculum, lack of special collar chaetae and mostly lack of any characteristic ornamentation of the tube (although *Protula diomedeae*

Benedict, 1887 has a fairly recognizable tube, and some others too may be determined by tubes only). In Australia, two species are currently commonly reported: the large forms with distinct spiralled radioles (white or white and yellow in colour) as *P. bispiralis* (Savigny, 1822) and all smaller forms as *P. palliata* (Willey, 1905). For an extensive discussion see Ben-Eliahu & ten Hove (2011: 44–62). The real number of species is unknown and it is most likely impossible to determine without a dedicated morphological and molecular revisionary study.

Protula bispiralis (Savigny, 1822)

(Fig. 15D)

Serpula (*Spiramella*) *bispiralis* Savigny, 1822: 75–76 [Indian Ocean; original description].

Protula bispiralis.—Ehlers 1907: 31 [New Zealand, Stewart Island; diagnosis]; Fauvel 1922: 498–499, fig. 2 [W. Australia, Houtman Abrolhos; redescription]; Augener 1925: 68–69 [St. Matthias Islands]; 1926: 276–277 [Pegasus Bay, Stewart Island]; 1934: 121 [Indonesia, Java; diagnosis]; Benham 1927: 162–166, pl. 6 figs 191–192 [New Zealand; interesting discussion]; Day 1967: 459–878 [Southern Africa; diagnosis]; Straughan 1967b: 251 [Australia]; Smith 1985: 92–97, figs 9e, 12d–e [Australia, Qld, e.g., Lizard Island; redescription]; ten Hove 1994: 107–116 [Seychelles]; Sun *et al.* 2012a: 24, fig. 3 [Hong Kong].

Protula magnifica Straughan, 1967a: 41–42 [Heron Island, Qld].

Protula magnifica.—Mather & Bennett 1984: pl. 3 fig. 3 [Australia, Heron Island, Qld; colour photograph]; Colin & Arneson 1995: 152–153, photo 706 [Micronesia; colour photograph]; Erhardt & Moosleitner 1995: 866 [tropical Indo-Pacific; colour photograph]; Allen & Steene 1994: 130 [Indo-Pacific; colour photograph]; Gosliner *et al.* 1996: 119 [Indonesia, Sulawesi; colour photograph]; Humann & Deloach 2010: 70 [Indo-West Pacific; colour photograph].

Material examined. AM W.28302, North Point, 14°40'S, 145°28'E, sloping reef with sand & thinly silted corals, coll. R. Smith & C. J. Watson, 1 Mar 1986; **AM** W.42245, Yonge Reef, back reef bommie, north channel, 14°36'S, 145°37'E, rubble, coll. R. Smith, 6 Nov 1985; **AM** W.42247, same; **ZMA** V.Pol. 4762**,** stn.17, Palfrey Island, south of lighthouse, 14°40'S, 145°28'E, coral heads on sandy bottom, 7 m, coll. H. ten Hove, P. Hutchings & M. Reid, 2 Mar 1986; **SAM** stn.G238, east lagoon near Bird Islet, 10 m, 31 Oct 2005, photo by G. Rouse *in situ*, specimen not taken.

Diagnosis. Largest Australian species. Conspicuous radioles as evidenced by numerous pictures in field guides (however often mistaken for feather duster worms (Sabellidae) or for Christmas tree worms (*Spirobranchus*) and *vice versa*, and even in a travel guide (Finlay *et al.* 1998: 80)). Radioles white, reddish or mottled, arranged in two spires of up to 6 whorls, up to 4 cm across and 4.5 cm high (Fig. 15D).

Remarks. The nominal taxon is badly in need of revision. Though usually reported from the tropical region, it was mentioned from cold-temperate areas as the Cape, South Africa and Stewart Island, New Zealand (e.g., Day 1967: 818–820; Augener 1926: 276–277), a very unlikely distributional pattern. Opinion 1461 in the Bulletin of Zoological Nomenclature 44 (3): 219–220 gives as date for Savigny's paper 1822 (as opposed to the generally circulating 1820).

Distribution. Currently unknown.

Protula spp.

(Fig. 15A–C)

Protula sp.—Stock 1988: 217 [Lizard Island; parasitized]; ten Hove & Smith 1990: 114 [Indonesia, Java]; Allen & Steene 1994: 130 [Indo-Pacific; colour photograph]; Colin & Arneson 1995: 154 [Indonesia, Papua New Guinea; colour photograph]; Nishi 1996: 312 [in dead coral, Okinawa, Japan]; Nishi & Asakura 1996: 56–57 [Marianas]; Fiege & Sun 1999: 136 [Hainan Island, China]; Rouse & Pleijel 2001: plate 10b, insert [Qld; colour photograph]; Rousset *et al.* 2007: 48 [Qld, Australia; phylogeny].

Material examined. AM W.23094, stn.z 00-24(36)-4-8, between Bird and South Islets, 14°40'S, 145°28'E, from dead *Porites* blocks, coll. P. Hutchings, Jan 1987, det. P. Knight-Jones, 1995; **AM** W.28329, stn.18, lagoon near east entrance, 14°40'S, 145°28'E, sheltered side of reef, near sandy bottom, 3 Mar 1986; **AM** W.28424, stn.21, south of South Island, 14°42'S, 145°28'E, sloping silty reef, little coral cover, coll. H. ten Hove & P. Hutchings, 6 Mar 1986; **AM** W.28429, North Reef, 14°40'S, 145°27'E, underside of boulders on rock, low tide, little sand, coll.

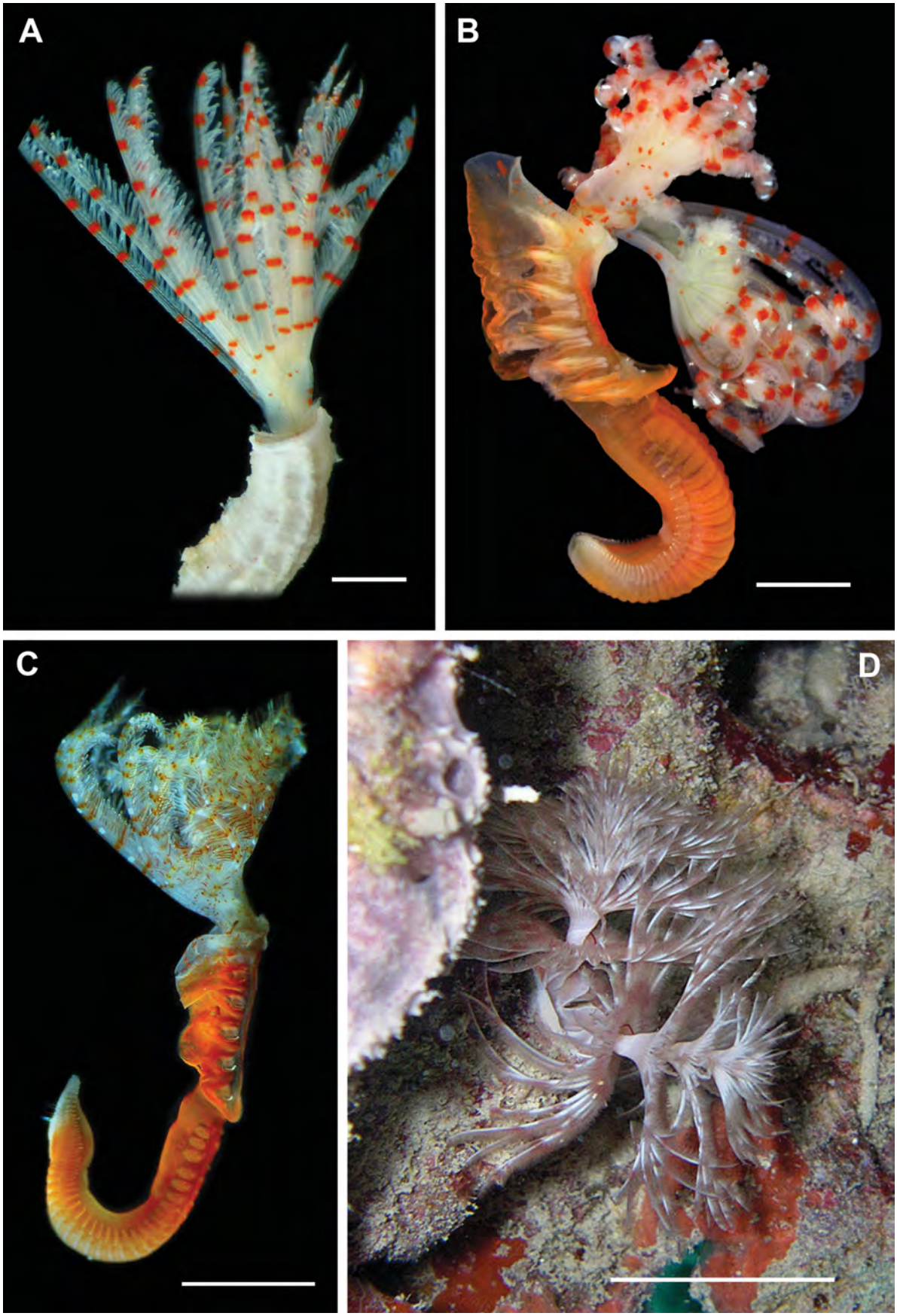

FIGURE 15. *Protula* spp., live specimens. A. Animal in tube, stn.G235, **SAM**; B. **AM** W.45075; C. Stn.231, **SAM**; D. *P. bispiralis,* live specimen *in situ,* stn.G238. Photo: A, C, D—G. Rouse, B—A. Semenov. Scale bars: A = 3 mm, B = 2 mm, C = 10 mm, D = 50 mm.

H. ten Hove, 22 Jun 1983; **AM** W.28434, stn. 19, Turtle Beach, 14°40'S, 145°27'E, intertidal, boulders in sand, coll. H. ten Hove, 5 Mar 1986, det. H. ten Hove; **AM** W.44532, MI QLD 2371; **AM** W.45049, MI QLD 2406; **AM** W.45061, MI QLD 2413; **AM** W.45075, MI QLD 2417; **AM** W.45082, MI QLD 2423; **AM** W.45099, MI QLD 2435; **AM** W.47586, stn.G232, rubble between First Beach & Osprey Island, 1 m, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005; **MAGNT** W025494, off Casuarina Beach, lagoon of Patch Reef, 14°40'48"S, 145°26'42"E, coral rubble, 2 m, coll. P. Bock; **SAM** E3588, stn.G246, off Granite Bluff, 7 m, coll. G. Rouse & E. Kupriyanova, 3 Nov 2005; **SAM** stn.G231, Coconut Beach, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005; **SAM** stn.G235, Coconut Beach, 14°0'S, 145°0'E, coral rubble, coll. G. Rouse & E. Kupriyanova, 28 Oct 2005; **ZMA** V.Pol. 4707, between Bird and South Islets, 1–5 m, coll. P. Hutchings, 10 Mar 1986; **ZMA** V.Pol. 4718, between First Beach & Osprey Island, reef flat, dead corals & rubble in sand, 3–4 m, coll. H. ten Hove, 17 Jun 1983; **ZMA** V.Pol. 4721 (2), between Research Point & Freshwater Beach, in lagoon, subtidally, from dead coral cobbles on sand, 1 m, coll. H. ten Hove, 16 Jun 1983; **ZMA** V.Pol. 4723 (many), stn.22, between Osprey Island & beach of Resort, intertidal collecting at low tide, from below large boulders on rocky bottom, coll. H. ten Hove & P. Hutchings, 6 Mar 1986.

Remarks. The specimens collected at Lizard Island belong to an unknown number of most likely undescribed species (see Remarks after the generic diagnosis).

Distribution. Currently unknown.

Genus *Pseudovermilia* Bush, 1907

Type-species. *Spirobranchus occidentalis* McIntosh, 1885

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube white (in one species with transverse brown bands), opaque, with longitudinal keel(s), sub-triangular or triangular in cross-section; generally with regular ornamentation of ribs, pits, or teeth. Double or single brooding scoops may be present. Granular overlay absent. Operculum consisting of bulbous ampulla terminated by chitinous endplate or cap, usually with spine(s). Pseudoperculum absent. Peduncle smooth, cylindrical, without wings, clearly separated from ampulla by constriction; inserted just below and between first and second radiole on one side. Arrangement of radioles pectinate, up to 17 per lobe, inter-radiolar membrane absent. Branchial eyes not known. Stylodes absent. Filiform mouth palps present. Seven thoracic chaetigerous segments. Collar with unpaired medio-ventral lobe and two latero-dorsal lobes continuous with short thoracic membranes, continuing to second thoracic chaetiger. Tonguelets between ventral and lateral collar lobes absent. Collar chaetae limbate. *Apomatus* chaetae from second or third chaetiger onward. Thoracic uncini saw-shaped, with 9–17 teeth above gouged peg (seemingly bifurcate). Triangular depression absent. Abdominal chaetae flat narrow geniculate, with rounded teeth on edge. Abdominal uncini rasp-shaped with 9–13 teeth in profile view, up to 6 teeth in a row above gouged peg. Short achaetous anterior abdominal zone may be present. Long posterior capillary chaetae present. Posterior glandular pad may be present.

Remarks. The genus *Pseudovermilia* is most similar to the genus *Semivermilia*, the differences being the insertion of the peduncle (inserted just below and between first and second radiole in the former *versus* inserted as second radiole in the latter); the arrangement of the radioles, long pectiniform *versus* short pectiniform; the structure of thoracic uncini (saw-shaped in the former *versus* saw- to-rasp-shaped in the latter) and the (mostly) regular ornamentation of the tube in *Pseudovermilia,* missing in *Semivermilia.* All these characters show clinal variation and it remains to be seen if ten Hove's (1975) proposed differentiation holds under DNA scrutiny.

Pseudovermilia pacifica Imajima, 1978
(Fig. 16)

Pseudovermilia pacifica Imajima, 1978: 57–59, fig. 4a–n [Ponape Island; original description].

Pseudovermilia pacifica.—Imajima, 1979: 170 [Japan]; 1987: 81 [Okinawa, Japan]; Imajima & ten Hove 1984: 58 [Truk Islands, Ponape and Majuro Atoll]; ten Hove 1994: 110 [Seychelles]; Sun & Yang 2001a: 187, fig. 1I–N [Xisha Island, China]; Bailey-Brock *et al.* 2012: 976–977, fig. 7A–M [Marshall Islands].

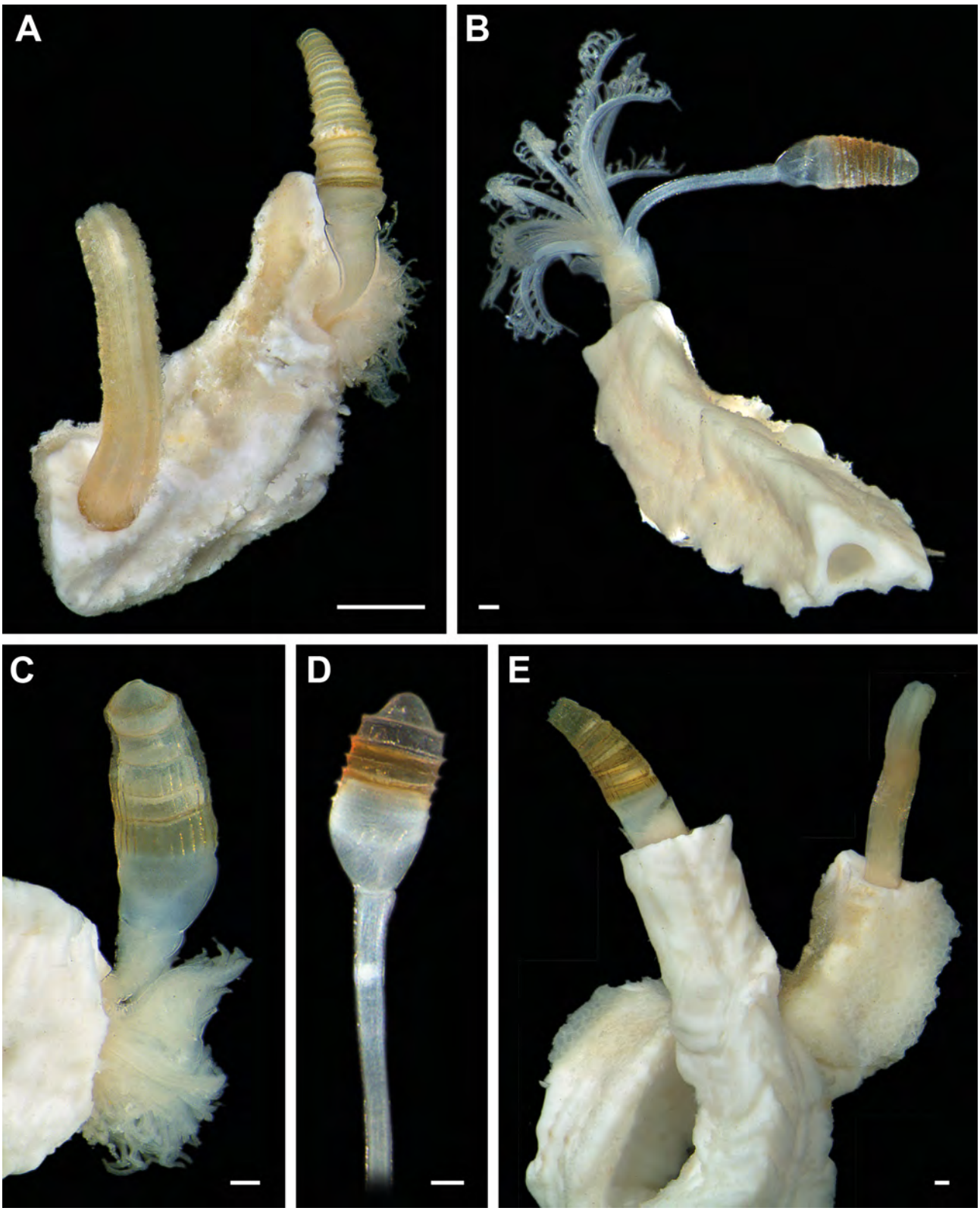

FIGURE 16. *Pseudovermilia pacifica*. A. Specimen in tube, **AM** W.28343; B. Specimen in tube, **AM** W.28326; C. Operculum, **AM** W.28305; D. Operculum, **AM** W.28326; E. Specimen in tube, **AM** W.28305. Photo: E. Wong. Scale bars: A = 0.5 mm, B–E = 0.1 mm.

Material examined. AM W.28305, **ZMA** V.Pol. 4774, Carter Reef, 14°32'S, 145°35'E, coll. P. Hutchings, 10 Mar 1986, det. E. Kupriyanova (10 respectively 8, as *Pseudovermilia* sp. by ten Hove); **AM** W.28326, outer reef, Yonge Reef, 14°40'S, 145°27'E, dead & living corals, 8–10 m, coll. H. ten Hove, 21 Jun 1983 (5 as *Semivermilia* sp.); **AM** W.28327, stn. 16, North Point, 14°40'S, 145°28'E, sloping reef with mainly dead & thinly silted corals, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986; **AM** W.28343, Turtle Beach, 14°40'S, 145°27'E, underside of dead &

living corals, coll. H. ten Hove, 22 Jun 1983; **AM** W.44053, MI QLD 2352; **AM** W.44538, MI QLD 2388 (5); **AM** W.47301, Fore Reef, 14°36'54"S, 145°37'12"E, 12 m, coll. M. Blazewicz-Paskowycz, 13 Feb 2009; **AM** W.47580, stn.G231, Coconut Beach, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005; **AM** W.47583, stn.G232, rubble between First Beach & Osprey Island, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005; **AM** W.47585, stn.G232, rubble between First Beach & Osprey Island, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005; **MAGNT** W025499, Patch Reef near lagoon entrance, 14°41'20"S, 145°28'12"E, coral rubble, 2 m, coll. N. Bruce, 11 Apr 2008, det. Kupriyanova; **ZMA** V.Pol. 4765 (6), between First Beach & Osprey Island, reef flat, dead corals & rubble in sand, 3–4 m, coll. H. ten Hove, 17 Jun 1983; **ZMA** V.Pol. 4766, stn.20, reef front north of South Island, sloping reef outside lagoon & sandy bottom below, 10–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 5 Mar 1986 (operculum lost); **ZMA** V.Pol. 4770 (2), stn.17, Palfrey Island, south of lighthouse, coral heads on sandy bottom, 7 m, coll. H. ten Hove, P. Hutchings & M. Reid, 2 Mar 1986; **ZMA** V.Pol. 4776 (3), stn.18, lagoon near east entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, 3 Mar 1986.

Diagnosis. Tube white, triangular in cross-section, with thick, rounded median ridge, two finely toothed lateral ridges and lateral flanges. Peduncle with asymmetrical swelling at the distal end. Operculum with a bell-shaped ampulla and a stack (3–14) of diabolo-like yellow tiers, chitinous in appearance, with distinct margins; with or without a hook at the top (Fig. 16).

Remarks. The tubes are very faintly striated transversely, as opposed to the clear ribs figured by Imajima (1978, fig. 4m–o) and visible in the paratype (**ZMA** V.Pol. 3295).

Distribution. Izu Island, Japan, Indo-West Pacific. New record for Australia.

Genus *Rhodopsis* Bush, 1905

Type-species. *Rhodopsis pusilla* Bush, 1905

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube white, circular in cross-section, thin-walled, not increasing in diameter, distal part sometimes erect, unattached, with peristomes; granular overlay absent. Animals with tube diameter < 0.2 mm. Some tubes may have one or more unpaired, inverted brood-chambers associated with peristomial rings. Operculum pear-shaped, laterally compressed, usually with well-developed chitinous plate bearing spines. Opercular plate may be deeply infolded and sunk, angled, within the opercular ampulla, then with halves closely appressed; plate rarely flat and terminal. Rarely operculum a simple ampulla only. Peduncle smooth, cylindrical, without wings, separated from ampulla by constriction; inserted proximal to 1st radiole on one side. Pseudoperculum absent. Arrangement of radioles short pectinate, only 2–3 radioles per lobe. Inter-radiolar membrane absent. Branchial eyes not observed. Stylodes absent. Mouth palps present. Four to six thoracic chaetigerous segments present. Collar (tri-)tetra-lobed. Thoracic membranes short, reaching 1st thoracic chaetiger. Collar chaetae absent. *Apomatus* chaetae present from second chaetiger onward. Thoracic and abdominal uncini rasp-shaped, with 6–8 teeth in a row in edge view and about 8 teeth in profile, anterior fang simple pointed. Triangular depression absent. Single capillary chaeta on middle abdominal chaetigers accompanied by single flat narrow geniculate chaeta with blunt teeth. Achaetous anterior abdominal zone long, followed by up to 15 chaetigers. Posterior capillary chaetae present. Posterior glandular pad not observed.

Rhodopsis pusilla Bush, 1905

(Fig. 17A)

Rhodopsis pusillus Bush, 1905: 289–290 [Bermuda; original description].

Josephella marenzelleri not Caullery & Mesnil, 1896 (*partim*).—Straughan 1967a: 42, fig. 5i [Straughan refers to Dew's (1959) material correctly identified as *J. marenzelleri,* but Straughan's material from Heron Island clearly is *Rhodopsis*].

Rhodopsis pusilla.—Ben-Eliahu & ten Hove 1989: 383–390, figs 1–11 [Bermuda, Netherlands Antilles, Cyprus, Red Sea (Elat), Reunion, Indonesia (Banda Sea), Australia (Lizard and Heron Islands, Qld); detailed redescription]; Bailey-Brock 1991: 201–204 [Hawaii]; Nishi 1993a: 12, table 1 [reproductive biology, Okinawa, Japan]; 1993b: 17–19, fig. 1D [tube ultrastructure, Okinawa, Japan]; 1993d: 6–9, fig. 2 [hypothesized origin of brooding characteristics, SEM of tube brooding ovicells and operculum]; 1996: 312, 314, fig. 4a–c [attached to dead coral skeletons, Okinawa Japan]; Nishi & Nishihira

1997: 109 [Okinawa, Japan, Sesoko Aquarium]; Nishi & Yamasu 1992b: 93–99, figs 1–6, 2 [brooding and development, SEM of tube ovicells, operculum and larvae; Okinawa, Japan]; ten Hove & San Martin 1995: 19 [Cuba]; Kupriyanova *et al.* 2001: 11, 41 figs 3D, 4F, 9D [life history]; Vinn *et al.* 2008: 634–635 [Reunion; tube ultrastructure]; ten Hove & Kupriyanova 2009: 88–89, fig. 2a, fig. 43 [tube with brooding chambers, SEM of chaetae].

Material examined. AM W.202470, back reef of Carter outer reef, 14°40'S, 145°28'E, 10–15 m, coll. P. Hutchings, 20 Mar 1986; **AM** W.47590, G236, east lagoon near Bird Islet, 9 m, coll. Rouse & Kupriyanova, 29 Oct 2005; **SAM** E3621, Ser56, stn.G236, east lagoon near Bird Islet, 9 m, coll. G. Rouse & E. Kupriyanova, 29 Oct 2005; **ZMA** V.Pol. 3622, between First Beach & Osprey Island, reef flat, dead corals & rubble in sand, 3–4 m, coll. H. ten Hove, 17 Jun 1983.

Diagnosis. Tube diameter 0.11–0.17 mm, some tubes may have one or more unpaired, inverted brood-chambers (see ten Hove & Kupriyanova 2009, fig. 2A). Operculum pear-shaped, laterally compressed, usually with chitinous plate bearing spines (Fig. 17A). Opercular plate may be deeply infolded and sunk, angled, within the opercular ampulla, then with halves closely appressed.

Remarks. This little known species, characterized by numerous irregular spines in its chitinous opercular plate, was incompletely described by Bush (1905) from a tiny worm collected on corals off Bermuda. The type material was lost. Ben-Eliahu & ten Hove (1989) designated a neotype and re-described the species in detail.

Distribution. Bermuda, Caribbean, Mediterranean, Indo-West Pacific.

Genus *Salmacina* Claparède, 1870

Type-species. *Salmacina incrustans* Claparède, 1870

Diagnosis. (from ten Hove & Kupriyanova 2009). Worms form open aggregates consisting of large numbers of tiny whitish tubes, circular in cross-section without further diagnostic features; granular overlay absent. Operculum and pseudoperculum absent, sometimes swollen tips of radioles present. Radioles arranged in semi-circles, up to 4 radioles per lobe. Inter-radiolar membrane and stylodes absent. Branchial eyes may be present. Mouth palps present. Six to twelve thoracic chaetigerous segments. Collar trilobed, tonguelets absent. Thoracic membranes forming apron. Collar chaetae fin-and-blade, distal blade well separated from fin, and limbate. *Apomatus* chaetae present. Thoracic uncini rasp-shaped, rectangular to wedge-shaped (triangular) in frontal view, with 2–12 teeth in a transverse row, with up to 10 teeth in profile view; anterior fang pointed. Thoracic triangular depression absent. Achaetous anterior abdominal zone present. Abdominal chaetae flat narrow geniculate with pointed teeth along edge. Uncini similar to thoracic ones, with more teeth in the transverse rows, and squarish peg. Long posterior capillary chaetae and posterior glandular pad absent.

Remarks. The nominal genera *Filograna* Berkeley, 1835 (operculate) and *Salmacina* (non-operculate), contain a number of small, asexually reproducing taxa, without distinctive morphological characters. Discussions are given by Nogueira & ten Hove (2000: 151–153), ten Hove & Kupriyanova (2009: 42) and most recently a very extensive analysis was given by Ben-Eliahu & ten Hove (2011: 62–71); however, they all conclude that the complex is badly in need of a revision. Moreover, being small, often unnoticed but nevertheless very common in (ship)fouling communities, a distribution heavily influenced by human interference is very likely; such a revision only can be furthered with help of molecular data. One nominal species, *Salmacina australis* Haswell, 1885, was described from Port Jackson, NSW, Australia, and later mentioned from the temperate-cold southern part of Australia, and New Zealand. From biogeographic and ecological viewpoints, it is unlikely that such a cold-temperate taxon would occur in the tropical Indo-West Pacific region as well. We therefore refrain from attributing a specific name to the material from Lizard Island.

Salmacina spec.

(Fig. 17B, C)

Material examined. AM W.44544, MI QLD 2399; **AM** W.47347 (many), Bird Islet, front reef, 14°41'48"S, 145°27'54"E, coral rubble, 3 m, coll. C. Watson, 8 Feb 2009; **AM** W. 47460 (10), stn.G237, Patch Reef near Palfrey Island, 6 m, coll. G. Rouse & E. Kupriyanova, 30 Oct 2005.

Diagnosis. Forming open aggregates consisting of large numbers of tiny (0.2–0.35 mm diameter), whitish tubes, circular in cross-section (Fig. 17C); granular overlay absent. Operculum and pseudoperculum absent. Asexual reproduction common (Fig. 17B).

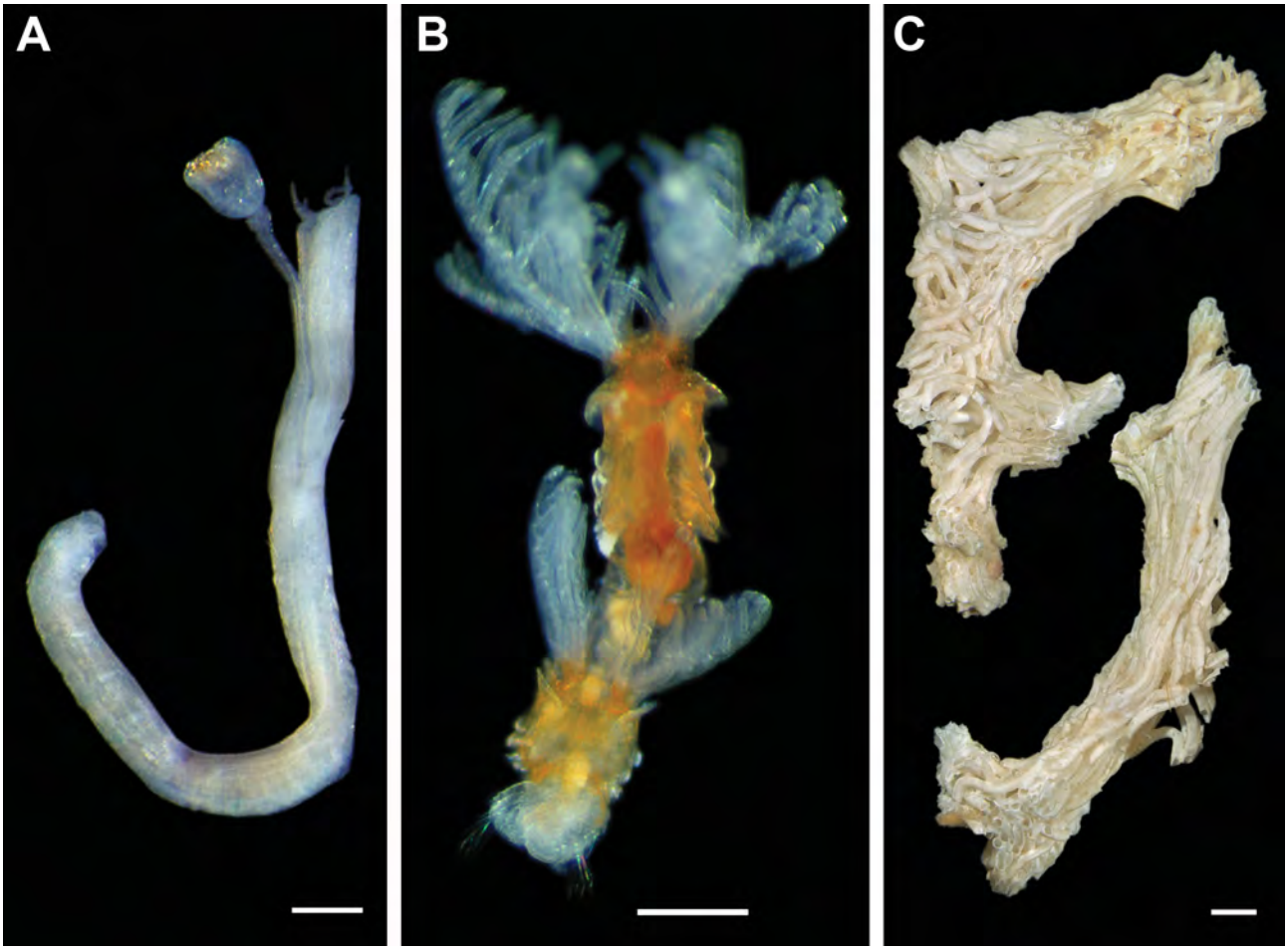

FIGURE 17. A. *Rhodopsis pusilla,* fixed specimen removed from its tube, **AM** W.202470; B. *Salmacina* sp., live asexually reproducing specimens, stn.G237, **AM** W.47460; C. Pseudo-colony of tubes of *Salmacina* sp., **AM** W.47347. Photo: A, C–E. Wong, B–G. Rouse. Scale bars: A–B = 0.1 mm, C = 1 mm.

Genus *Semivermilia* ten Hove, 1975

Type-species. *Vermiliopsis pomatostegoides* Zibrowius, 1969

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube triangular to sub-triangular in cross-section, keels present, otherwise variable; without flaring peristomes; granular overlay absent. Operculum inverse conical with chitinous endplate, more often a cap or series of diabolo-like plates; sometimes with terminal spine. Peduncle inserted as second radiole, cylindrical in cross-section; constriction present. Pseudoperculum absent. Radiolar arrangement short pectinately, up to 7 radioles per lobe. Inter-radiolar membrane absent. Branchial eyes may be present. Stylodes absent. Mouth palps present. Five to seven thoracic chaetigerous segments. Collar tri- to penta-lobed, tonguelets absent. Thoracic membranes end at chaetiger 2. Collar chaetae limbate. *Apomatus* chaetae present on posterior thoracic segments. Thoracic uncini saw- to-rasp-shaped; with about 15 teeth in profile view, 1 tooth at the apex of the uncinus to 5 teeth in the row above the wide gouged peg (dental formula e.g., P:5:3:2:2:1:1:1:1:1:1:1:1:1:1:1). Triangular depression absent. Abdominal chaetae flat narrow geniculate, with rounded teeth on edge; abdominal uncini smaller than thoracic ones, entirely rasp-shaped, with about 13 teeth in profile view, up to 8 teeth in a row. Achaetous anterior abdominal zone, if present, very short. Long posterior capillary chaetae absent. Posterior glandular pad may be present.

Remarks. See remarks under *Pseudovermilia*. The nominal genus includes 8 species, opercula of which are

characterised by elongated distal chitinous caps made of series of diabolo-like plates (*S. elliptica, S. parapomatostega, S. pomatostegoides,* and *S. uchidai,*), by simple caps or plates without terminal spine (*S. cribrata, S. agglutinata, S. torquata*) or with flattened endplate with terminal spine (*S. crenata*). The tubes of these species are more distinct and often allow specific recognition better than opercula do.

***Semivermilia annehoggettae* n. sp.**
(Figs 18, 19)

Semivermilia spec.—ten Hove & Kupriyanova 2009: 21 fig. 7D [Lizard Island, Qld; SEM of double hollow chambers].

Type material. Holotype: **AM** W.47575, stn.G236, east lagoon near Bird Islet, 9 m, coll. G. Rouse & E. Kupriyanova, 29 Oct 2005, specimen in tube with partly damaged ovicells. Paratypes: **AM** W.47576, stn.G240, Osprey Island, intertidal rubble zone, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005 (3 plus 3 used for SEM).

Other material examined. AM W.28200 (7 plus tubes on granite rock), stn.19, Turtle Beach, intertidal, boulders and cobbles in coarse sand, coll. H. ten Hove, 5 Mar 1986; **AM** W.28325 (2, tube fragments only), between Lizard Head and Coconut Beach, undersides of boulders on rock, little sand, low tide, coll. H. ten Hove, 23 Jun 1983; **AM** W.28418 (as *Pseudovermilia*), lagoon, coll. J. Anderson, 22 Jun 1983; **AM** W.45411, MI QLD 2386; **AM** W.47577 (tube with ovicells), stn.G232, between First Beach and Osprey Island, coral rubble, snorkeling, 1 m, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005; **AM** W.47578 (3), stn.G241, off Osprey Island, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **SAM** E3628, Ser54, stn.G240, Osprey Island, intertidal rubble zone, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **ZMA** V.Pol. 4796 (4+4?), between First Beach & Osprey Island, reef flat, dead corals & rubble in sand, 3–4 m, coll. H. ten Hove, 17 Jun 1983; **ZMA** V.Pol. 5533 (2), stn.16, North Point, sloping reef, mainly dead, slightly silted corals, 3–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986; **ZMA** V.Pol. 5534 (13, as *Semivermilia* spec.), North Reef, 14°40'S, 145°27'E, underside of boulders on rock, low tide, little sand, coll. H. ten Hove, 22 Jun 1983; **ZMA** V.Pol. 5535, stn.18, lagoon near east entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, 3 Mar 1986 (separated from **ZMA** V.Pol. 4776, *Pseudovermilia* or *Semivermilia* spec.); **ZMA** V.Pol. 4800 (10), Granite Head, 14°39'S, 145°27'E, from underside of boulders on rock, little sand, subtidally, coll. H. ten Hove, 18 Jun 1983; **ZMA** V.Pol. 4806 (12), Mermaid Cove, underside boulders in surf, subtidal & low intertidal, coll. H. ten Hove, 20 Jun 1983.

Description. TUBE: white, about 0.4 mm wide, with lumen of 0.3 mm; anteriorly with double hollow chambers on top (Fig. 18A–D). If broken, these chambers may appear as three separate thin sharp longitudinal keels.

BRANCHIAE: with 5–6 pairs of radioles, arranged pectinately, not connected by inter-radiolar membrane. Branchial eyes absent.

PEDUNCLE: smooth, circular in cross section, inserted as second radiole; without distal wings, clearly separated from opercular ampulla by constriction (Fig. 18C).

OPERCULUM: simple semi-transparent inverted cone, sometimes inner vesicle visible inside, with flat, also (semi-)transparent endplate or just flat surface (Figs 18B, C; 19A). Pseudoperculum absent.

COLLAR AND THORACIC MEMBRANES: collar trilobed, continuous with short thoracic membranes ending at 2nd thoracic chaetiger.

THORAX: with collar chaetiger and 6 uncinigerous chaetigers (Fig. 19A). Tori positioned along mid-line, triangular depression absent. Collar chaetae limbate, of two sizes (Fig. 19B). Subsequent chaetae limbate, of two sizes, *Apomatus* chaetae starting at chaetiger 3 (Fig. 19C). Uncini saw-to-rasp shaped, with up to 15 teeth in profile view and up to 4 teeth in the row above the wide gouged peg (dental formula P:5:4:3:3:2:1:1:2:2:1:1:1:1:1) (Fig. 19D).

ABDOMEN: abdominal chaetigers up to 30. Uncini rasp-shaped, with up to 12 teeth in profile view and up to 6 rows of teeth above wide gouged (Fig. 19E). Anterior chaetae and posterior capillary chaetae not observed (see Remarks). Posterior glandular pad absent.

SIZE: length up to 2 mm, width of thorax up to 0.2 mm. Branchiae and operculum accounting for 1/3 of entire length.

COLOUR: white to yellowish (Fig. 18B, C).

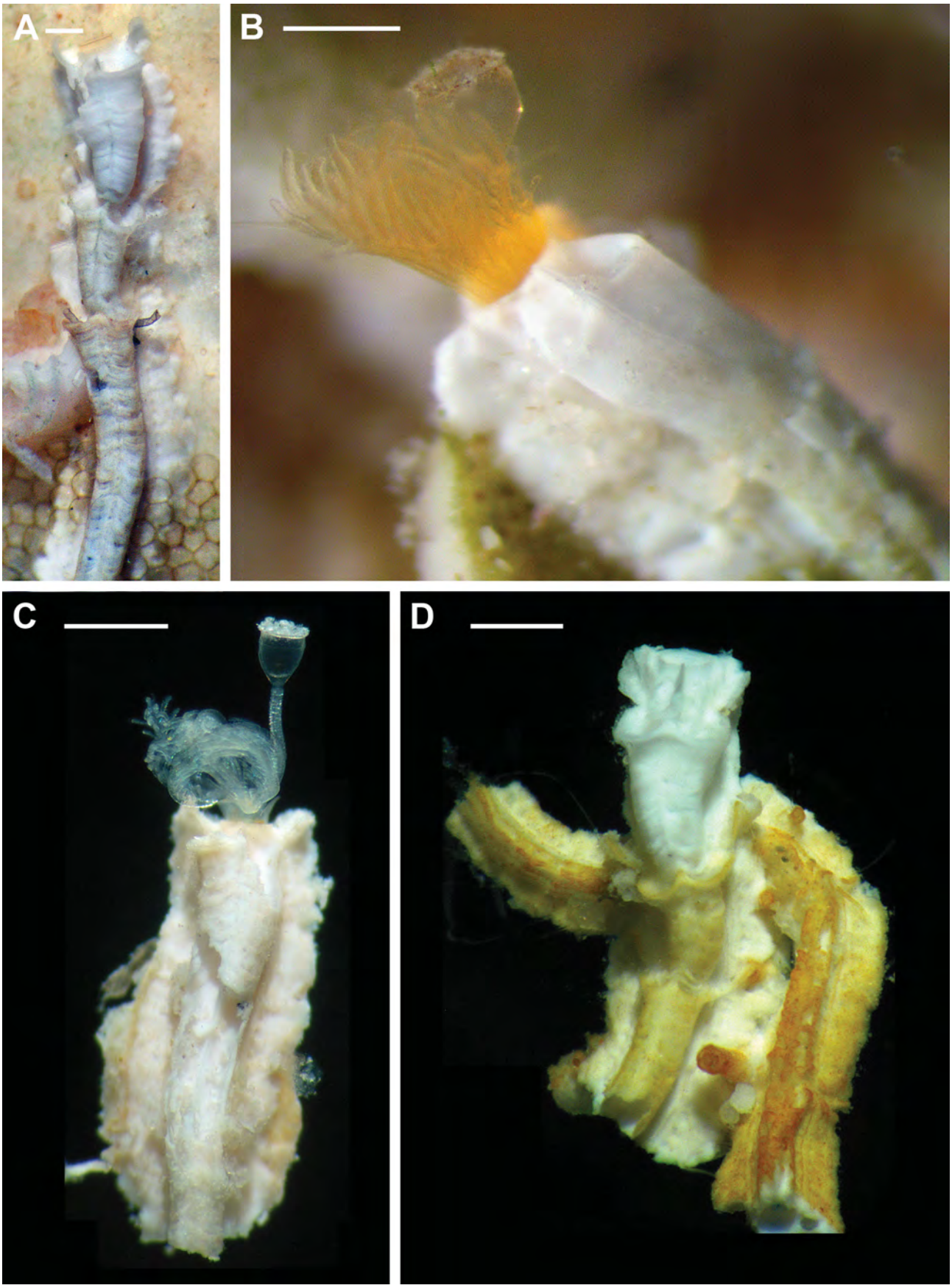

FIGURE 18. *Semivermilia annehoggettae* n. sp. A. Tube with typical paired ovicells, **SAM**, stn.G241; B. Live animal in tube, stn.G240, **AM** 47576; C. Holotype, stn.G236, **AM** W.47575; D. Tubes with typical paired ovicells, stn.G232, **AM** W.47577. Photos: G. Rouse. Scale bars: A, B = 0.2 mm, C, D = 0.5 mm.

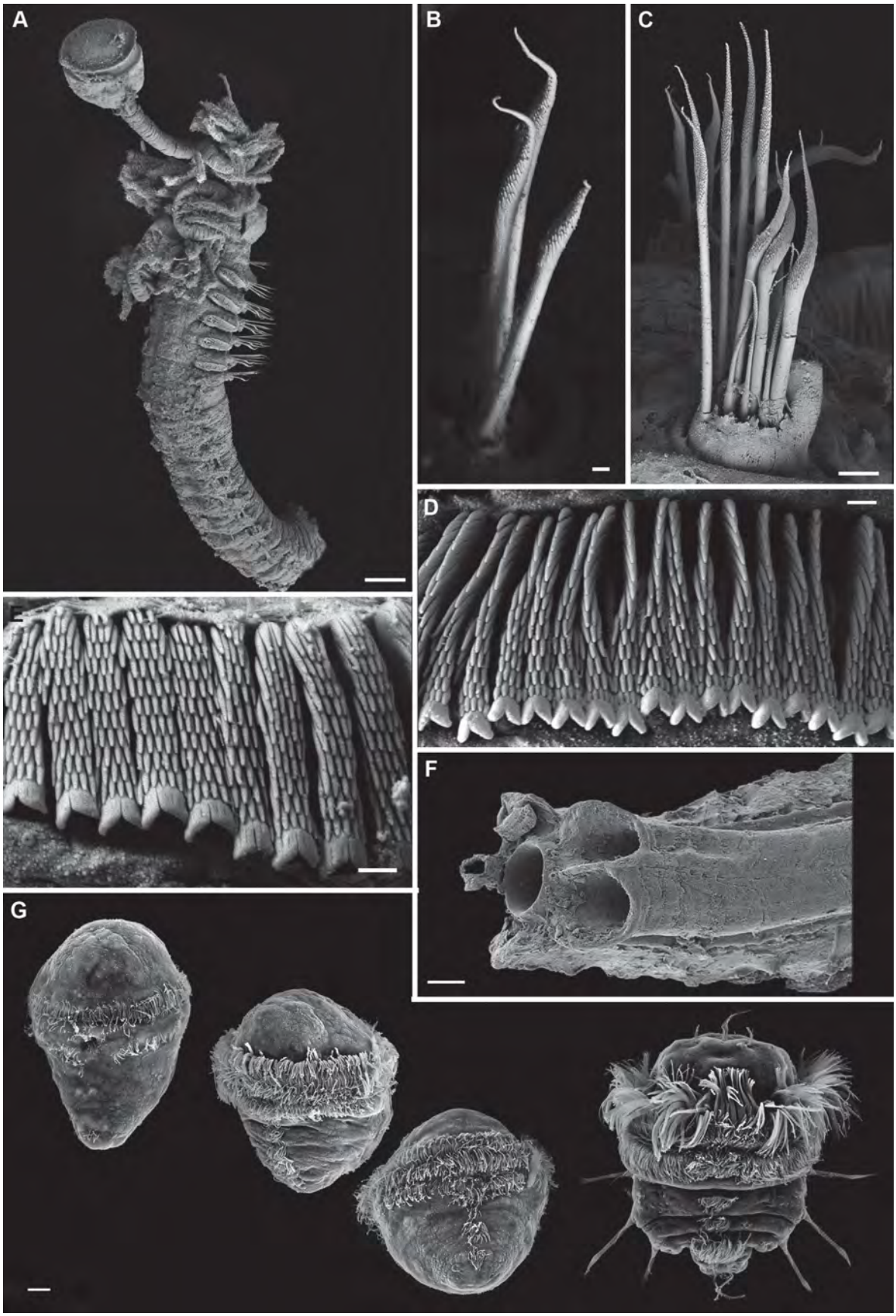

FIGURE 19. *Semivermilia annehoggettae* n. sp., SEM images, **AM** W.47576 (A–E), **SAM** stn.G232 (F, G). A. Ventro-lateral view of entire animal; B. Collar chaetae; C. *Apomatus* and limbate chaetae of third thoracic chaetiger; D. Uncini of second chaetiger; E. Uncini of posterior chaetiger; F. Tube with paired brooding chambers; G. Larvae of various developmental stages: trochophore (leftmost), metatrochophore (middle two) and nectochaeta with 3 chaetigers (rightmost). Photo: A–E—E. Kupriyanova & S. Lindsay, F, G—G. Rouse. Scale bars: A = 100 μm, B, D–E = 2 μm, C, F–G = 10 μm.

Etymology. The species is named after Dr. Anne Hoggett, the director of LIRS.

Remarks. This small species occurs cryptically, it is reminiscent of *S. pomatostegoides,* but with very different operculum, simple transparent inverted cone lacking any chitinous enforcement. The most distinct character of this species is the tube with one or several consecutive pairs of hollow "pipes" anteriorly. These hollow chambers on top break easily and only rarely remain intact, but the remaining tube, with its flattened chambered sides, is typical enough. The function of these pipes is unclear, they clearly resemble brood chambers found in other small serpulids, but we actually observed lecithotrophic larvae of various stages (Fig. 19G) being brooded inside the tubes proper, not in the chambers. The thoracic uncini are saw-to-rasp shaped, which is typical for *Semivermilia*. Abdominal chaetae were looked for under SEM in three specimens, but not observed, so assumed absent.

Reproduction. Lecithotrophic larvae brooded inside the tube, no larvae were found inside paired ovicells.

Type locality. Lizard Island, Qld, Australia.

Distribution. Qld, Australia.

***Semivermilia lylevaili* n. sp.**
(Figs 20, 21)

Material examined. Holotype: specimen in tube fragment (Fig. 20A) **AM** W.47579, stn.G237, Patch Reef near Palfrey Island, coll. G. Rouse & E. Kupriyanova, 30 Oct 2005. Paratypes: **AM** W.47458 (2 without tubes), stn.G241, off Osprey Island, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **AM** W.47582 (1 used for SEM), stn.G244, off South Island, coll. G. Rouse & E. Kupriyanova, 2 Nov 2005; **SAM** E3629, stn.G237, Ser59, Patch Reef near Palfrey Island, coll. G. Rouse & E. Kupriyanova, 30 Oct 2005.

Additional material: AM W.45076, MI QLD 2417 (5); **AM** W.45077, MI QLD 2417 (2); **AM** 47631, MI QLD 2386; **AM** W.47632, MI QLD 2352; **AM** W.47633, MI QLD 2406.

Description. TUBE: white, about 0.4 mm wide, with lumen of 0.3 mm. Circular in cross section, with two not very distinct longitudinal ridges (Fig. 20A), without flaring peristomes; granular overlay absent.

BRANCHIAE: with 5–6 pairs of radioles, arranged short pectinately, not connected by inter-radiolar membrane. Branchial eyes absent (Fig. 20B, C).

PEDUNCLE: smooth, circular in cross section, inserted just below first and second normal radiole; without wings, clearly separated from opercular ampulla by a constriction (Fig. 20B, C).

OPERCULUM: slightly asymmetrical, with simple convex thin brownish endplate, terminal spine absent (Figs 20A–C, 21A). Pseudoperculum absent.

COLLAR AND THORACIC MEMBRANES: collar relatively high, trilobed, continuous with thoracic membranes ending at 2nd thoracic chaetiger (Fig. 21A).

THORAX: with collar chaetiger and 6 uncinigerous chaetigers. Tori positioned along mid-line, triangular depression absent. Collar chaetae limbate of two sizes (Fig. 21B). Subsequent chaetae limbate, of two sizes, with *Apomatus chaetae* starting at chaetiger 3 (Fig. 21C). Uncini saw-to-rasp shaped, with up to 15 teeth in profile view and up to 4 teeth in the row above the wide gouged peg (dental formula depending place in row from P:4:4:2:1:2:2:1:1:1, 9 in profile view, to P:4:3:2:2:2:1:1:1:1:1:1:1:1:1, 14 in side view) (Fig. 21D).

ABDOMEN: abdominal chaetigers up to 30. Uncini rasp-shaped, with 8–10 rows of 7–3 teeth each above wide, slightly crenulated peg (Fig. 21F). Chaetae narrow flat geniculate with rounded teeth (Fig. 21E). Achaetous anterior abdominal zone short. Posterior glandular pad absent. Long posterior capillary chaetae absent (Fig. 21A).

SIZE: length up to 1.6 mm, width of thorax 0.2 mm. Branchiae and operculum accounting for 1/3 of entire length.

COLOUR: orange to yellow (Fig. 20).

Etymology. The species is named after Dr Lyle Vail, director of LIRS.

Remarks. By its simple operculum, this new species resembles *S. annehoggettae* n. sp., but lacks distinct elongated ovicells typical for the latter species.

Reproduction. Lecithotrophic larvae brooded inside the tube.

Type locality. Lizard Island, Qld, Australia.

Distribution. Qld, Australia.

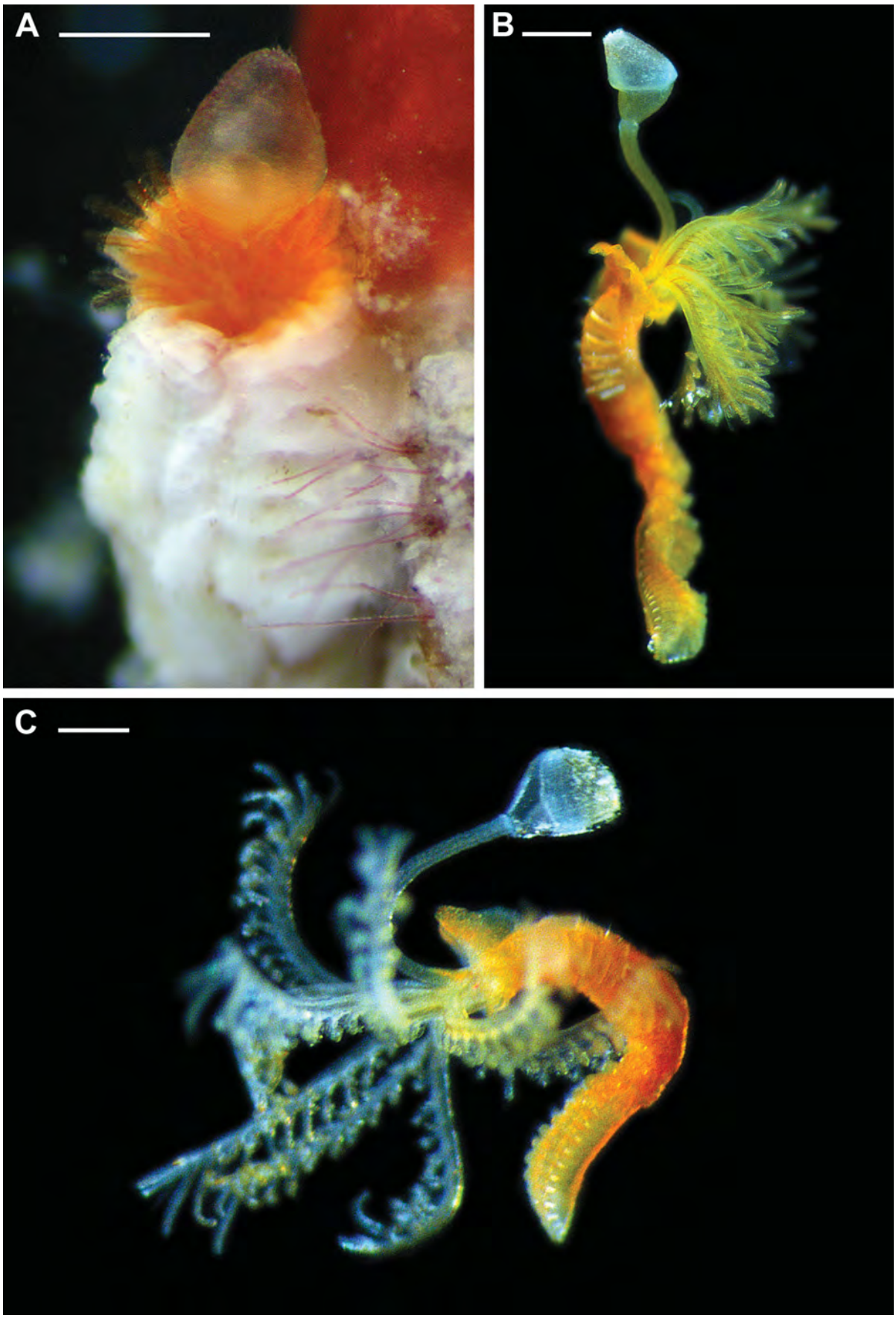

FIGURE 20. *Semivermilia lylevaili* n. sp. A. Holotype, live animal in tube, stn.G237, **AM** W.47579; B. Live animal removed from its tube, stn.G237, **SAM** E3629; C. Live animal removed from its tube, stn.G244, **AM** W.47582. Photos: G. Rouse. Scale bars: A–C = 0.3 mm.

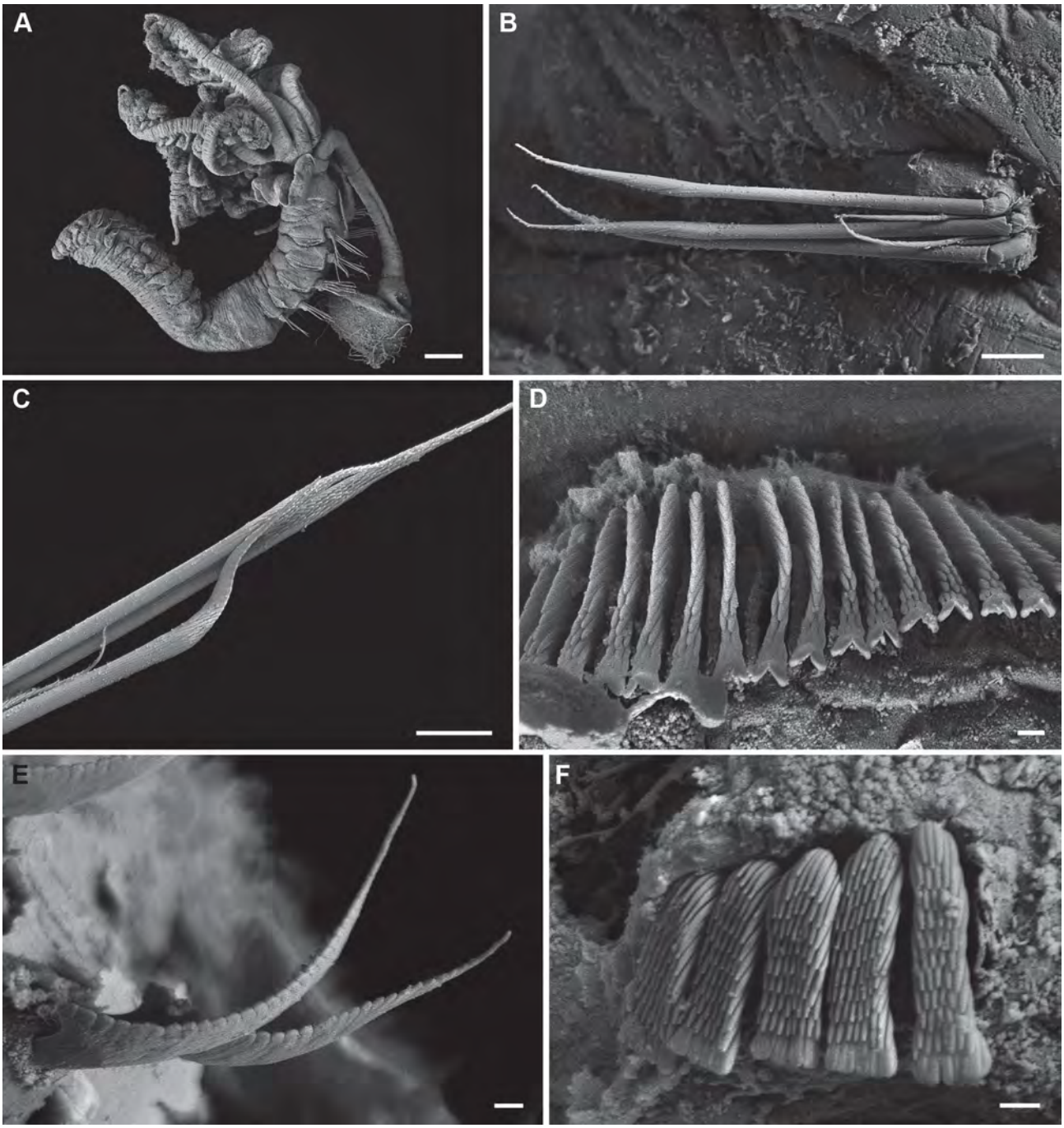

FIGURE 21. *Semivermilia lylevaili* n. sp., SEM images, **AM** W.47582. A. Lateral view of entire worm; B. Collar chaetae; C. Thoracic chaetae with *Apomatus* chaeta; D. Thoracic uncini; E. Abdominal chaetae; F. Abdominal uncini. Photo: A–F—E. Kupriyanova & S. Lindsay. Scale bars: A = 100 µm, B–C = 10 µm, D–F = 2 µm.

***Semivermilia pomatostegoides* (Zibrowius, 1969)**
(Figs 22A, 23)

Vermiliopsis pomatostegoides Zibrowius, 1969: 129–130, figs 4–10 [Tripoli; original description].

Semivermilia pomatostegoides.—ten Hove 1975: 55, 56, 84 [transferred to *Semivermilia*]; Vine & Bailey-Brock 1984: 143–144, fig. 3H–I [Red Sea; diagnosis]; Bailey-Brock 1985: 208–209, fig. 10 [Fiji; diagnosis]; 1987: 425 [Hawaii; diagnosis]; ten Hove 1993: 83 [Seychelles; name in list]; 1994: 110 [same]; Gischler & Ginsburg 1996: 582 [Belize; det. H. ten Hove cf. *pomatostegoides*]; Hassan 1997: 52, figure [as *S. pomatostgeoides* (sic !), Red Sea; diagnosis]; Small *et al.* 1998: 19 [Caribbean; det. H. ten Hove]; ten Hove & Kupriyanova 2009: 92 [name only].

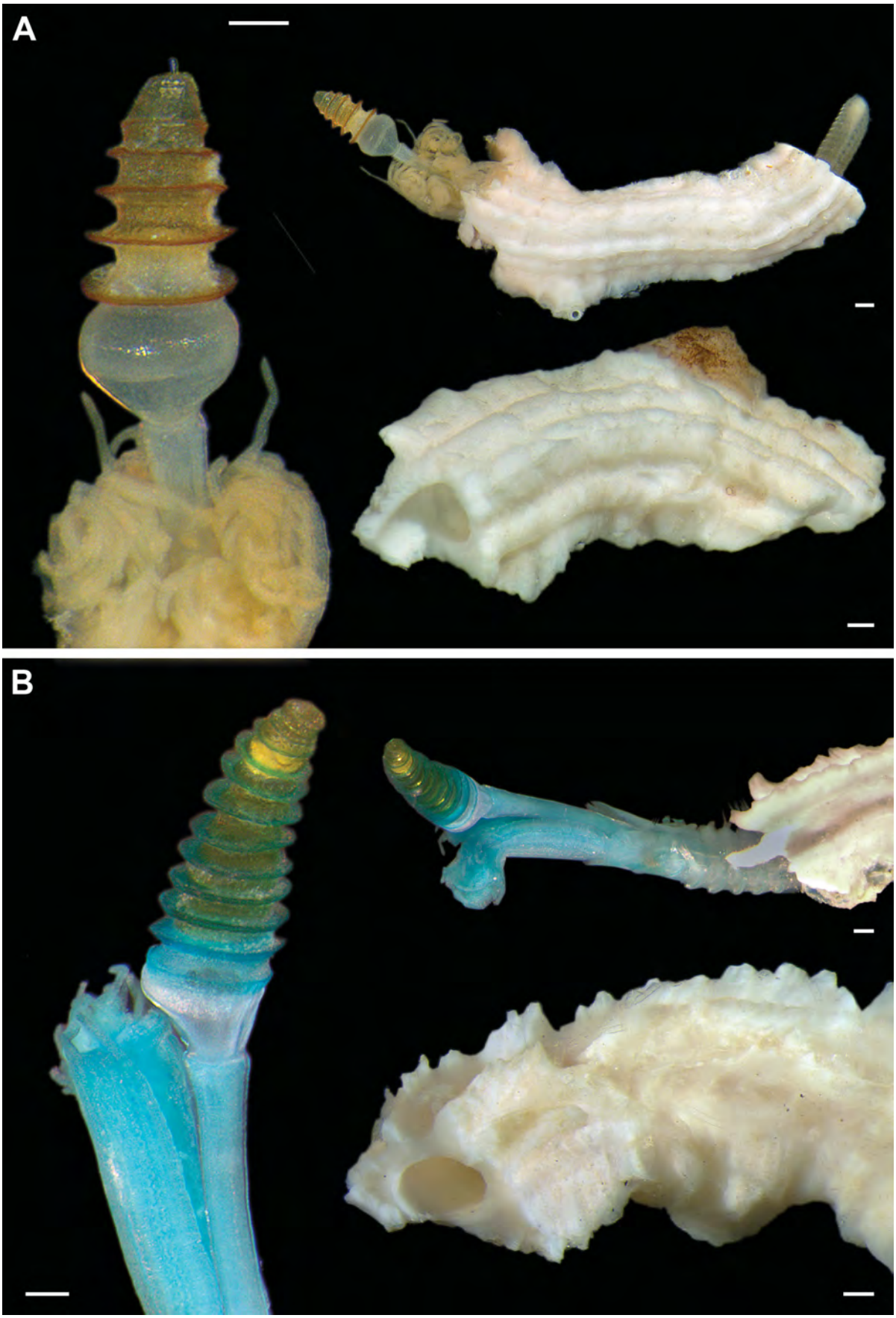

FIGURE 22. A. *Semivermilia pomatostegoides*, close-up of operculum (left) (**AM** W.28421), animal in tube (top right) (**AM** W.47635) and empty tube (bottom right) (**AM** W.28452); B. *Semivermilis uchidai*, specimen stained with methyl green, close-up of operculum (left) (**AM** W.45052), animal in tube (top right) (**AM** W.45052) and empty tube (bottom right) (**AM** W.47635). Photos: E. Wong. Scale bars: A–B = 0.1 mm.

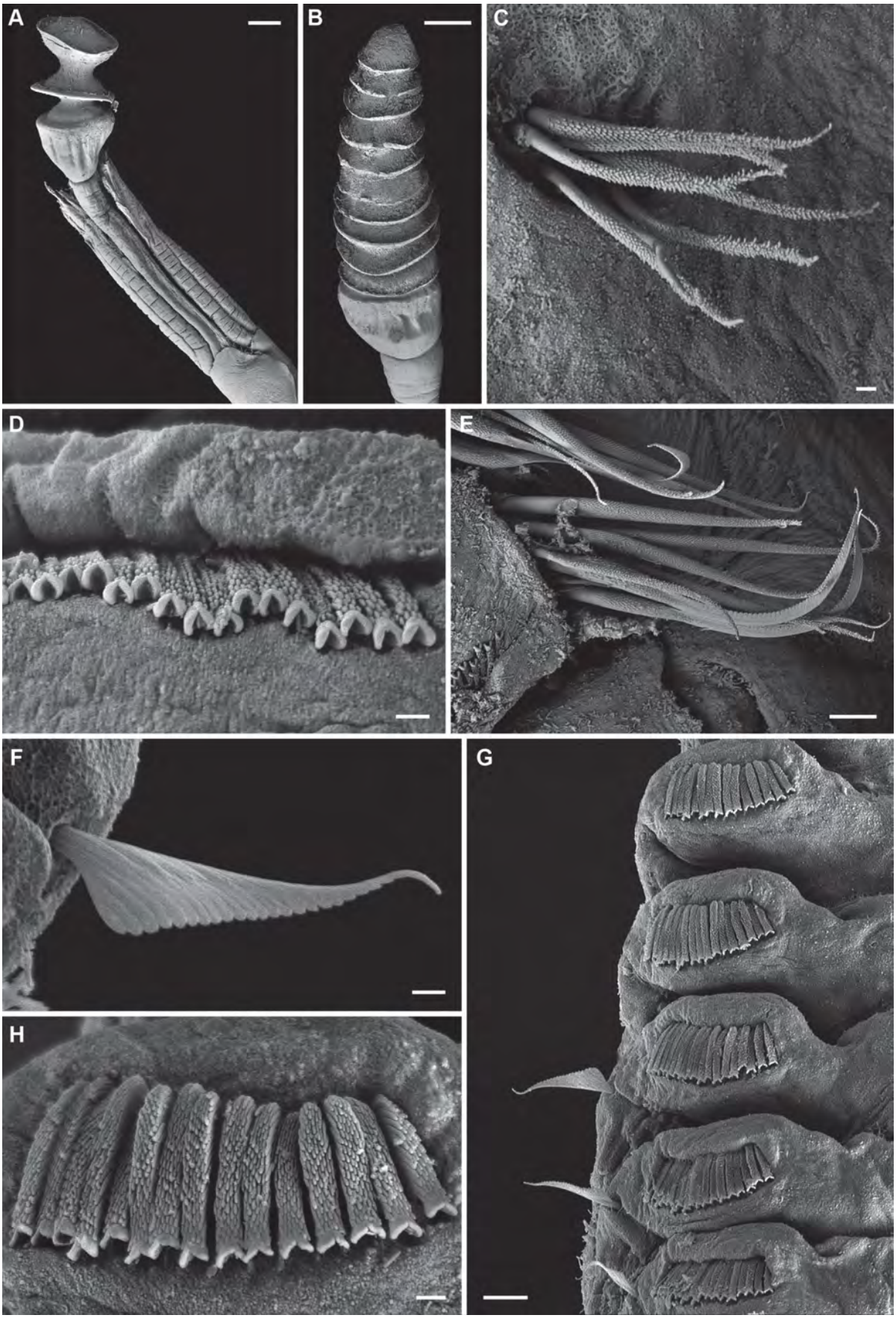

FIGURE 23. *Semivermilia pomatostegoides*, SEM images, **AM** W.47634 (A–H, except B), **AM** W.47635 (B). A. Peduncle and operculum; B. Close-up of operculum; C. Collar chaetae; D. Uncini of first thoracic chaetiger; E. *Apomatus* chaetae on chaetiger 3; F. Triangular chaetae of posterior abdomen; G. Overview of posterior abdominal chaetigers; H. Uncini of posterior abdomen. Photo: A–H—E. Kupriyanova & S. Lindsay. Scale bars: A–B = 100 µm, C–D, F, H = 2 µm, E, G = 10 µm.

Material examined. AM W.28452, south of Palfrey Island, sandy, gently sloping, nearly horizontal reef, 14°40'S, 145°28'E, coll. H. ten Hove, 23 Jun 1983, det. H. ten Hove; **AM** W.45051, MI QLD 2406; **AM** W.47581, stn.G236, east lagoon near Bird Islet, 9 m, coll. G. Rouse & E. Kupriyanova; **AM** W.47634 (without tube, used for SEM), Carter Reef, 14°32'S, 145°35'E, coll. P. Hutchings, 10 Mar 1986; **AM** W.47584, stn.G232, between First Beach and Osprey Island, coral rubble, snorkeling, 1 m, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005; **AM** W.47635 (as *Pseudovermilia*, on SEM stub), Granite Head, 14°39'S, 145°27'E, underside of boulders on rock, little sand subtidally, coll. H. ten Hove, 18 Jun 1983; **ZMA** V.Pol. 4797 (2), stn.16, North Point, sloping reef, mainly dead, slightly silted corals, 3–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986; **ZMA** V.Pol. 4780 (3), stn.21, south of South Island, 14°42'S, 145°28'E, sloping silty reef, little coral cover, 18–20 m, coll. H. ten Hove & P. Hutchings, 6 Mar 1986; **ZMA** V.Pol. 4781, Mermaid Cove, on reef, 6–10 m, from crevices in dead coral, coll. H. ten Hove, 20 Jun 1983; **ZMA** V.Pol. 4805 (as *Semivermilia* sp.), Turtle Beach, from underside of dead & living corals, fairly cryptic, 6 m, coll. H. ten Hove, 22 Jun 1983.

Diagnosis. Tube white and relatively smooth, triangular in cross section, with a well-defined median ridge, two lateral longitudinal ridges, and broad lateral flanges. Operculum consisting of an ampulla bearing 2–6 chitinous tiers, the most distal may be with a short spine. The ampulla shows a slight swelling medio-ventrally at the junction with the peduncle; in fresh material it is red and clearly an eyespot (Vine & Bailey-Brock 1984: 144, fig. 3I). Thoracic uncini saw-to-rasp shaped, dental formula P:5:4:4:3:?:? ??, P:4:2:3:?:? ??. Abdominal uncini rasp shaped, with up to 11 rows of 6–2 teeth (not entirely regularly placed).

Remarks. This taxon was described from material from 130 m depth off Tripoli (Mediterranean) as *Vermiliopsis pomatostegoides* Zibrowius, 1969, and referred to *Semivermilia* by ten Hove (1975). It has been recorded commonly from the Mediterranean/Atlantic, but also from diving depths in the Caribbean and Indo-Pacific. Though Zibrowius does not mention the medio-ventral eyespot on the opercular bulb, it was present in material from the Seychelles and from the Netherlands Antilles (Bonaire; both ten Hove, unpubl.). It remains to be seen if all those far distant populations belong to a single species.

Whether or not *Semivermilia parapomatostega* Wu & Chen, 1981b (p. 248–249, fig. 2) from the Xisha Islands, South China Sea is a synonym should be decided for a direct comparison of material. The "distinctive" characters given by its authors are not distinctive at all: 5 discs in *S. parapomatostega* already fall within the range given by Zibrowius for *S. pomatostegoides* (4–6), the difference between a terminal spine and the bulge figured by Zibrowius is minor as well as the width of the columella. The nature of the square blocks figured on the mid-dorsal keel of *S. parapomatostega* is unclear, a "longitudinal row of subcircular processes" according to Wu & Chen, 1981b has the feeling of an irregularly growth of a median keel.

Reproduction. One specimen (**ZMA** V.Pol. 4797) shed eggs, embryos and actively swimming 3 chaetiger trochophore larvae, when the tube was accidentally opened.

Distribution. Mediterranean Sea, East and West (sub)tropical Atlantic, Seychelles, Red Sea, ? South China Sea; Qld, Australia. A new record for Australia.

Remarks. The species is so similar in the shape of the operculum to *S. uchidai* that they are difficult to distinguish. The two species can only be separated by the shape of their tubes, which bear three longitudinal keels in both species, but the lateral keels are high and oblique in *S. uchidai*, and are shallowly blunt in S. *pomatostegoides.*

Semivermilia uchidai **Imajima & ten Hove, 1986**
(Fig. 22B)

Semivermilia uchidai Imajima & ten Hove, 1986: 9–11, fig. 2a–k [Solomon Islands; Lizard Island, Australia; original description].

Material examined. AM W.28421 (4, as *Pseudovermilia*), Granite Head, underside of boulders on rock, little sand subtidally, coll. H. ten Hove, 18 Jun 1983; **AM** W.45052, MI QLD 2406 (2); **ZMA** V.Pol. 5536 (separated from **ZMA** V.Pol. 4776, *Pseudovermilia* or *Semivermilia*), stn.18, lagoon near east entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, 3 Mar 1986; **ZMA** V.Pol. 4798 (13, as *Semivermilia*), North Reef, 14°40'S, 145°27'E, underside of boulders on rock, low tide, little sand, coll. H. ten Hove, 22 Jun 1983; **ZMA** V.Pol. 5537 (4), Mermaid Cove, underside of boulders in surf, subtidal & low intertidal, coll. H. ten Hove, 20 Jun 1983.

Diagnosis. Tube white, more or less trapezoidal in cross section, with one erect and two oblique longitudinal keels; keels irregularly serrated and ending in tooth over entrance; just above anterior basal attachment area there are two more projecting teeth. Tube at most with narrow lateral flanges. Operculum consisting of an ampulla bearing 3–8 chitinous tiers (narrow diabolos), the most distal may bear a short spine.

Remarks. As in 1986, one of us (HtH) compared the present material side by side with 2 paratypes of *Semivermilia uchidai* (**ZMA** V.Pol. 3563, Solomon Islands, Nggela group, Makambo, 18 Aug 1984, det. Imajima & ten Hove 1986). The sample **ZMA** V.Pol. 4776, registered under field identification *Pseudovermilia* spec., contained three specimens of *Pseudovermilia pacifica*, 1 specimen of the tube brooding *Semivermilia annehoggettae* n. sp. and one specimen identical in size, shape of operculum and three keeled tube with *S. uchidai*. See also remarks after *S. pomatostegoides*.

Distribution. Mediterranean Sea, East and West (sub)tropical Atlantic, Seychelles, Red Sea, ? South China Sea; Qld, Australia.

Genus *Serpula* Linnaeus, 1767

Type-species. *Serpula vermicularis* Linnaeus, 1767, designated by Heppell 1963.

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube white, pink, orange, or yellowish, opaque; (semi)circular to trapezoidal in cross-section, rarely polygonal; longitudinal keels, peristomes, a hyaline outer layer or granular overlay may be present. Operculum soft to cartilaginous, funnel shaped with crenulated edge (fused radii). Peduncle smooth, cylindrical, without wings; inserted just below and between first and second dorsal radiole on one side. In large specimens the insertion outside the normal radioles, seemingly the first radiole. Radioles arranged in semi-circles, up to 50 per lobe in larger species. Pseudoperculum and inter-radiolar membrane present. Branchial eyes may be present. Mouth palps present. Stylodes absent. Seven (rarely 9) thoracic segments. Collar trilobed. Tonguelets absent, though wart-like protuberances may be present at base of cleft between ventral and latero-dorsal collar lobes. Thoracic membranes long, forming ventral apron across anterior abdominal segments. Collar chaetae bayonet-shaped and limbate. *Apomatus* chaetae absent. Uncini saw-shaped, with approximately 5 teeth, anterior fang simple pointed. Thoracic triangular depression present. Abdominal chaetae flat trumpet-shaped with denticulate edge; uncini similar to thoracic ones, smaller, anteriorly saw-shaped but becoming rasp-shaped towards the pygidium, with up to 12 teeth in profile, up to 8 teeth in a row. Achaetous anterior abdominal zone absent. Posterior capillary chaetae present. Posterior glandular pad absent.

Remarks. A recent study by Kupriyanova *et al*. (2008) demonstrates that the traditional genus *Serpula* is most probably paraphyletic.

Serpula vittata Augener, 1914
(Fig. 24A)

Serpula vittata Augener, 1914: 137–139, fig. 17, pl. 1, figs 18–19 [WA, Shark Bay; original desciption].
Serpula vittata.—Imajima & ten Hove 1984: 41–42 [WA, Palau Islands; type material studied and synonymy]; Imajima 1987: 79 [Okinawa, Japan]; Parab & Gaikwad 1989: 224 [India]; Nishi 1993b: 18–19, fig. 1e, table 1 [Okinawa, Japan; in living coral]; Kupriyanova *et al.* 2008: 95, fig. 1E [Lizard Island, Qld; DNA data, colour photo]; ten Hove & Kupriyanova 2009: 8, fig. 1C [colour photo].
Not *Serpula vittata*.— Straughan 1967a: 30 [Heron Island, Qld; see Imajima & ten Hove 1984: 41]; Nishi & Asakura 1996: 56 [description; Marianas].
Serpula palauense Imajima, 1982: 40–42, fig. 2a–m [*fide* Imajima & ten Hove 1984: 41].

Material examined. AM W.47832, between Bird and South Islands, 15 m, coll. P. Hutchings, 12 Mar 1986; **AM** W.42060, stn.G242, east lagoon near Bird Islet, coll. G. Rouse & E. Kupriyanova, 1 Nov 2005; **AM** W.42056, stn.G244, off South Island, coll. G. Rouse & E. Kupriyanova, 2 Nov 2005; **AM** W.45063, MI QLD 2413 (tube); **SAM** E3594, stn.G236, east lagoon near Bird Islet, 9 m, coll. G. Rouse & E. Kupriyanova, 29 Oct 2005; **ZMA** V.Pol. 5532, stn.16, North Point, sloping reef, mainly dead, slightly silted corals, 3–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986.

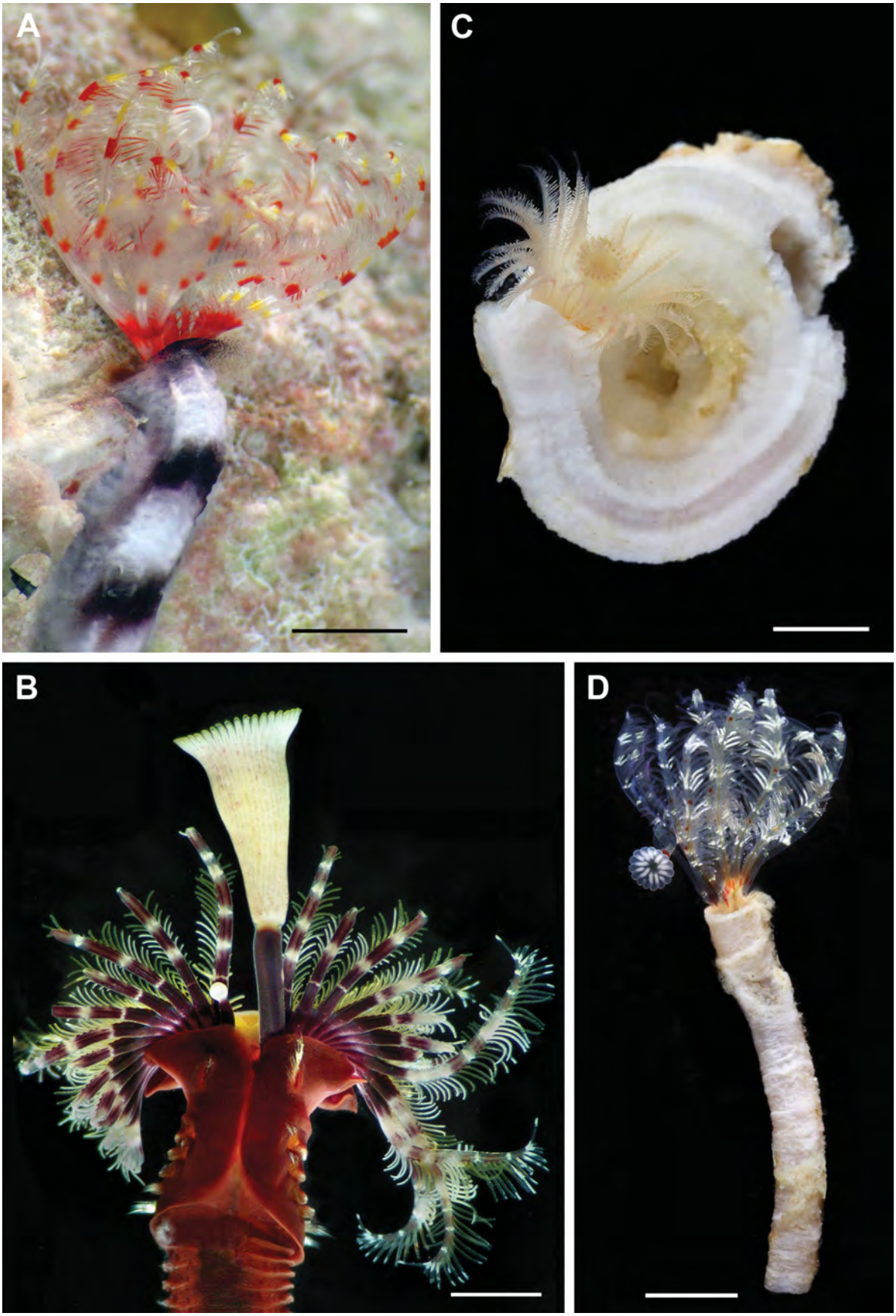

FIGURE 24. A. *Serpula vittata*, live specimen in tube, stn.G236, **SAM** E3594; B. *S. watsoni* removed from tube, stn.G235, **AM** W.42062; C. *Serpula* sp. 1 in tube, **AM** W.45048; D. *Serpula* sp. 2 in tube, **AM** W.45413. Photo: A, B—G. Rouse, C, D—A. Semenov. Scale bars: A–D = 1 mm.

Diagnosis. Tube white with (3–)5 longitudinal ridges, dotted with small deep-brown speckles (to almost orange in fresh material) between those ridges (Imajima 1982: 41, fig. 2m; as *S. palauense*) to complete transverse bands of brown.

Remarks. *Serpula vittata* differs from all other known *Serpula* spp. in its very characteristic tube. Though the operculum has been decribed with 18–23 radii (Augener 1914: 138, fig. 18 respectively Imajima 1982: 40, fig. 2a), in our material the operculum occasionally is globular only, with 6 longitudinal grooves (probably still developing from the pseudoperculum; Fig. 24A). From the diagnosis of the tube by Straughan (1967a: 30), round and white, her material evidently belongs to a different species. Similarly, Nishi & Asakura (1996) describe the tube as "white, thick walled, with a granular surface, irregularly coiled and lacking longitudinal ridges".

Distribution. WA, Qld Australia; Palau Islands. First record from Lizard Island.

Serpula watsoni **Willey, 1905**
(Fig. 24B)

Serpula watsoni Willey, 1905: 317, pl. 7, fig. 187, pl. 8, fig. 6 [Trincomalee, Sri Lanka].
Serpula watsoni.—Straughan 1967a: 207–208, fig. 3b [Havannah Island, Qld]; Imajima 1977: 91–92, fig. 2a–j [Ogasawara Islands, Japan; redescription]; 1987: 78 [Okinawa, Japan]; Mak 1982: 609 [Hong Kong]; Morton & Morton 1983: 348 [Hong Kong]; Imajima & ten Hove 1984: 39, fig. 2 [Truk, Ponape, Majuro; Lizard Island; opercular variation]; 1986: 2 [Solomon Islands]; Parab & Gaikwad 1989: 224–225 [India]; Nishi 1992c: 79–80 [occurrence on living coral; Okinawa, Japan]; Wang & Huang 1993: 7 [Hong Kong; fouling]; Sun & Yang 2001a: 194–195, fig. 6G–M [South China Sea]; Bastida-Zavala 2008: 46–47, fig. 11L–M [Hawaii]; Kupriyanova *et al*. 2008: 429 [Lizard Island, Qld; DNA data].
Serpula cf. *watsoni*.—Nishi 1996: 314 [Okinawa, Japan].

Material examined. AM W.42062, stn.G235, Coconut Beach, 14°0'S, 145°0'E, coral rubble, coll. G. Rouse & E. Kupriyanova**,** 28 Oct 2005; **AM** W.44048, MI QLD 2341; **AM** W.45098, MI QLD 2435; **AM** W.47574, stn.G240, Osprey Island, intertidal rubble zone, 31 October 2005, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **SAM** E3595, stn.G241, granite boulders, Bird Islet, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005.

Diagnosis. Opercular funnel with 33 to 55 radii, very elongated, about as long as peduncle, with deep hollow, and inter-radiolar grooves almost reaching towards the constriction between funnel and peduncle.

Remarks. A taxon with a very similar operculum, but probably a different species, has been found at Long Reef (Sydney) and in the Abrolhos Archipelago (ten Hove unpubl.).

Distribution. Sri Lanka; Indo-West Pacific.

Serpula **spp.**
(Fig. 24C, D)

Material examined. AM W.42065, stn.G246, off Granite Bluff, coll. G. Rouse & E. Kupriyanova, 3 Nov 2005; **AM** W.42089, stn.G240, Osprey Island, intertidal rubble zone, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **AM** W.42373, south of Mermaid Cove, 14°38'53"S, 145°27'00"E, coll. E. Kupriyanova, P. Hutchings, M. Capa, 1 Sep 2010; **AM** W.44045, MI QLD 2351; **AM** W.44049, MI QLD 2350 (2); **AM** W.44058, MI QLD 2355; **AM** W.44531, MI OLD 2359; **AM** W.44539, MI QLD 2388; **AM** W.45047, MI QLD 2406; **AM** W.45048, MI QLD 2406; **AM** W.45413, MI QLD 2444; **AM** W.45426, MI QLD 2447; **AM** W.47343, inter-reef sand, 14°23'24"S, 145°16'24"E, artificial substrate, 10 m, coll. M. Timmers, 13 Feb 2009; **AM** W.47353, same, 10 Feb 2009; **AM** W.47356, Yonge Reef, Deep Reef slope, 14°36'24"S, 145°27'00"E, coral rubble, 22 Feb 2009; **AM** W.47457, G246, off Granite Bluff, coll. G. Rouse & E. Kupriyanova, 3 Nov 2005; **AM** W.47459, G240, Osprey Island, intertidal rubble zone, 31 Oct 2005, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005.

Diagnosis. Tube white, opaque; (semi)circular to trapezoidal in cross-section; longitudinal keels, peristomes, may be present. Operculum funnel shaped with crenulated edge (fused radii). Peduncle smooth, cylindrical, without wings; inserted just below and between first and second dorsal radiole. Radioles arranged in semi-circles. Pseudoperculum and inter-radiolar membrane present. Branchial eyes may be present. Seven thoracic segments. Collar trilobed. Thoracic membranes long, forming ventral apron across anterior abdominal segments. Collar chaetae bayonet-shaped and limbate. *Apomatus* chaetae absent. Uncini saw-shaped, with approximately 5 teeth,

anterior fang simple pointed. Thoracic triangular depression present. Abdominal chaetae flat trumpet-shaped with denticulate edge; uncini similar to thoracic ones, smaller, anteriorly saw-shaped but becoming rasp-shaped towards the pygidium.

Remarks. The diagnosis above is essentially the shortened generic diagnosis that fits a general "*Serpula*". A generic revision is badly needed.

Distribution. Currently unknown.

Genus *Spiraserpula* Regenhardt, 1961

Type-species. *Spiraserpula spiraserpula* Regenhardt, 1961

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube variable in colour, from white to orange and mustard, or with pink lateral longitudinal stripes; opaque; circular to trapezoidal in cross-section, rarely with small peristomes. Rounded longitudinal keels may be present; hyaline granular overlay present. Tube with internal longitudinal keels or other structures and/or rows of teeth. Operculum soft, funnel shaped, formed of fused radii, endplate absent. Operculum absent in some species. Peduncle smooth, cylindrical, without wings; it is formed from the second dorsal radiole on one side. Pseudoperculum present. Radioles arranged in semi-circles, up to 8 per lobe. Interradiolar membrane present. Branchial eyes may be present. Stylodes absent. Mouth palps absent. Five to ten thoracic chaetigerous segments. Collar trilobed, tonguelets absent. Thoracic membranes ending in mid-thorax. Collar chaetae bayonet-shaped and limbate. *Apomatus* chaetae absent. Thoracic uncini saw-shaped, with up to 7 teeth above anterior pointed fang. Thoracic triangular depression present. Abdominal chaetae flat trumpet-shaped with denticulate edge. Abdominal uncini similar to thoracic ones, smaller, anteriorly saw-shaped but becoming rasp-shaped towards the pygidium, with up to 8 teeth in profile, up to 7 teeth in a row. Achaetous anterior abdominal zone absent. Posterior capillary chaetae present. Posterior glandular pad absent.

Remarks. The genus was previously known only from fossils. It was revised by Pillai & ten Hove (1994) to include 18 *Serpula*-like species that lack an apron, but most characteristically possess sharp ridges and spines ("internal tube structures", ITS) sticking out into the lumen of their tubes. During the first contacts between Pillai, ten Hove, and Zibrowius in the startup of what ended with the revision by Pillai & ten Hove (1994), the three specially searched existing collections for the presence of what possibly might be representatives of what they thought to be a special group of *Serpula*. This action indeed revealed a fair number of candidates. It is only after that process of increasing awareness that ten Hove, diving in the Caribbean (1987–1992) found new material in almost every dive. Nevertheless, it is a rather cryptic genus, as evidenced too by the fact that after its revision in 1994 hardly any new material has been recorded.

Spiraserpula snellii Pillai & ten Hove, 1994

Spiraserpula snellii Pillai & ten Hove, 1994: 84, 88–89, 91, fig. 26–28 [Red Sea, Indonesia; Lizard Island, Boulton Reef, Australia; Loyalty Islands; Okinawa, Japan; original description].
Spiraserpula sp.—ten Hove 1994: 112 [Amirantes, Seychelles].
Spiraserpula snellii.—Pillai 2009: 143–144, fig. 34A–E [Kimberley, WA, material studied].

Material examined. AM W.20342, **AM** W.21677, **ZMA** V.Pol. 3830 (4), stn.21, south of South Island, 14°42'S, 145°28'E, sloping silty reef, little coral cover, 18–20 m, coll. H. ten Hove & P. Hutchings, 6 Mar 1986; **BM(NH)** 1992.65, stn.17, Palfrey Island south of lighthouse, 14°40'S, 145°28'E, coral heads on sandy bottom, 7 m, coll. H. ten Hove, P. Hutchings & M. Reid, 5 Mar 1986, det. Pillai & H. ten Hove; **ZMA** V.Pol. 3734, stn.20, reef front north of South Island, 14°40'S, 145°28'E, sloping reef outside lagoon & sandy bottom below, 10–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 5 Mar 1986, det. Pillai & H. ten Hove.

Diagnosis. Tubes up to 0.6 mm in external diameter, brownish in live and fresh material, but appearing mustard coloured after a few months in alcohol, with a pair of darker longitudinal bands along each flank. Tubes may be coiled more or less parallel to one another in the horizontal plane, mutually bonded together or spread out on the substrate and branched in places. Operculum absent, or simple, nearly globular.

Distribution. Taka Bone Rate, Indonesia, widely distributed in the Indo-West Pacific.

***Spiraserpula iugoconvexa* Pillai & ten Hove, 1994**
(Fig. 25)

Spiraserpula iugoconvexa Pillai & ten Hove, 1994: 82, figs 24–25 [Flores and Banda Seas, Indonesia; Lizard Island; original description, material studied].

Material examined. AM W.21676 (paratype, tube), stn.21, south of South Island, 14°42'S, 145°28'E, sloping silty reef, little coral cover, coll. H. ten Hove & P. Hutchings, 6 Mar 1986; **AM** W.42093, stn.G232, between First Beach and Osprey Island, 14°42'S, 145°30'E, coll. E. Kupriyanova & G. Rouse, 26 Oct 2005.

Diagnosis. Tube rose, red in fresh material, with a translucent granular overlay, coiled posteriorly, but not anteriorly. The operculum, when present, *Serpula*-type, with about 12 radii, zygomorphic, markedly convex distally, separated by a sharp constriction from the peduncle.

Distribution. North-East Flores Sea, Indonesia, Central Indo-West Pacific.

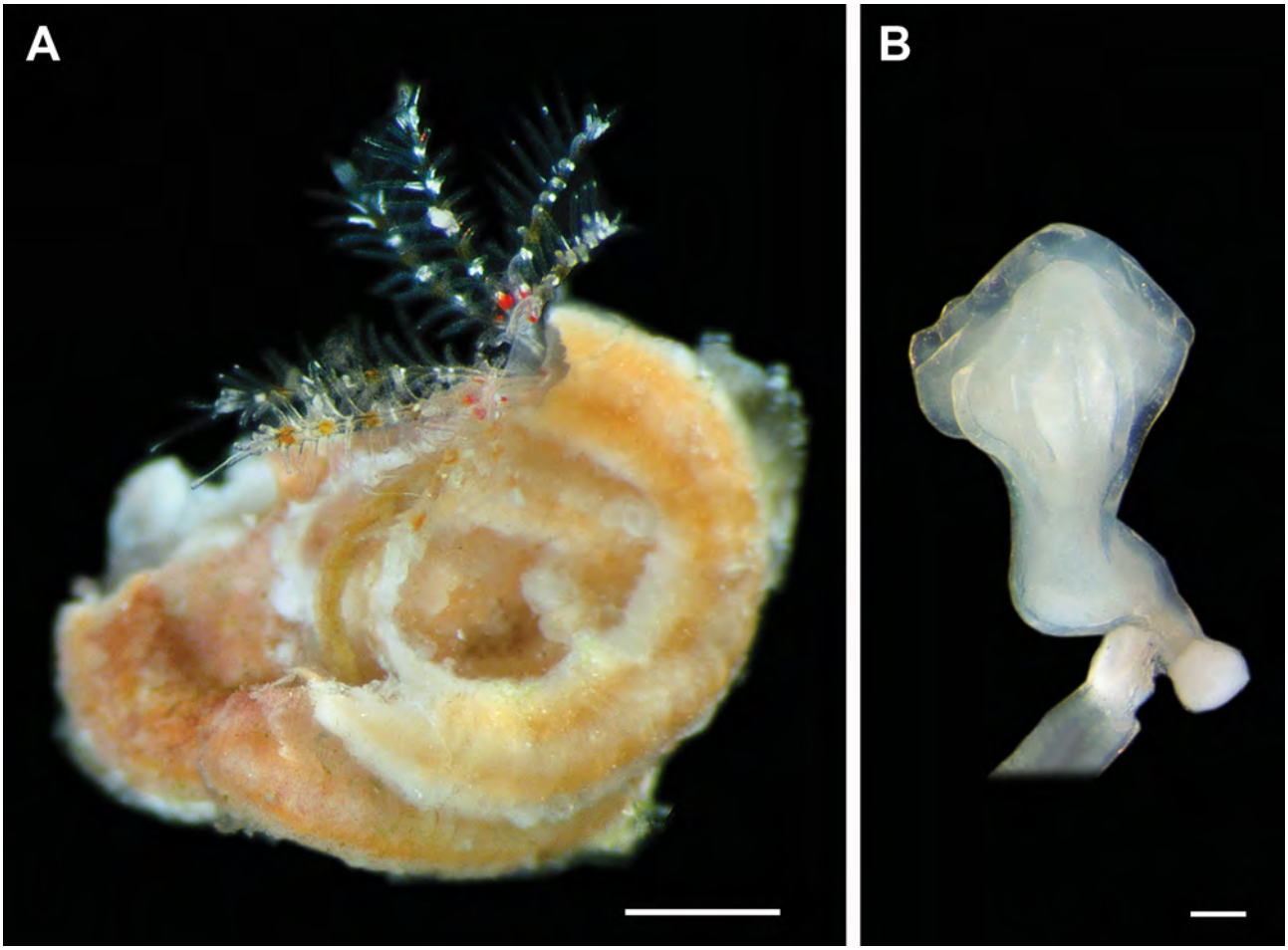

FIGURE 25. *Spiraserpula iugoconvexa.* A. Live specimen, stn.G232, **AM** W.42093; B. Operculum of fixed paratype **AM** W.21676. Photo: A—G. Rouse, B—E. Wong. Scale bars: A = 0.5 mm, B = 0.1 mm.

Genus *Spirobranchus* de Blainville, 1818

Type-species. *Serpula gigantea* Pallas, 1766

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube colour white, blue, pink or salmon, inside and/or outside. Tube typically (sub)triangular in cross-section, with median keel, rarely (sub)circular. Granular overlay absent. Operculum with inverse conical to rather shallow ampulla, covered by calcified endplate, with or without group of spines, sometimes branching. Peduncle broad, thickly triangular in cross-section, with distal lateral wings; inserted at base of branchial crown just left of medial line (formed between first and second normal dorsal radiole on left

side). Pseudoperculum absent. Operculum rarely lacking. Radioles may be arranged in a clear spiral of up to 8 whorls, but in most small species as well as in *Spirobranchus tetraceros* arranged in a circle. Up to 50–60 pairs of radioles in larger species. Inter-radiolar membrane present. Branchial eyes may be present; stylodes absent. Mouth palps present. Seven thoracic chaetigerous segments. Collar trilobed (exceptionally pentalobed). Tonguelets present. Thoracic membranes forming ventral apron across anterior abdominal segment. Collar chaetae bayonet-like, with numerous hairlike processes on its basal portion (*Spirobranchus* chaetae), and limbate. *Apomatus* chaetae absent. All uncini saw-shaped (9–25 teeth), incidentally with 2 teeth above peg; anterior peg blunt, clearly gouged underneath. Ventral ends of thoracic uncinigerous tori widely separated anteriorly, gradually approaching one another towards the end of thorax, thus leaving a triangular depression. Abdominal chaetae true trumpet-shaped, abruptly bent distally, with two rows of denticles separated by a hollow groove and forming long lateral spine. Achaetous anterior abdominal zone absent. Chaetae becoming increasingly longer posteriorly, but posterior capillary chaetae absent. Posterior glandular pad absent.

Remarks. The larger representatives of this genus, with spiralised branchiae, are spectacularly colourful and generally known as Christmas tree worms. They figure in many guides to reef animals, even in a travel guide (Finlay *et al.* 1998: 80). However, not all animals reported under this name are indeed *Spirobranchus giganteus sensu latissimo* as defined in Fiege & ten Hove (1999 fig. 4), there are quite a few mix-ups with *Protula bispiralis* and *vice versa*, even with phoronids. Members of the genus have confusing synonymies, the infraspecific variability of its main diagnostic character, the operculum, resulted in many mistaken identifications. Small specimens are even more difficult to identify, the opercula of juveniles of large sized species such as members of the *Sp. giganteus*-complex may resemble full grown opercula of small sized species (e.g., ten Hove & Ben-Eliahu 2005, fig. 6). Longitudinal rows of foramina, characteristic for species as *Sp.* cf. *polytrema* (Imajima 1977 fig. 8j) may be present in juvenile tubes of larger sized species, but disappear with increasing size (ten Hove, unpubl.).

***Spirobranchus corniculatus* (Grube, 1862)**
(Fig. 26)

Serpula (*Pomatoceros*) *corniculata* Grube, 1862: 66, fig. 5 [Java; original description].

Spirobranchus giganteus not (Pallas, 1766).—Straughan 1967b: 245, fig. 14e [Qld, Australia; in part, several of the synonyms included by Straughan belong to *Sp. tetraceros*]; Smith 1984a: 461–483 [Magnetic, Orpheus and Lizard Island, Qld, Australia; larval development].

Spirobranchus giganteus sp. A, B, C.—Smith 1985: 24–37, figs 2B–C, 3A–F, 4A–E, J–N, O–Q, 5A–C, F–K, P–R, Table 1 [Lizard Island and other localities Qld, Australia; extensive descriptions, material partly studied by HtH in 1986].

Spirobranchus giganteus corniculatus.—ten Hove 1970: 24–32, 50–51, figs 63–73 [widely distributed in the Indo-West Pacific; including most of the extensive synonymy; *Sp. paumotanus* in the meantime has been reinstated and *Sp. gardineri* too is a full species, though Fauvel's identifications –at least partly– belong to *Sp. corniculatus*]; Imajima & ten Hove 1984: 54 [Truk, Ponape, Majuro; Lizard Island]; Smith 1984b: 951–955 [Magnetic Island, Qld, Australia; photoreceptors]; Marsden 1987: 71-64 [Heron Island, Qld, Australia; coral preference].

Spirobranchus gaymardi (Quatrefages, 1866).—Fiege & ten Hove 1999: 355–364, figs 1–3 [redescription; Japan, Philippines, Indonesia, India, Australia (e.g., Lizard Island)].

Spirobranchus corniculatus.—Willette *et al.* 2015: figs 1, 2 [Australia, Fiji, Indonesia, Phillipines; DNA data].

Spirobranchus corniculatus-complex.—Hutchings 2008: 248, 250–251 [Great Barrier Reef, Australia].

Material examined. AM W.201350 (11), North Ridge, 14°40'S, 145°28'E, coll. P. Hutchings, Jul 1977, det. H. ten Hove; **AM** W.24045 (as *Sp. gaymardi*), Carter Reef, 14°35'S , 145°35'E, 15 m, coll. P. Hutchings, 10 Mar 1986, det. D. Fiege & H. ten Hove; **AM** W.24046 (3, as *Sp. gaymardi*), SMF 6087 (2, as *Sp. gaymardi*), stn.17, Palfrey Island, south of lighthouse, 14°40'S , 145°28'E, coral heads on sandy bottom, coll. H. ten Hove, P. Hutchings & M. Reid, 2 Mar 1986, det. D. Fiege & H. ten Hove; **AM** W.27389, Carter Reef, 14°35'S, 145°35'E, coll. P. Hutchings, 10 Mar 1986; **AM** W.28309 (2), between Lizard Head and Coconut Beach, 14°40'S , 145°28'E, undersides of boulders on rock, little sand, low tide, coll. H. ten Hove, 23 Jun 1983; **AM** W.28433, Mermaid Cove, 14°40'S, 145°28'E, from crevices in dead coral, coll. H. ten Hove, 20 Jun 1983; **AM** W.40282, Yonge Reef, back reef, 14°36'S, 145°37'E, 2 m, coll. P. Hutchings & P. Weate, 19 Jan 1975; **AM** W.40283, same; **AM** W.41739, Yonge Reef, back reef, 14°36'S, 145°37'E, in *Millepora*, coll. R. Smith, Nov 1985; **AM** W.41741 (as *Sp. gaymardi*), Yonge Reef, reef flat, 14°36'S, 145°37'E, on *Acropora palifera*, coll. R. Smith, Nov 1985; **AM** W.41746 (4, as *Sp. gaymardi*), Yonge Reef, 14°35'S, 145°37'E, coll. R. Smith, Dec 1983; **AM** W.41753 (3, as *Sp. gaymardi*), same,

coll. R. Smith, 5 Nov 1985; **AM** W.41804 (as *Sp. gaymardi*), Yonge Reef, back reef, 14°36'S, 145°37'E, coll. R. Smith, Nov 1985; **AM** W.41806, Yonge Reef, 14°36'S, 145°37'E, coll. R. Smith, 5 Nov 1985; **AM** W.41808 (as *Sp. gaymardi*), Yonge Reef, back reef, 14°36'S, 145°37'E, in *Porites lichen*, coll. R. Smith, Nov 1985; **AM** W.41810 (3, as *Sp. gaymardi*), Yonge Reef, 14°36'S, 145°37'E, coll. R. Smith, 5 Nov 1985; **AM** W.41811 (as *Sp. gaymardi*), same, coll. R. Smith, Nov 1985; **AM** W.41816 (2, as *Sp. gaymardi*), Lizard Island, 14°40'S, 145°27'E, in *Porites*, coll. R. Smith, 1983; **AM** W.41817 (as *Sp. gaymardi*), Yonge Reef, back reef patch, 14°36'S, 145°37'E, in *Stylophora pistillata*, coll. R. Smith, 8 Nov 1985; **AM** W.41818 (2, as *Sp. gaymardi*), Yonge Reef, 14°35'S, 145°37'E, coll. G. Kelly & R. Smith, Dec 1983; **AM** W.41826 (2, as *Sp. gaymardi*), Mrs Watsons Bay, off Chinamans Ridge, 14°40'S, 145°27'E, coll. R. Smith, 8 Jan 1983; **AM** W.41836 (2), lagoon, 14°40'S, 145°27'E, coll. R. Smith & D. Randall, 20 Jan 1983; **AM** W.41742 (2), Yonge Reef, back reef, 14°36'S, 145°37'E, in *Acropora palifera*, coll. R. Smith, 11 Nov 1985; **AM** W.41821 (4), Yonge Reef, back reef patch, 14°36'S , 145°37'E, in *Acropora palifera*, coll. R. Smith, 11 Nov 1985; **AM** W.41834 (2), Waining Reef, back reef area, 14°27'S, 145°13'E, in *Porites*, coll. R. Smith, Dec 1983; **AM** W.41886 (3, as *Sp. gaymardi*), Yonge Reef, back reef, 14°36'S, 145°37'E, in *Porites*, 10 m, coll. R. Smith, Nov 1985; **AM** W.41913 (3, as *Sp. gaymardi*), Mrs Watsons Bay, off Chinamans Ridge, 14°40'S, 145°27'E, in *Porites*, coll. R. Smith, 26 Jul 1985; **AM** W.41931 (2, as *Sp. gaymardi*), Yonge Reef, 14°35'S, 145°37'E, coll. R. Smith, Dec 1983; **AM** W.41933 (as *Sp. gaymardi*), Mrs Watsons Bay, off Chinamans Ridge, 14°40'S, 145°27'E, in *Porites*, coll. R. Smith, 8 Jan 1983; **AM** W.41934 (2, as *Sp. gaymardi*), Lizard Island, 14°40'S , 145°27'E, coll. R. Smith; **AM** W.41936 (2, as *Sp. gaymardi*), Yonge Reef, back reef patch, 14°36'S, 145°37'E, in *Porites* sp. and *Porites lichen*, coll. R. Smith, 11 Nov 1985; **AM** W.41938 (as *Sp. cruciger*), Yonge Reef, 14°36'S, 145°37'E, in *Acropora pistillata*, coll. I. Dight & R. Smith, 15 Jan 1985; **AM** W.41940 (as *Sp. cruciger*), Waining Reef, back reef area, 14°27'S, 145°13'E, 5 m, coll. R. Smith, Dec 1983; **AM** W.41941 (2, as *Sp. cruciger*), North Point, 14°39'S, 145°27'E, coll. R. Smith, 8 Jan 1983; **AM** W.41942 (as *Sp. cruciger*), Yonge Reef, reef flat, 14°36'S, 145°37'E, on old *Tridacna gigas* shell, coll. R. Smith, Nov 1985; **AM** W.42026 (7, as *Sp. gaymardi*), Mrs Watsons Bay, off Chinamans Ridge, 14°40'S, 145°27'E, in *Porites*, coll. R. Smith, 26 Jun 1982; **AM** W.42028 (4, as *Sp. cruciger*), Yonge Reef, reef flat, 14°36'S, 145°37'E, in *Porites*, coll. R. Smith, Nov 1985; **AM** W.42034 (as *Sp. gaymardi*), Yonge Reef, back reef, 14°36'S, 145°37'E, in *Millepora*, coll. R. Smith, Nov 1985; **AM** W.42035, Mrs Watsons Bay, off Chinamans Ridge, 14°40'S, 145°27'E, coll. R. Smith; **AM** W.42043 (as *Sp. cruciger*), Yonge Reef, back reef bommie crest, 14°36'S, 145°37'E, coll. R. Smith, 11 Nov 1985; **AM** W.42101 (many), Howick Group, Coquet Island, in natural harbour, below lighthouse, 14°32'24"S, 144°59'47"E, in *Porites*, coll. R. Smith, Dec 1983; **AM** W.42103 (2), Mrs Watsons Bay, off Chinamans Ridge, 14°40'S, 145°27'E, coll. R. Smith, 1983; **AM** W.42105 (2), Mrs Watsons Bay, off Chinamans Ridge, 14°40'S, 145°27'E, coll. R. Smith, 8 Jan 1983; **AM** W.45041, MI QLD 2406; **AM** W.45042, MI QLD 2406; **AM** W.45043, MI QLD 2406; **AM** W.45044, MI QLD 2406; **AM** W.45045, MI QLD 2406; **AM** W.45046, MI QLD 2406 (2); **AM** W.45428, MI QLD 2447; **AM** W.45429, MI QLD 2447; **AM** W.47318, North Direction Island, Deep Reef slope, 14°44'36"S, 145°30'54"E, coral rubble, 2 m, coll. C. Watson; **SAM** E3608, Ser90, stn.G230, North Point, 14 m, scuba, coll. G. Rouse & E. Kupriyanova, 25 Oct 2005; **ZMA** V.Pol. 4027 (5, as *Sp. gaymardi*), stn.21, south of South Island, 14°42'S, 145°28'E, sloping silty reef, little coral cover, 18–20 m, coll. H. ten Hove & P. Hutchings, 6 Mar 1986, det. D. Fiege & H. ten Hove; **ZMA** V.Pol. 4028 (8, as *Sp. corniculatus*), stn.18, lagoon near east entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, 3 Mar 1986; **ZMA** V.Pol. 4840 (5, as *Sp. corniculatus*-complex), stn.16, North Point, sloping reef, mainly dead, slightly silted corals, 3–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986; **ZMA** V.Pol. 4851 (as *Sp. corniculatus*-complex), North Reef, 14°40'S, 145°27'E, underside of boulders on rock, low tide, little sand, coll. H. ten Hove, 22 Jun 1983; **ZMA** V.Pol. 4852 (2, as *Sp. cruciger*), Yonge Reef, depth 8–10 m, from dead & living corals, coll. H. ten Hove, 21 Jun 1983; **ZMA** V.Pol. 4853 (as *Sp. corniculatus*), between Research Point & Freshwater Beach, in lagoon, subtidally, dead coral cobbles on sand, 1 m, coll. H. ten Hove, 16 Jun 1983.

Diagnosis. Spiral branchiae. Peduncular wings with entire edge. Opercular endplate with two dorso-lateral antler-like spines originating from a short common stem, often each spine with 2–3 secondary spinules and with basal short, dorsal tine; medio-ventral spines may be present. Spine morphology very variable, dorsal tines may be short and broad, with blunt abraded tips and meeting above the midline ("*Sp. gaymardi*" morphotype); all opercular spines may be small, and tines, if present, narrow ("*Sp. corniculatus*" morphotype); dorso-lateral spines may be long, unabraded thin dorsal tines terminating in sharp spinules and spaced widely apart, and the medio-ventral spine long and branching ("*Sp. cruciger*" morphotype).

FIGURE 26. *Spirobranchus corniculatus*, live animals in tubes. A. **AM** W.45041; B. **AM** W.45427. Photo: A, B—A. Semenov. Scale bars: A, B = 1 mm.

Remarks. Based on analysis of nuclear and mitochondrial markers, Willette *et al.* (2015) concluded that the *Spirobranchus corniculatus*-complex of morphospecies identifiable by their opercula mainly (see Smith 1985 for further differences), which includes *Sp. corniculatus sensu stricto, Sp. cruciger* and *Sp. gaymardi* (Smith's 1985 *Sp. giganteus* sp. A, sp. C and sp. B respectively) is a single, morphologically variable species widely distributed across the Indo-Pacific. We have followed this genetic appraisal here and synonymized the former morphospecies. However, sampling in the study of Willete *et al.* (2015) was limited to the Central Indo-Pacific, excluding the West and East Indo-Pacific regions. According to unpublished observations of one of us (HtH), the "*cruciger*"and "*gaymardi*" morphotypes are very common on the Red Sea, but "*corniculatus"* type opercula are very uncommon. The range of variation given for the "*gaymardi*" morphotypes from the Central Indo-Pacific is enormous as compared to that in the Red Sea. Further molecular studies are needed to determine whether or not the specimens from the Red Sea belong to different species as those found in Indo-Pacific. In view of the remarks given with the generic diagnosis, the many mistaken identifications (see for instance above, *Spirobranchus giganteus* not (Pallas, 1766) — Straughan 1967b), the difficulties in interpreting figures as (if) given in the literature, we have refrained from an extensive synonymy.

Distribution. Central Indo-West Pacific.

Spirobranchus coronatus Straughan, 1967a

(Fig. 27A)

Spirobranchus coronatus Straughan, 1967a: 247–248, fig. 15 [Qld, Australia, material studied; diagnosis, see Remarks].
Spirobranchus coronatus.— Straughan 1976b: 39 [Qld, Australia].

Material examined. AM W.41751, Yonge Reef, 14°35'S, 145°37'E, coll. R. Smith, 5 Nov 1985; **AM** W.47305 (2), Day Reef, Deep Reef slope, 14°29'S, 145°33'E, coral rubble, 14 m, coll. N. Bruce, 19 Feb 2009; **AM** W.47315, Deep Reef slope, Fore Reef, 14°28'18"S, 145°31'48"E, coral rubble, 10 m, coll. M. Blazewicz-Paskowycz, 13 Feb 2009; **AM** W.47318, North Direction Island, Deep Reef slope, 14°44'36"S, 145°30'54"E, coral rubble, 2 m, coll. C. Watson; **AM** W.47348, Bird Islet, front reef, 14°41'48"S, 145°27'54"E, coral rubble, 3 m, coll. C. Watson, 8 Feb 2009; **AM** W.47357, North Head Reef, Fore Reef, 14°38'42"S, 145°27'12"E, coral rubble, 12 m, coll. M. Blazewicz-Paskowycz, 14 Feb 2008; **AM** W.47358, Patch Reef near lagoon entrance, 14°41'48"S, 145°27'54"E, coral rubble, 2 m, coll. N. Bruce, 11 Apr 2008; **SAM** stn.G231, Coconut Beach, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005.

Diagnosis. Opercular plate with eight or ten almost erect and almost separate spines, basally arranged in 3 or 4 dichotomously branching groups. Peduncular wings without terminal digitate processes but may be laterally crenulated.

Remarks. Straughan's poor description and figures led ten Hove (1970: 48) to synonymise this taxon with *Sp. tetraceros.* In 1983 and 1986, ten Hove (unpubl.) studied Straughan's holotype (**AM** W.4025) and two presumed paratypes (**AM** W.4038 and **AM** W.4123), and based on this he reinstated the name (1993: 83; 1994: 112) for material from the Seychelles. However, Pillai (2009: 148–150, fig. 37 A–H) described *Sp. baileybrockae* from Western Australia, differing from *Sp. coronatus* mainly in the presence of centrally directed spinules on the not branching opercular spines and the presence of a central spine. The latter characters were figured by Bailey-Brock (1985: fig. 8d–e) for material from Fiji as well. In this light, the material from the Seychelles should be restudied and held against the variability of the Lizard Island population (and Straughan's original material which included some variation as well), but a full revision of these forms falls outside the scope of this paper.

Distribution. Qld, Australia.

Spirobranchus corrugatus Straughan, 1967a

(Fig. 27B–D)

Spirobranchus corrugatus Straughan, 1967a: 39–41, fig. 5a–e [Heron Island, Qld; diagnosis].
Spirobranchus corrugatus.—ten Hove 1994: 112 [Amirantes Island, Seychelles; diagnosis, synonymy]; ten Hove & Nishi 1996: 87–93, figs 1–5 [Lizard Island and other Qld localities; Abrolhos Islands, WA; Indonesia, Japan, Seychelles, Red Sea; re-description]; Hassan 1998: 53 [Red Sea; figure]; Fiege & Sun 1999: 124–125, fig. 13A–D [Hainan Island, South China Sea; description]; Sun & Yang 2001a: 195 [Hainan Island; South China Sea]; ten Hove & Kupriyanova 2009: 18, figs 4A, 98 [colour photo, name; Lizard Island].

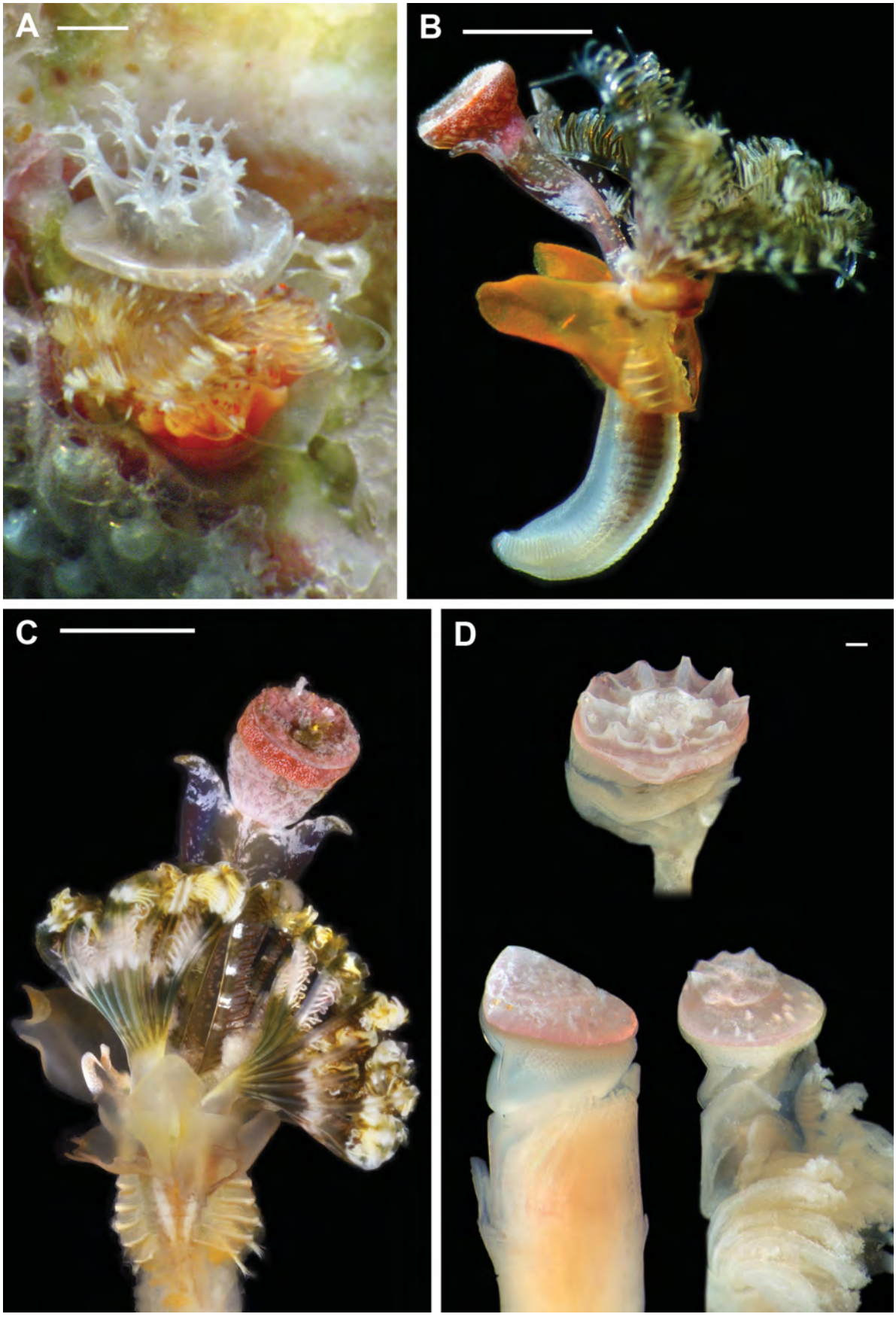

FIGURE 27. A. *Spirobranchus coronatus*, live animal in tube, stn.G231 **SAM**; B–C. *Sp. corrugatus,* live animals removed from their tubes, stn.G246 **SAM** and **AM** W.43887 respectively; D. Opercula of fixed specimens, **AM** W.21678. Photo: A, B–G. Rouse, C–A. Semenov, D–E. Wong. Scale bars: A–C = 1 mm, D = 0.1 mm.

Spirobranchus sp.—Vine & Bailey-Brock 1984: 146, fig. 5B–C [Sudanese Red Sea; synonymy *fide* ten Hove & Nishi 1996: 87].
Spirobranchus denisdevaneyi Bailey-Brock, 1985: 207–208, fig. 9a–e [Fiji; *fide* ten Hove & Nishi 1996: 87].
Spirobranchus denisdevaneyi.— Bailey-Brock 1987: 283 [Tonga].

Material examined. AM W.21678 (12), **ZMA** V.Pol. 4000 (7), stn.21, south of South Island, 14°42'S, 145°28'E, sloping silty reef, little coral cover, 20 m, coll. H. ten Hove & P. Hutchings, 6 Mar 1986; **AM** W.23497, stn.17, Palfrey Island, south of lighthouse, 14°40'S, 145°28'E, 7 m, coll. H. ten Hove & P. Hutchings, 1 Mar 1986; **AM** W.28318, outer reef, 14°40'S, 145°27'E, dead & living corals, 10 m, coll. H. ten Hove, 21 Jun 1983; **AM** W.40279, off Coconut Beach, 14°40'S, 145°28'E, 15 m, coll. P. Berents & P. Hutchings, 17 Jan 1975; **AM** W.43887 (2), MI QLD 2331; **AM** W.43910, MI QLD 2335; **AM** W.44064, MI QLD 2359; **AM** W.47306, Day Reef, Fore Reef, 14°30'06"S, 145°30'30"E, coral rubble, 30 m, coll. J. Caley & K. Mills, 21 Feb 2009; **AM** W.47319, inter-reef sand, 14°23'24"S, 145°16'24"E, artificial substrate, 10 m, coll. M. Timmers, 11 Feb 2009; **AM** W.47352, same, 9 Feb 2009; **MAGNT** W016581, Turtle Beach, reef flat, 14°40'S, 145°27'E, undersides of dead and living corals, 6 m, coll. H. ten Hove, 22 Jun 1983; **MAGNT** W025503, Yonge Reef, 14°34'30"S, 145°36'18"E, coll. C. Glasby, 20 Apr 2008; **ZMA** V.Pol. 4882 (as *Sp. oligotrema*, dried out ?), Turtle Beach, underside of dead & living corals, generally fairly cryptic, about 6 m, coll. H. ten Hove, 22 Jun 1983, det. D. Makhan, 1985; **ZMA** V.Pol. 4002 (as *Sp. dennisdevaneyi*), stn.18, lagoon near east entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, 3 Mar 1986; **ZMA** V.Pol. 5538 (2, as cf. *polytrema*), stn.16, North Point, sloping reef, mainly dead, slightly silted corals, 3–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986; **ZMA** V.Pol.5323 (as *Sp.* ?*corrugatus*), stn. G.246, Granite Bluff, 17 m, coll. G. Rouse & E. Kupriyanova, 3 Nov 2005.

Diagnosis. Operculum with slanting, flat to subconical endplate, sometimes with smooth surface but most typically with 10–20 radiating ridges ending in as many marginal teeth. In fresh material a very diagnostic feature is the intensely red band of single lensed ocelli in the ventral edge of the opercular ampulla immediately below the calcareous endplate, thinning out towards the dorsal side (Fig. 21B–D). However, ocelli are difficult to see in preserved material. Peduncular wings with entire edge, at most slightly crenulated, but terminal digitate processes absent.

Remarks. Tube may be difficult to find, deeply imbedded into substrate and having a greenish to pink tinge in fresh material. The material from North Point still showed the typical band of ocelli in their opercula upon re-examination in 2015.

Distribution. Qld Australia, widely distributed in the Indo-West Pacific.

Spirobranchus decoratus Imajima, 1982

Spirobranchus tricornigerus decoratus Imajima, 1982: 48–50, fig. 5a–m [Palau and Yap Islands; original description].
Spirobranchus tricornigerus var. *racemosus* Pillai, 1971: 99–100, fig. 3e [Sri Lanka; description].
Spirobranchus decoratus.—Imajima & ten Hove 1984: 52–53, fig. 5d [Truk Islands, Ponape and Majuro Atoll; discussion, synonymy]; Imajima & ten Hove 1986: 8 [Nauru, the Gilbert Islands, the Solomon Islands]; Imajima 1987: 79 [Okinawa, Japan]; Fiege & Sun 1999: 125–126, fig. 14a–d [Hainan Island, China; description]; Sun & Yang 2001a: 195–196, fig.7A–F [Hainan Island, South China Sea]; Bailey-Brock *et al.* 2012: 979–980, fig. 8A–H [Marshall Islands].

Material examined. ZMA V.Pol. 4537, Granite Head, 14°39'S, 145°27'E, from underside of boulders on rock, little sand, subtidally, coll. H. ten Hove, 18 Jun 1983.

Diagnosis. Tubes wine-red to pink and white, triangular in cross-section with median keel of coarse spines flanked at both sides by a row of pits. Opercular plate flat, bearing a crown of 5–6 (or even more) dichotomously branching spines. Spines bear small paired denticles along their length. Spines all in same plane giving a finely pinnate, stellate appearance to the operculum. Peduncle with wide distal wings ending in a single (exceptionally two) process(es).

Remarks. See the discussion in Imajima & ten Hove (1984: 53).

Distribution. Indo-West Pacific, recorded from South Japan, South China Sea, the Islands Palau, Truk and Ponape, Majuro Atoll, Solomon Islands; Lizard Island, Australia and Sri Lanka.

***Spirobranchus gardineri* Pixell, 1913**
(Fig. 28A, B)

Spirobranchus gardineri Pixell, 1913: 81–82, fig. 7a–f [Providence Reef, N. of Madagascar; original description].
Spirobranchus gardineri.—Fauvel 1933a: 79 [Gulf of Suez, Red Sea; diagnosis]; 1933b: 143 [same]; ?Straughan 1967b: 243–244, fig. 14a [Qld; diagnosis and figure not typical]; Pillai 1971: 100–101 [Sri Lanka; diagnosis]; Fiege & ten Hove 1999: 362–363 [in part; discussion and mention of 2 taxa under this name; the material from South China Sea belongs to *Sp. richardsmithi*]; Fosså & Nilsen 1996: 140, 148 [Seychelles; colour photograph]; 2000: 142, 146 [same]; Smith 1985: 40–44, figs 2E–F, 3G–H, 4E, T–W, 5N [Lizard Island, Australia; *partim*, not variant types 1 and 2].
Spirobranchus giganteus corniculatus not (Grube, 1862).—Bailey-Brock 1985: 203–204, fig. 6a–c [Fiji; diagnosis].
Spirobranchus tetraceros not (Schmarda, 1861).—Erhardt & Moosleitner 1995: 872 [the colour photograph clearly is not *Sp. tetraceros* but *Sp. gardineri* by spiraled branchiae and opercular set-up].

Material examined. AM W.201840, Carter Reef, 14°40'S, 145°28'E, coll. P. Hutchings, 10 Mar 1986, det. H. ten Hove; **AM** W.28292 (2), stn.16, North Point, 14°40'S, 145°28'E, sloping reef with mainly dead, thinly silted corals, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986; **AM** W.41752, Yonge Reef, 14°35'S, 145°37'E, coll. R. Smith, 5 Nov 1985; **AM** W.41755, same, back reef bommie, coll. R. Smith, 5 Nov 1985; **AM** W.41756, same, coll. R. Smith, Nov 1985; **AM** W.41790, same, back reef, in *Porites lichen*, coll. R. Smith, Nov 1985; **AM** W.41805, same, in *Millepora*, coll. R. Smith, Nov 1985; **AM** W.41809, same, coll. R. Smith, Nov 1985; **AM** W.41832, same, back reef, in *Millepora*, coll. R. Smith, Nov 1985; **AM** W.41844, same, back reef, in *Millepora*, coll. R. Smith, Nov 1985; **AM** W.41919 (2), same, back reef, in *Millepora*, coll. R. Smith, Nov 1985; **AM** W.41921, Waining Reef, back reef area, 14°27'S, 145°13'E, coll. R. Smith, Dec 1983; **AM** W.41954, Yonge Reef, 14°35'S, 145°37'E, coll. R. Smith, Dec 1983; **AM** W.42032 (4), same, back reef, 14°36'S, 145°37'E, in *Porites lichen*, coll. R. Smith, Nov 1985; **AM** W.45089, MI QLD 2424; **AM** W.45412, MI QLD 2424; **AM** W.45430, MI QLD 2446; **AM** W.47299, Day Reef, Fore Reef, 14°29'S, 145°33'E, coral rubble, 4–10 m, coll. M. Blazewicz-Paskowycz, 19 Feb 2009; **AM** W.47314, Fore Reef, 14°26'54"S, 145°30'00"E, coral rubble, 10 m, coll. N. Bruce & M. Blazewicz-Paskowycz, 21 Feb 2009; **ZMA** V.Pol. 3578, Yonge Reef, 14°35'S, 145°37'E, coll. R. Smith, 5 Nov 1985.

Diagnosis. Opercular plate bearing a (fairly long) column ending in a pair of latero-dorsal spines and a bifid medioventral spine, all with tips curved away from the opercular plate. Latero-dorsal spines each bear one pair of short spinules and two unpaired ones, the largest one located latero-ventrally, and the other three located subterminally. Peduncle with wide distal wings with entire edge (no processes).

Remarks. *Spirobranchus gardineri* resembles *Sp. richardsmithi* in having a column arising from distal plate and bearing three spines/processes distally. However, the three distal processes in *Sp. gardineri* are less elaborate, and are all directed anteriorly, away from the opercular plate, while the ventral bifurcate spine as well as the proximal side spinules of the two latero-dorsal spines are recurving towards the opercular plate in *Sp. richardsmithi*. This was noted for the first time by Smith (1985: 43–47, fig. 3G–H *versus* I–L), and formalized in a new description by Pillai (2009: 154–158). All records from before the last date should be checked whether or not they belong to *Sp. gardineri sensu stricto*; we have only given references where the identity is clear from either description or figures.

Pillai (2009: 182–184, fig. 60A–G) describes as *Spirobranchus* sp. 6 a single specimen from the South China Sea with an operculum almost intermediate between those of *Sp. gardineri* and *Sp. richardsmithi*, however, more complicated in that the two dorsal spines are bifid as well as the ventral one, which is pointing upward as in *Sp. gardineri*. It remains to be seen if this falls within the (as yet poorly documented) variability of *Sp. gardineri* or indeed merits a specific status.

Distribution. North of Madagascar, widely distributed in the Indo-West Pacific.

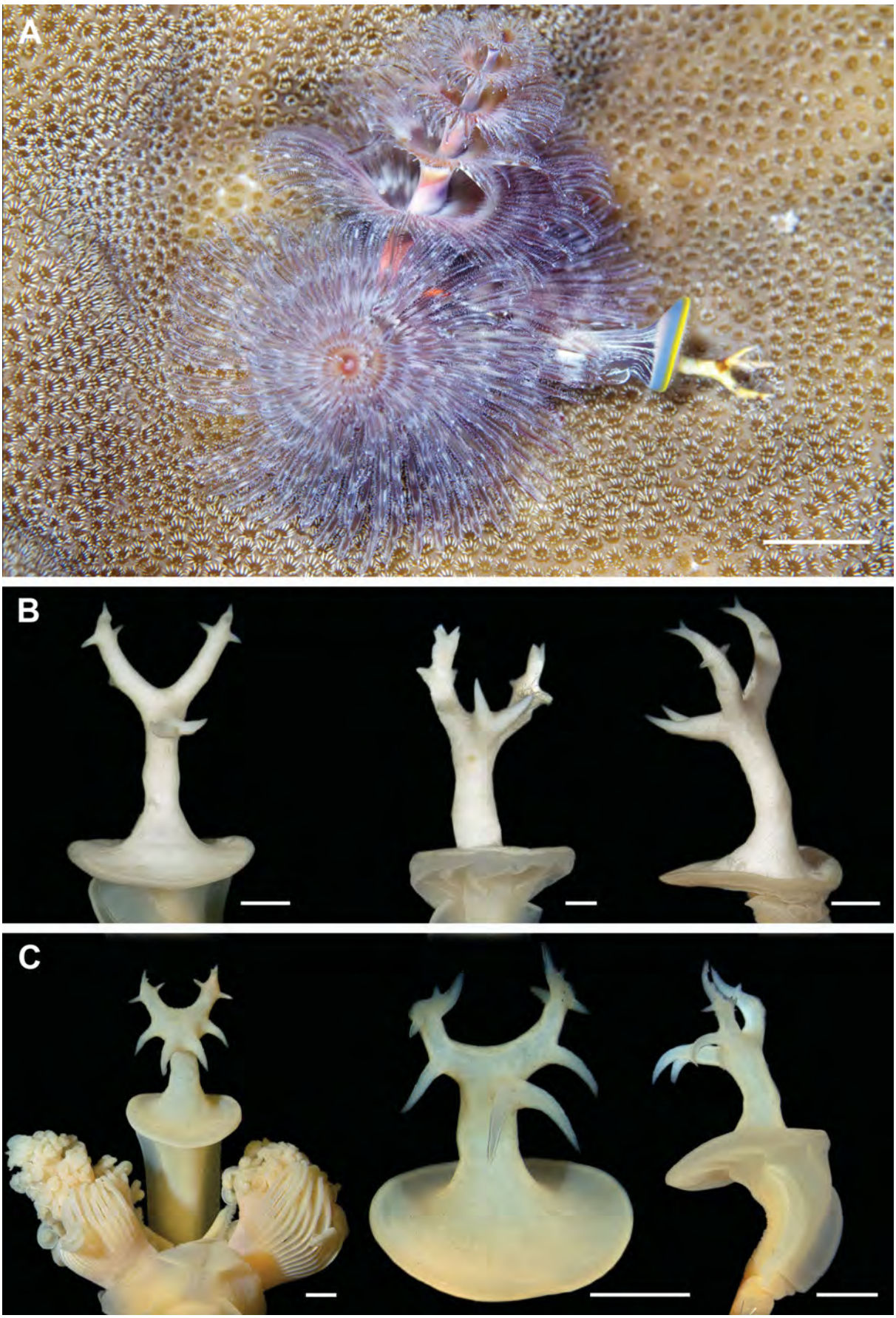

FIGURE 28. A. *Spirobranchus gardineri,* live specimen *in situ*, **AM** W.45089; B. Opercula of fixed specimens of *Sp. gardineri* **AM** W.41832 (middle) & **AM** W.41756 (left, right); C. Opercula of fixed specimens of *Sp. richardsmithi*, **AM** W.41955. Photo: A—A. Semenov, B, C—E. Wong. Scale bars: A = 3 mm, B–C = 1 mm.

***Spirobranchus latiscapus* (Marenzeller, 1885)**
(Fig. 29A, B)

Pomatostegus latiscapus Marenzeller, 1885: 218–219, pl. 4, fig. 5 [South Japan, 183 m; description].
Pomatoceros auritubus Moore & Bush, 1904: 174–175, pl. 11 fig. 20, pl. 12, figs 33–37 [Suruga Bay, Japan, 82 m; description].
Spirobranchus latiscapus.—Fauvel 1936: 89 [Setozaki, Shirahama, Japan; diagnosis]; Imajma & Hartman 1964: 272–274 [Japan; diagnosis]; Bailey-Brock 1972: 405–406, fig. 1a–d [Hawaii]; Imajima 1976b: 137–138 [Tanega-shima, Southwest Japan]; Yang & Sun 1988: 314–315, fig. 2F–G [South China Sea]; Sun & Yang 2001a: 197–198, fig. 7G–N [northwest of South China Sea].
?*Spirobranchus sinensis* Wu & Chen, 1981b: 247–248, fig. 1 [South China Sea, 28 m; see Remarks].

Material examined. AM W.201802 (2), Yonge Reef, 14°35'S, 145°37'E, shell of *Nautilus*, 300 m, coll. M. Wells, Nov 1985, det. H. ten Hove; **AM** W.201837, Carter Reef, off Lizard Island, 14°40'S, 145°28'E, 20–30 m, coll. P. Hutchings, 10 Mar 1986, det. H. ten Hove.

Diagnosis. Operculum with 1–5 (3–7) calcareous diabolo-like tiers, decreasing in size distally, with flat to conical tip. Tube: colour shades of reddish/orange (colour may be lost in preservation), triangular, with one large keel and a pair of lower lateral keels, with or without paired rows of pits at sides when attached, free parts often hexangular. Peduncle with long (2/3rd to 4/5th of length) wings, with entire edge (no processes).

Remarks. Because *Spirobranchus latiscapus* has a confusing synonymy, we have only given the most likely synonyms/references. Being originally decribed from Southern Japan, the nominal taxon subsequently has been reported from areas as distant as Gulf of Suez to New Zealand, from diving depths in tropical seas to temperate New Zealand, down to almost 200 m, an unlikely distribution. Pillai (2009: 165, 170–174, 184–190) split the nominal taxon in 5 species, reinstating and redescribing *Sp. maldivensis* Pixell, 1913 from the Maldives and Gulf of Oman, and describing 3 new species: *Sp. murrayi* from the Gulf of Oman, *Sp. tenhovei* from Tasmania and *Sp. zelandicus* from New Zealand, all formerly labelled *Sp. latiscapus*. From New South Wales he described *Sp. zibrowii*, also similar in operculum and tube. *Spirobranchus latiscapus* is the only taxon with a rose-red tube, as shown by our specimen **AM** W.201837 as well. All other nominal taxa have orange to caramel, to white or even bluish tubes. Furthermore, *Sp. sinensis* Wu & Chen, 1981b (247–248, fig. 1) is very similar if not the same, the "distinctive character" of chitinous spines on the operculum in the latter being remnants of epibiontic Hydrozoa (*cf.* Bouillon 1974). The complex should be revised.

Distribution. South Japan to tropical Australia; usually off shore, in deeper water.

***Spirobranchus nigranucha* (Fischli, 1903)**
(Fig. 29C, D)

Protula (*Protulopsis*) *nigranucha* Fischli, 1903: 128–129, pl. 5 fig. 31, pl.7 figs 73–75, pl. 8 figs 87–88 [Ternate, Indonesia; original description].
Protula nigra-nucha.—Hartman 1959: 590 [name].
Spirobranchus nigranucha.—ten Hove 1989: 136 [transferred from *Protula* to *Spirobranchus*]; Fosså & Nielsen 1996: 140 [taxonomic scheme]; 2000: 142 [same]; Fiege & ten Hove 1999: 362, fig. 4 [same]; ten Hove & Kupriyanova 2009: 98 [name only]; Stella *et al.* 2011: 102 [name].
Spirobranchus giganteus sp. D.—Smith 1985: 37–40, figs 2D, 5D, L, M, S [Lizard Island and other Qld localities, Australia; extensive description, material partly studied by HtH 1986].

Material examined. AM W.201836, Carter Reef, 14°40'S, 145°28'E, attached to coral rubble, coll. P. Hutchings, 10 Mar 1986, det. H. ten Hove; **AM** W.201841, Carter Reef, 14°40'S , 145°28'E, coll. P. Hutchings, 10 Mar 1986; **AM** W.41738 (2), **ZMA** V.Pol. 3579, Yonge Reef, 14°35'S, 145°37'E, coll. R. Smith, det. *Sp. giganteus* sp. D, 5 Nov 1985; **AM** W.41754, same, coll. R. Smith, 5 Nov 1985; **AM** W.41812, same, coll. R. Smith, det. E. Kupriyanova; **AM** W.41927, Waining Reef, back reef area, 14°27'S, 145°13'E, coll. R. Smith, Dec 1983; **AM** W.41820, Jewell Reef, 14°24'S, 145°24'E, coll. R. Smith, Dec 1983; **AM** W.41825 (2), Yonge Reef, back reef patch, 14°36'S, 145°37'E, coll. R. Smith, 11 Nov 1985; **AM** W.41945 (4), Yonge Reef, 14°35'S, 145°37'E, coll. R. Smith, Dec 1983; **AM** W.41948 (2), same, coll. R. Smith, Dec 1983; **AM** W.45093, MI QLD 2435; **AM** W.47317, North Direction Island, Deep Reef slope, 14°44'36"S, 145°30'54"E, coral rubble, 2 m, coll. C. Watson; **ZMA** V.Pol. 4812, stn.18, lagoon near East entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, 3 Mar 1986; **ZMA** V.Pol. 5316, stn.G230, North Point, reef slope, 14 m, scuba, coll. G. Rouse & E. Kupriyanova, 25 Oct 2005.

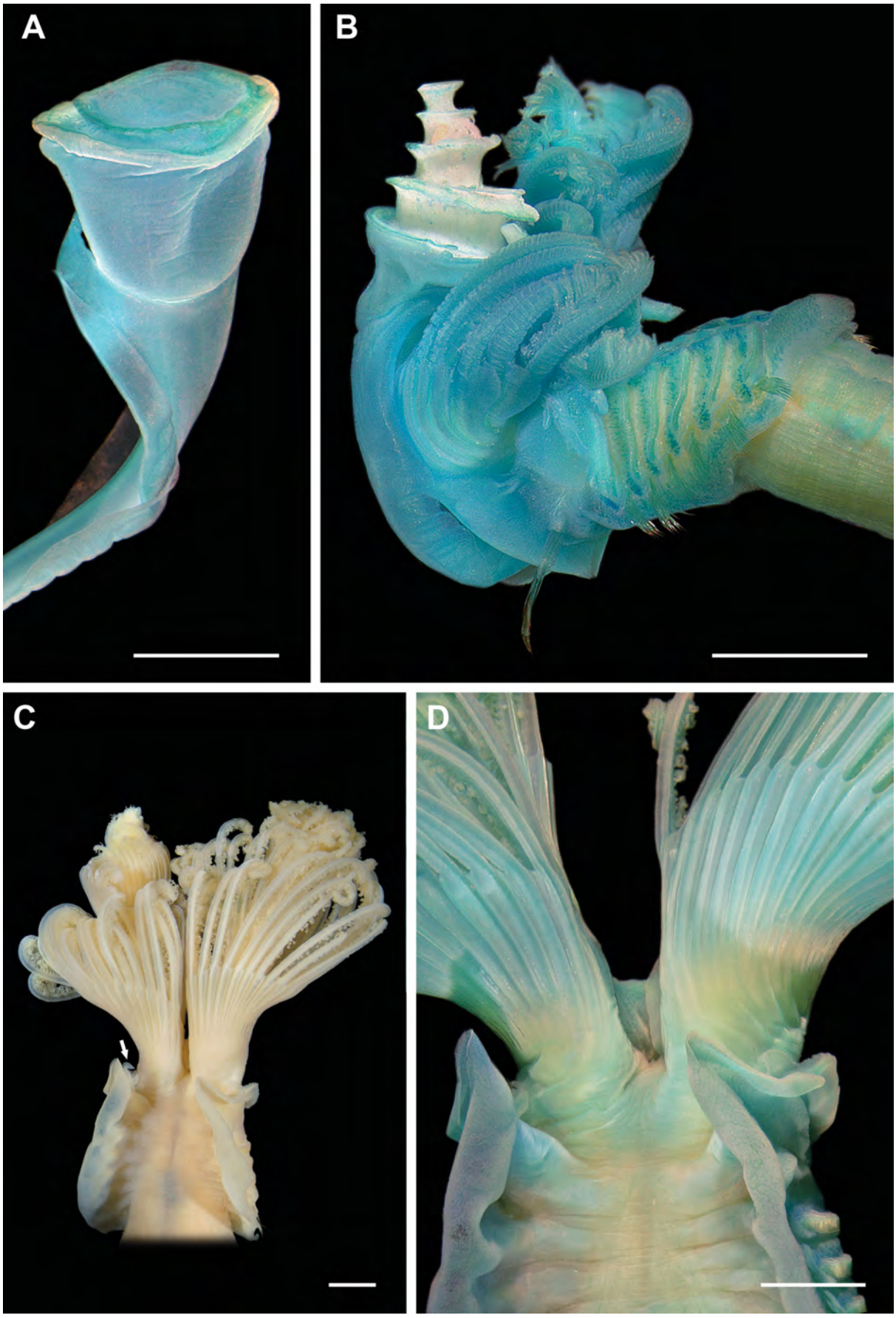

FIGURE 29. A. *Spirobranchus latiscapus*, operculum of fixed specimen (stained with methyl green), **AM** W.201802; B. *Sp. latiscapus*, anterior end (stained with methyl green), **AM** W.201837; C. *Sp. nigranucha,* dorsal view of radiolar crown showing lack of peduncle (arrow indicates a tonguelet), **AM** W.41948; D. Close-up view of the same specimen (stained with methyl green). Photo: A–D—E. Wong. Scale bars: A–D = 1 mm.

Diagnosis. Operculum or scar of peduncle absent, yellowish orange radioles in 4–5 whorls, clear reniform eyes at base, tube deeply embedded inside *Acropora* colonies. A further distinction with *Protula bispiralis* is the presence of tonguelets between latero-dorsal and ventral collar parts in *Spirobranchus* (Fig. 25C, D).

Remarks. *Sp. nigranucha* is unique among all *Spirobranchus* spp. because it lacks an operculum.

Distribution. Ternate, Indonesia, Indo-West Pacific. New record for Australia.

Spirobranchus cf. *polytrema* (Philippi, 1844)

(Fig. 30A, B)

Vermilia polytrema Philippi, 1844: 194. Pl. 6, fig. N [Mediterranean; original combination, however, probably different species].

Not *Temporaria polytrema.*—Straughan 1967a: 239 [NSW, Australia; at least for the larger part split and redescribed as *Sp. pseudopolytremus* Pillai, 2009 (p. 176–178, fig. 56A–I) and *Sp. zibrowii* Pillai, 2009 (p. 188–190, fig. 63A–L)].

Temporaria polytrema.—Pillai 1971: 94–96, fig. 3A–D [Sri Lanka].

Temporaria oligotrema Straughan, 1967b: 240–241, fig. 13 a–1 [Noosa Heads, Qld; description, *cf.* Type A of Imajima; holotype and other material restudied by HAtH 1996, **AM** W.4026, **AM** W.4046].

Spirobranchus cf. *polytrema.*—Imajima 1977: 102–104, fig. 8a–j [Ogasawara Islands, Japan; description of two types, A & B]; 1978: 56 [O-Shima, Japan]; 1979: 177 [Honshu, Japan; types A and B]; 1987: 79 [Okinawa, Japan]; Imajima & ten Hove 1986: Fiege & Sun 1999: 126–129, fig. 16A–G [Hainan Island, South China Sea; description of types A & B]; Sun & Yang 2001a: 200–201, fig. 10A–L [Fujian; Hainan Island].

Spirobranchus cf. *polytrema* not (Philippi, 1844), Type A *sensu* Imajima.—Sun *et al*. 2012a: 30–32, figs 14A–C, F, 15A–E [Hong Kong; description, discussion].

Spirobranchus cf. *polycerus* not (Schmarda, 1861).—Sun & Yang 2001a: 188–199, fig. 9 [South China Sea].

Spirobranchus polytrema.—Hartmann-Schröder 1979: 154, fig. 369 [Port Hedland, WA, Australia]; Imajima & ten Hove 1986: 8 [Solomon Islands].

Spirobranchus cf. *polytremus.*—Pillai 2009: 153–154, fig. 40D–F [WA, Australia; type A *sensu* Imajima].

Material examined. AM W.28322, stn.17, Palfrey Island, south of lighthouse, 14°40'S, 145°28'E, coll. H. ten Hove & P. Hutchings, 1 Mar 1986; **AM** W.28430, between First Beach and Osprey Island, 14°40'09"S, 145°26'36"E, dead corals and rubble in sand, coll. H. ten Hove, 17 Jun 1983; **AM** W.42053, stn.G246, Granite Bluff, 17 m, G. Rouse & E. Kupriyanova, 3 Nov 2005; **SAM** E3611, Ser98, stn.G231, Lizard Island, Coconut Beach, 14°41'S, 145°28'E, G. Rouse & E. Kupriyanova, 26 Oct 2005; **MAGNT** W025502 (as *Pseudovermilia pacifica*), Yonge Reef, 14°34'30"S, 145°36'18"E, coll. C. Glasby, 20 Apr 2008; **ZMA** V.Pol. 4886 (4, as *Sp. oligotrema*, Type B), Mermaid Cove, on reef, depth 6–10 m, from crevices in dead coral, coll. H. ten Hove, 20 Jun 1983, det. D. Makhan 1985; **ZMA** V.Pol. 4887 (7, as cf. *polytrema*, Type B), stn.16, North Point, sloping reef, mainly dead, slightly silted corals, 3–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986; **ZMA** V.Pol. 4860 (2, as cf. *polytrema*, Type B), lagoon near east entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, stn.18, 3/4 Mar 1986; **ZMA** V.Pol. 4880 (as cf. *polytrema*, Type B), Turtle Beach, steeply sloping reef above sand bottom, 6–8 m, from dead & living corals, coll. H. ten Hove, 18 Jun 1983.

Diagnosis. Calcareous part of operculum variable in shape, from almost simple plate with two dorsal knobs only to conical or even a diabolo; never with spines. Peduncular wings either with 4–6 digitate processes or simple narrow without such processes (exceptionally with 2 fingerlike processes). Tube one to three longitudinal keels flanked by rows of foramina (pits).

Remarks. The occurrence of the temperate/subtropical Atlantic/Mediterranean species *Spirobranchus polytrema* (Philippi, 1844) in the tropical Indo-West Pacific is rather doubtful (discussions in Imajima (1977: 106) and Pillai (2009: 153)). Likely this material will prove to be genetically different, therefore, we prefer to indicate this taxon with *Sp.* cf. *polytrema*. Records of *Spirobranchus* cf. *polytrema* from the Indo-West Pacific include two morphotypes, type A and type B (Imajima 1977; also in Fiege & Sun 1999), differing in the distal calcareous opercular cone, peduncular wings with or without digitate processes and expression of longitudinal rows of foramina in the tube. Our material resembles type B in the shape of peduncular wings and tube. However, Straughan's material (of *Temporaria oligotrema*) mostly is conform Imajima's type A, with many foramina (contrary to the name which suggests few; in fact the tube is indistinguishable from that of *Spirobranchus minutus* Rioja, 1941), as well as Hartmann-Schröder's (1979) from Western Australia, Pillai's (1971) material from Sri Lanka and that of Sun & Yang (2001a) from the South China Sea. Under the Caribbean name *Sp.* cf. *polycerus* the

latter authors describe a form with intermediate characters between Types A and B. Some of Straughan's material identified as *oligotrema* and restudied by one of us (HtH, between 1983 and 2005, unpublished) probably belongs to *Sp. corrugatus* or even juvenile *corniculatus* or *tetraceros*. A complete revision is badly needed but falls out of the scope of this paper. The specific name *polytrema* is a noun in apposition and need not get the same ending as the generic name (contrary to Pillai 2009), see Article 34.2.1 of ICZN (1999).

Distribution. The nominal species is quite common in the Mediterranean, Atlantic; however, records from the Indo-West Pacific form probably a complex of species by themselves.

Spirobranchus richardsmithi Pillai, 2009

(Fig. 28C)

Spirobranchus richardsmithi Pillai, 2009: 154–158, figs 41A–N, 42A–H, 43A–K [Kimberley, WA].

Spirobranchus gardineri not Pixell, 1913.—Smith 1985: 43–47, fig. 3I–L [Lizard Island, Australia; *partim*, variant types 1 and 2 only]; Fiege & ten Hove 1999: 362–363 [in part; discussion and mention of 2 taxa under this name; the material from Hainan Island belongs to *Sp. richardsmithi*]; Fiege & Sun 1999: 126, fig. 15A, B [Hainan Island, China].

Material examined. AM W.41735, Yonge Reef, 14°35'S, 145°37'E, in *Millepora* sp., coll. R. Smith, Nov 1985; **AM** W.41740, Yonge Reef, back reef, 14°36'S, 145°37'E, on *Sp. gardineri*, coll. R. Smith, 7 Nov 1985; **AM** W.41743, same, in *Porites* sp., coll. R. Smith, Nov 1985; **AM** W.41744, same, in *Millepora*, coll. R. Smith, Nov 1985; **AM** W.41745, same, in *Millepora*, coll. R. Smith, Nov 1985; **AM** W.41750, same, coll. R. Smith, 6 Nov 1985; **AM** W.41803, same, in *Millepora*, coll. R. Smith, Nov 1985; **AM** W.41807, same, in *Millepora*, coll. R. Smith, Nov 1985; **AM** W.41828, same, in *Millepora*, coll. R. Smith, Nov 1985; **AM** W.41914 (many), same, coll. R. Smith, Nov 1985; **AM** W.41918, same in *Millepora*, coll. R. Smith, Nov 1985; **AM** W.41956 (2), same, in *Porites lichen*, coll. R. Smith, Nov 1985; **AM** W.45427, MI QLD 2447; **SAM** E3610 (as *S. gardineri*), Ser92, stn.G231, Coconut Beach, 14°41'S, 145°28'E, scuba, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005; **ZMA** V.Pol. 4829 (3), stn.18, lagoon near east entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, 3 Mar 1986; **ZMA** V.Pol. 4830 (2, det HtH 1986 as *Sp. gardineri*-complex), stn.17, Palfrey Island, south of lighthouse, 14°40'S, 145°28'E, coral heads on sandy bottom, 7 m, coll. H. ten Hove, P. Hutchings & M. Reid, 2 Mar 1986.

Diagnosis. Opercular plate bearing a column ending in a pair of latero-dorsal spines with tips almost curving upright and a bifid medio-ventral spine with tips recurving towards opercular plate. Latero-dorsal spines each bear three short spinules, one single located latero-ventrally and clearly recurving towards opercular plate, the other pair located sub-terminally, not recurving. Peduncle with wide distal wings with entire edge (no processes).

Remarks. See remarks under *Sp. gardineri.*

Distribution. Widely distributed in the Indo-West Pacific.

Spirobranchus tetraceros (Schmarda, 1861)

(Fig. 30C, D)

Pomatoceros tetraceros Schmarda, 1861: 30, plate 21 fig. 179 [NSW, Australia].

Pomatoceros tetraceros.—Beesley *et al.* 2000: 8, Fig. 1.6B [reproduction of Schmarda's original figure].

Pomatoceros elaphus Haswell, 1885: 663–665, pl. 31 fig. 7, pl. 32 figs 9–10 [Port Jackson, NSW].

Spirobranchus semperi.—Augener 1913: 82 [Sharks Bay, WA; extensive description]; 1914: 148–142 [same]; Straughan 1967b: 246–247 [Qld, Australia; diagnosis].

Spirobranchus tetraceros.—Johansson 1918: 7–10, fig. 2 [Cape Jaubert, WA]; ten Hove 1970: 3–13, 47–49, figs 1–25 [synonymy, in part; see Remarks]; Imajima & ten Hove 1984: 51–52 [Truk Islands, Ponape and Majuro Atoll; Lizard Island, Qld and Capes Farquhar and Jaubert, WA]; Pillai 2009: 158–162, fig. 44A–C, 45A–I, 46A–K [Kimberley, WA, Australia].

Spirobranchus giganteus not (Pallas, 1766).—Dew 1959: 45, fig. 17 [at least in part, see Remarks].

Spirobranchus tricornis.—Straughan 1967a: 39 [Qld; diagnosis]; 1967b: 244, fig. 14b–d [NSW, Qld, Australia; diagnosis].

Spirobranchus coutierei.—Straughan 1967c: 224, fig. 1a–d [NT, Australia; diagnosis].

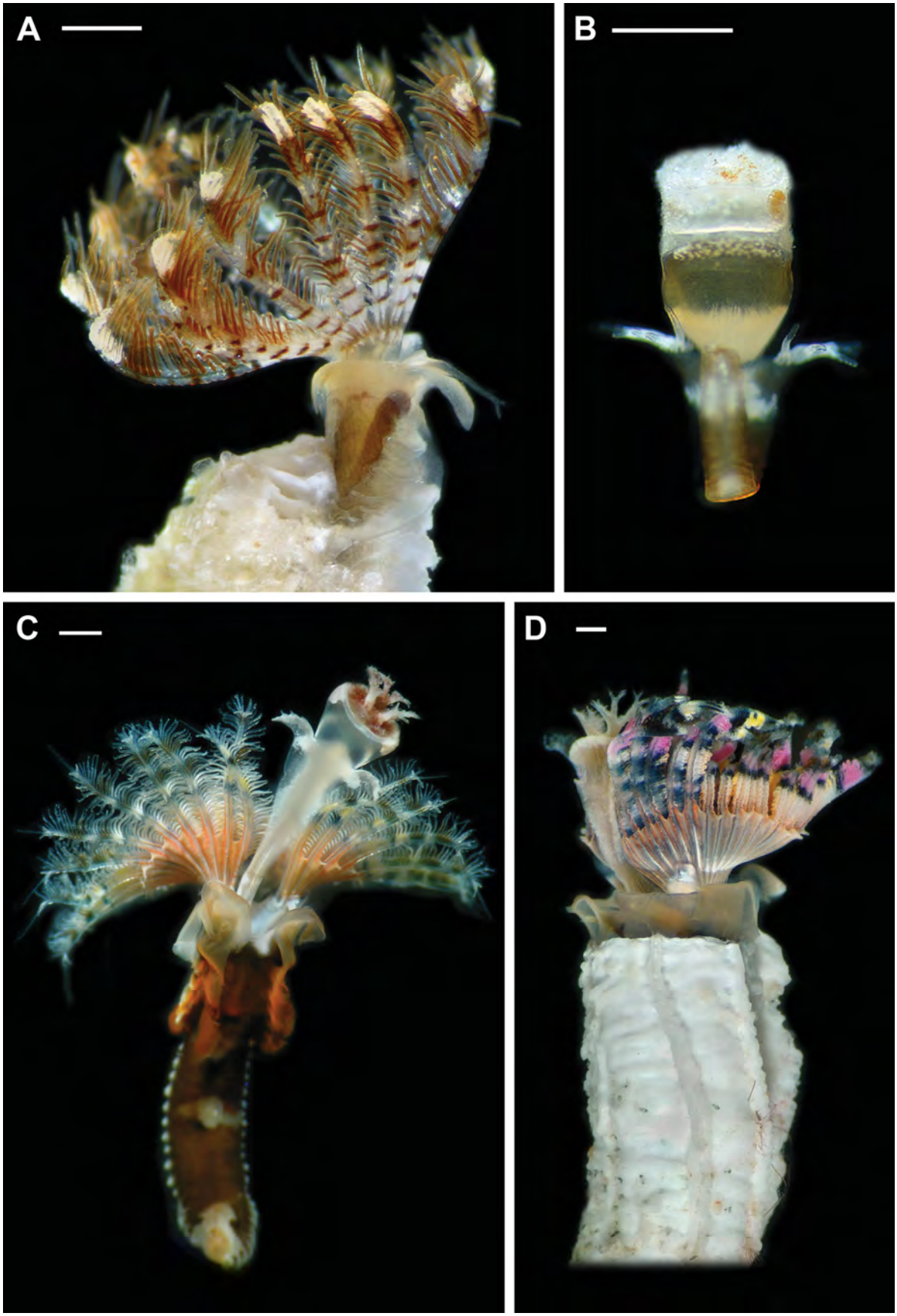

FIGURE 30. *Spirobranchus polytrema.* A. Radiolar crown of live animal, stn.G231, **SAM** E3611; B. Operculum of the same specimen; C. *Sp. tetraceros*, live animal removed from tube, stn.G247, **ZMA** V.Pol. 5317; D. *Sp. tetraceros*, live animal in tube, stn.G237, **SAM** E3609. Photo: A–D—G. Rouse. Scale bars: A–D = 1 mm.

Material examined. AM W.28328 (6), stn.16, North Point, 14°40'S, 145°28'E, sloping reef with mainly dead & thinly silted corals, 17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986; **AM** W.41819 (2), Yonge Reef, back reef patch, 14°36'S, 145°37'E, coll. R. Smith, 11 Nov 1985; **AM** W.41830 (4), Yonge Reef, back reef bommie, 14°36'S, 145°37'E, in *Stylophora pistillata*, coll. R. Smith, 7 Nov 1985; **AM** W.42352, Yonge Reef, back reef, 14°36'S, 145°37'E, coll. R. Smith, 7 Nov 1985; **AM** W.45073, MI QLD 2417; **AM** W.47304, North Direction Island, Fore Reef, 14°44'48"S, 145°30'18"E, coral rubble, 12 m, coll. M. Blazewicz-Paskowycz, 24 Feb 2009; **AM** W.47349, inter-reef sand, 14°23'24"S, 145°16'24"E, artificial substrate, 10 m, coll. M. Timmers, 9 Feb 2009; **MAGNT** W025492, North Point, Fore Reef, 14°38'42"S, 145°27'12"E, coral rubble, 2 m, coll. C. Watson, 12 Apr 2008; **SAM** E3609, Ser91, stn.G231, Coconut Beach, 14°41'S, 145°28'E, scuba, coll. G. Rouse & E. Kupriyanova, 26 Oct 2005; **ZMA** V.Pol. 4883 (as *Sp. oligotrema,* juvenile), North Reef, 14°40'S, 145°27'E, underside of boulders on rock, low tide, little sand, coll. H. ten Hove, 22 Jun 1983; **ZMA** V.Pol. 4897 (10), stn.18, lagoon near east entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, 3 Mar 1986; **ZMA** V.Pol. 4911 (9), Turtle Beach, from underside of dead & living corals, generally fairly cryptic, about 6 m, coll. H. ten Hove, 22 Jun 1983; **ZMA** V.Pol. 5317, stn.G247, channel near Bird Islet, 10 m, coll. G. Rouse & E. Kupriyanova, 3 Nov 2005; **ZMA** V. Pol 5322, stn.G237, Patch Reef near Palfrey Island, 6 m, coll. G. Rouse & E. Kupriyanova, 30 Oct 2005.

Diagnosis. Opercular plate mostly flat, sometimes conical; basally carrying 1 medio-ventral spine and 2 latero-dorsal spines ("*tricornis*"); alternatively the medio-ventral spine appears as two fully separate spines which with the two latero-dorsal spines leads to 4 primary spines ("*tetraceros*"). All spines are at least split once, generally twice or three times resulting in 6–14 spine tips. Completely conical opercula just with 3 rudimentary spines or without. Peduncular wings with finger-like processes distally (rarely without).

Remarks. We have refrained from giving an exhaustive list of synonyms and given some "trusted" Australian records only. This taxon is regarded to be a complex of species in recent years (e.g., Smith 1985: 51–61; Fiege & ten Hove 1999: 362; ten Hove & Kupriyanova 2009: 12, 98; Ben-Eliahu & ten Hove 2011: 91). Its synonymy is very complicated and far from settled. WoRMS (http://www.marinespecies.org/polychaeta/aphia.php?p=taxdetails &id=131055)—based mainly on ten Hove (1970) as last revision and not fully taking into account Pillai (2009)—lists for this species 33 combinations (including spelling errors) of names, under essentially 8 generic and 17 specific names, as well as 4 more likely synonyms in the remarks. This does not even take into account the frequent misidentifications of Indo-West Pacific material ranging from *Pomatoceros triqueter* (Linnaeus, 1758) to *Spirobranchus giganteus* (Pallas, 1776). Ben-Eliahu & ten Hove (2011: 91) give an extensive discussion. The (certainly partly anthropogenic) distribution is very unlikely for a single species in our present view: circumtropical, Lessepsian migrant to the Levantine Mediterranean and in Australia down to subtropical/temperate New South Wales, moreover from intertidal rocks to endobiotic in corals.

Indicative of the problems in this taxon is Dew's (1959: 45–46) record. Following e.g., Fauvel (1933a: 78–79, Gulf of Suez, Gulf of Aqaba) and Monro (1937: 317, Arabian Sea) she identified her material as *Sp. giganteus.* However, her figure 17 clearly belonged to *Sp. tetraceros* as well as her essentially NSW samples, while (part of) her material from Queensland belonged to what we presently would attribute to *Sp. corniculatus* (material largely restudied by HtH in 1970, 1986). Straughan (1967a, b, c) attributed three different names to her material, but checking that ten Hove (1970: 47–49) could not find consistent agreement between morphology and attributed names.

Distribution. Indo-West Pacific, including Australia (NSW, Qld, WA).

Genus *Vermiliopsis* Saint-Joseph, 1894

Type-species. *Vermilia multivaricosa* Mörch, 1863, new name for *Vermilia infundibulum sensu* Philippi, 1844

Diagnosis. (from ten Hove & Kupriyanova 2009). Tube white, opaque, circular to sub-quadrangular in cross-section; generally with 3–7 longitudinal keels and peristomes. Granular overlay absent. Operculum an inverse conical ampulla, with flat to conical chitinous endplate, sometimes a partitioned cap. Peduncle wrinkled, cylindrical, separated from opercular ampulla by a constriction; without distal wings, but a proximal wing may be present. Peduncle ontogenetically formed from second dorsal radiole on one side, but in adults at base of branchial crown covering 3–6 normal radioles. Pseudoperculum generally absent (but present as under-developed second radiole in *V. striaticeps*). Radioles arranged in (semi-)circles, up to 20 per lobe. Inter-radiolar membrane absent.

Branchial eyes (single pigmented ocelli) along dorsal side of rhachis. Stylodes absent. Mouth palps may be present. 7 thoracic chaetigerous segments present. Collar trilobed, tonguelets absent. Thoracic membranes short, continuing to 3rd–5th thoracic chaetiger. Collar chaetae limbate. *Apomatus* chaetae present. Thoracic uncini saw-shaped with up to 10–15 teeth above blunt indented peg. Triangular depression present. Abdominal chaetae flat narrow geniculate, with a more or less crenulated edge (rounded teeth) to the blade. Abdominal uncini rasp-shaped, anterior peg blunt. Achaetous anterior abdominal zone absent. Long posterior capillary chaetae present. Posterior glandular pad present.

Remarks. The genus *Vermiliopsis* is ill-defined, and designation of a neotype is unavoidable. The binomen *Vermiliopsis infundibulum* generally has been used for Mediterranean-Lusitanian forms, and only rarely for Indo-Pacific forms which normally have been identified as *Vermiliopsis glandigera/us* Gravier, 1906a or *Vermilia/ Vermiliopsis pygidialis* Willey, 1905. More extensive discussions on the taxonomic problems in this group have been given by ten Hove (1975: 55–59), ten Hove & Kupriyanova (2009: 100–101), Pillai (2009: 104–109), and Ben-Eliahu & ten Hove (2011: 95–96). Pillai (2009) added yet another name (*V. cylindindrica* Pillai, 2009) from Western Australia to the number of available names, based on the fact that this material had a cylindrical operculum, which should be "domeshaped or conical in the other known species of *Vermiliopsis*". However, such cylindrical opercula have been reported in the literature for other nominal taxa in the complex as well (e.g., Augener 1906 fig. 154 for his nominal species *V. annulituba* from the Caribbean; Saint-Joseph 1894 pl. 5 fig. 116, Bianchi 1981 fig. 1; 1981 fig. 25h for *V. infundibulum* (Philippi, 1844) from the Mediterranean; Imajima 1976b fig. 11a, f; Fiege & Sun 1999 fig. 21C, D; Sun & Yang 2001a fig. 12C for *V. infundibulum/glandigera* from the Indo-West Pacific), thus the validity of Pillai's new species should be checked. He, however, attributed most of his other material (and many other Indo-West Pacific records) of *Vermiliopsis* to *V. glandigera* Gravier, 1906a. See further remarks on the *Vermiliopsis glandigera/pygidialis*-complex below. We only have given some well illustrated literature records, as well as Australian references.

Vermiliopsis glandigera/pygidialis-complex

(Fig. 31A–C)

Vermiliopsis glandigera Gravier, 1906a: 112–113 [Red Sea; description].

Vermiliopsis glandigera.—Gravier 1906b pl. 8 figs 290–291 [same]; 1908: 121–124, figs 476–481 [same]; Pillai 2009: 103–108, figs 5A–E, 6A–L, 7A–N [Western Australia; description].

? *Vermiliopsis glandigera*.—Monro 1939: 150–151 [Tasmania; description].

Vermiliopsis pygidialis.—Dew 1958: 54–57 [Aquarium at Taronga Zoo, Sydney, NSW, Australia]; Kupriyanova *et al.* 2006: 423, table 1, figs 4–7 [Qld, Australia; DNA].

Vermiliopsis infundibulum (not Philippi, 1844).—Straughan 1967a: 233–234; 1967b: 35 [Qld, Australia]; 1967c: 222 [NT, Australia]; Knox & Cameron 1971: 40 [Vic, Australia; name].

Vermiliopsis infundibulum/glandigera.—ten Hove 1975: 55–59 [discussion of the complex]; Imajima 1976b: 139–141, fig. 11a–o [description; Tanega-shima, Japan]; Fiege & Sun 1999: 133, fig. 21A–E [Hainan Island, China].

? *Vermiliopsis cylindrica* Pillai, 2009: 100–103, figs 3A–N, 4A–E [Western Australia; description].

Material examined. AM W.198921, stn.77 LIZ C15-21-2, lagoon drop-off between Bird Islet and South Island, 14°42'S, 145°28'E, coll. P. Hutchings & P. Weate, Oct 1978, det. H. ten Hove; **AM** W.28300 (4), Turtle Beach, 14°40'S, 145°27'E, underside of dead & living corals, fairly cryptic, coll. H. ten Hove, 22 Jun 1983; **AM** W.28310, Mermaid Cove, 14°40'S, 145°28'E, underside of boulders in surf, subtidal and low intertidal, coll. H. ten Hove, 20 Jun 1983; **AM** W.28332, Mermaid Cove, 14°40'S, 145°28'E, from crevices in dead coral, 20 Jun 1983, coll. H. ten Hove; **AM** W.28333 (several), outer reef off Lizard Island, 14°40'S, 145°28'E, coll. H. ten Hove & P. Hutchings, 10 Mar 1986; **AM** W.28420, between First Beach and Osprey Island, 14°40'09"S, 145°26'36"E, dead corals and rubble in sand, 4 m, coll. H. ten Hove, 17 Jun 1983; **AM** W.28425 (several), between Lizard Head and Coconut Beach, 14°40'S, 145°28'E, undersides of boulders on rock, little sand, low tide, coll. H. ten Hove, 23 Jun 1983; **AM** W.28428 (2), stn. 21, south of South Island, 14°40'S, 145°28'E, coll. H. ten Hove, 6 Mar 1986; **AM** W.28444, stn.19, Turtle Beach, 14°40'S, 145°27'E, intertidal, boulders in sand, coll. H. ten Hove, 5 Mar 1986; **AM** W.38608 (few), North Point, 14°40'S, 145°28'E, coll. P. Hutchings, 9 Mar 1986, det. H. ten Hove; **AM** W.42055, stn.G241, off Osprey Island, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **AM** W42064 (3), stn.G248, Patch Reef, coll. G. Rouse & E. Kupriyanova, 4 Nov 2005; **AM** W.42069 (3), stn.G229, near Bird Islet, 7–8 m, coll. G. Rouse & E.

Kupriyanova, 24 Oct 2005; **AM** W.43965, MI QLD 2337; **AM** W.44046, MI QLD 2336 (2); **AM** W.43966, MI QLD 2336; **AM** W.44047, MI QLD 2337; **AM** W.44235, MI QLD 2370 (2); **AM** W.43971, MI QLD 2356 (4); **AM** W.44225, MI QLD 2359; **AM** W.44533, MI QLD 2375 (6); **AM** W.44535, MI QLD 2381 (2); **AM** W.44543, MI QLD 2390 (3); **AM** W.45054, MI QLD 2406 (21); **AM** W.45057, MI QLD 2406 (2); **AM** W.45066, MI QLD 2413 (2); **AM** W.45067, MI QLD 2413 (20); **AM** W.45072, MI QLD 2417(3); **AM** W.45088, MI QLD 2424; **AM** W.45091, MI QLD 2435 (4); **AM** W.45116, MI QLD 2446 (4); **AM** W.45421, MI QLD 2447; **AM** W.47302, Snake Pit, Deep Reef slope, 14°40'12"S, 145°34'06"E, coral rubble, 30 m, coll. J. Caley & S. Smith, 24 Feb 2009; **AM** W.47307, front of Deep Reef, 14°30'06"S, 145°30'30"E, coral rubble, 30 m, coll. J. Caley & K. Mills, 21 Feb 2009; **AM** W.47308, same; **AM** W.47310, Day Reef, 14°28'30"S, 145°32'12"E, coral rubble, 30 m, coll. S. Smith, 22 Feb 2009; **AM** W.47312, same, 10 m, coll. M. Blazewicz-Paskowycz, 13 Feb 2009; **AM** W.47316, North Direction Island, Deep Reef slope, 14°44'36"S, 145°30'54"E, coral rubble, 2 m, coll. C. Watson; **AM** W.47342, Hicks Reef Outer Barrier, Fore Reef, 14°28'48"S, 145°29'12"E, coral rubble, 2–18 m, coll. C. Watson & K. Mills, 14 Feb 2009; **AM** W.47350, inter-reef sand, 14°23'24"S, 145°16'24"E, artificial substrate, 10 m, coll. M. Timmers, 9 Feb 2009; **AM** W.47355, inter-reef sand, 14°23'24"S, 145°16'24"E, artificial substrate, 10 m, coll. M. Timmers, 10 Feb 2009; **AM** W.47359, southwest of Palfrey Island, lagoon, 14°41'36"S, 145°26'30"E, coral rubble, 4 m, coll. M. Ekins, 13 Apr 2008; **AM** W.47587 (2), stn.G246, off Granite Bluff, 17 m, coll. G. Rouse & E. Kupriyanova, 3 Nov 2005; **AM** W.47456 (16), stn.G241, off Osprey Island, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **AM** W.47573, stn.G242, east lagoon near Bird Islet, 14°0'S, 145°0'E, coll. G. Rouse & E. Kupriyanova, 1 Nov 2005; **MAGNT** W025497, North Head Reef, Fore Reef, 14°38'42"S, 145°27'12"E, coral rubble, 12 m, coll. C. Glasby, 14 Apr 2008; **SAM** E3590, stn.G240, intertidal rubble zone, Osprey Island, coll. G. Rouse & E. Kupriyanova, 31 Oct 2005; **ZMA** V.Pol. 4941 (2), Turtle Beach, steeply sloping reef above sand bottom, 6–8 m, from dead & living corals, coll. H. ten Hove, 18 Jun 1983; **ZMA** V.Pol. 4942 (14), Granite Head, 14°39'S, 145°27'E, underside of boulders on rock, little sand, subtidally, coll. H. ten Hove, 18 Jun 1983; **ZMA** V.Pol. 4949 (many), between Research Point and Freshwater Beach, in lagoon, subtidally, dead coral cobbles on sand, ca. 1 m, coll. H. ten Hove, 16 Jun 1983; **ZMA** V.Pol. 4951 (35), stn.18, lagoon near east entrance, sheltered side of reef, near sandy bottom, 2–20 m, coll. H. ten Hove, 3 Mar 1986; **ZMA** V.Pol. 4953 (8), stn.21, south of South Island, 14°42'S, 145°28'E, sloping silty reef, little coral cover, 18–20 m, coll. H. ten Hove & P. Hutchings, 6 Mar 1986.

Diagnosis. Operculum a soft basal ampulla and a distal brown chitinous cap, which may be elongated and divided into up to 7 layers by partitions. Cap conical or flat, then often with simple terminal spinelet. Peduncle cylindrical or slightly compressed and wrinkled (see, however, remarks). Tube semicircular to trapezoidal in cross-section, rugose, generally with 4 (3–7) longitudinal keels and some peristomes.

Remarks. In addition to the generic remarks, above, we want to draw the attention to the following observations. Some of Dew's specimens (1958: 54–57) from the aquarium at Taronga Zoo were restudied by one of us (HtH, 1975) and were exceptional in the presence of a kind of pseudoperculum. This character only has been reported for the Mediterranean/Atlantic taxon *Vermiliopsis striaticeps* (Grube, 1862), see ten Hove & Kupriyanova (2009: 14). Since this character hardly ever has been mentioned in the literature, its value should be checked in a very necessary revision of the genus. The same applies to the absence/presence of "wings" on the opercular peduncle, clearly present in the syntypes of *Vermiliopsis glandigera* Gravier, 1906a, though not mentioned in the original description (see ten Hove & Kupriyanova 2009: 22). Molecular genetic studies are needed to resolve the complex.

Reproduction. Specimen from **SAM** E3590 was found brooding lecithotrophic larvae in the tube.

Distribution. Unknown, likely Indo-Pacific.

Vermiliopsis labiata (Costa, 1861)

(Fig. 31D)

Serpula labiata Costa, 1861: 32, pl. 7, fig. 2 [Italy, Mediterranen Sea; diagnosis].

Vermiliopsis labiata.—Zibrowius 1972: 117–118, fig. 1 [transfer to *Vermiliopsis*; interesting synonymy and discussion]; 1973: 45–46 [West Africa, Indian Ocean; diagnosis]; Imajima 1977: 95–97, fig. 4 [Ogasawara Islands, Japan; description]; 1978: 57 [Izu Islands, Japan]; 1979: 170 [Ogasawara Islands, Japan]; 1987: 81 [Okinawa, Japan]; 1997: 214 [Suruga Bay, Japan]; 2006: 395 [Sagami Bay, Japan]; Imajima & ten Hove 1984: 55, 58 [Ponape]; ten Hove & Kupriyanova 2009: 15, 102 [name only].

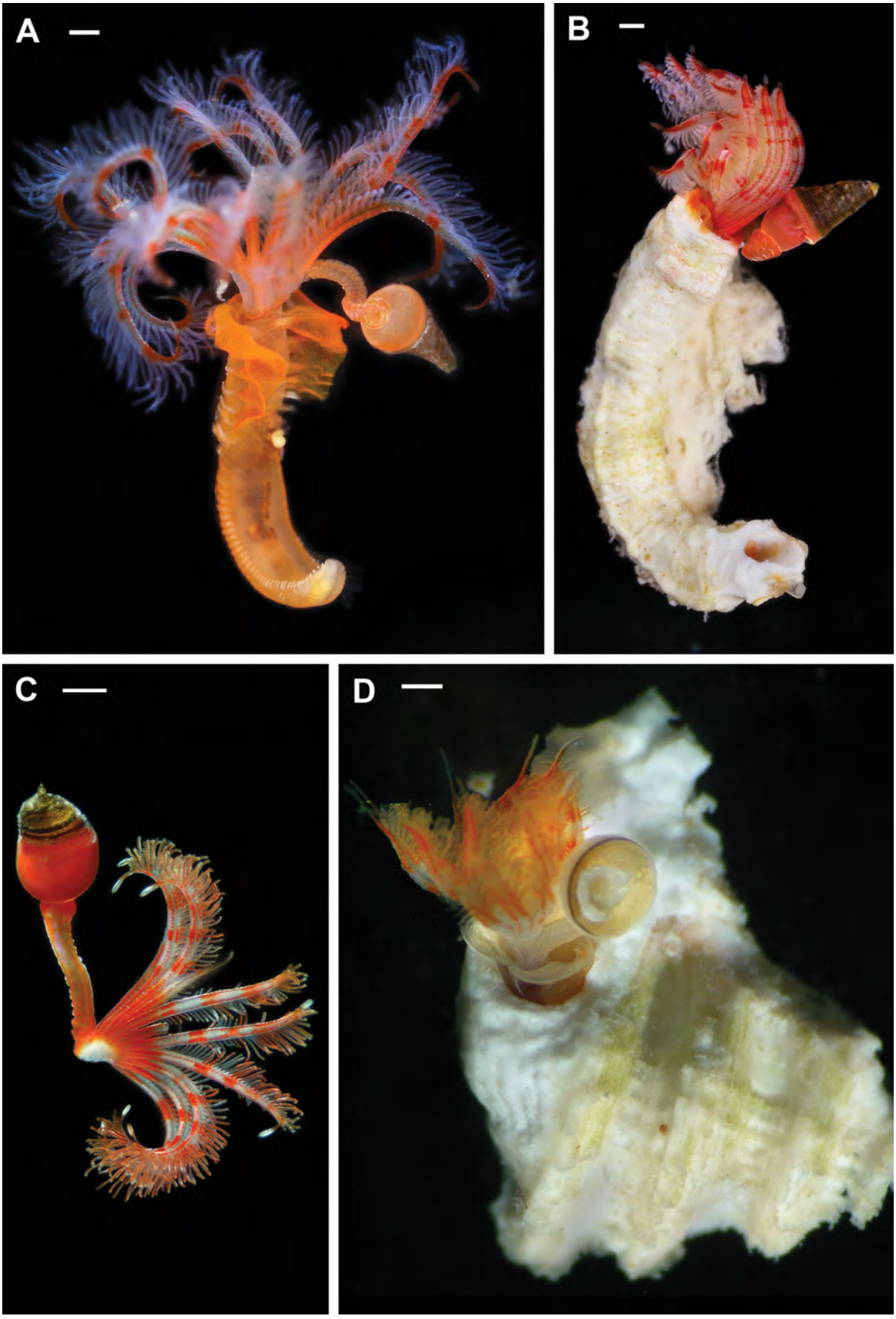

FIGURE 31. *Vermiliopsis glandigera/pygidialis*-complex. A. Live animal removed from the tube, **AM** W44047; B. Live animal in tube, **AM** W44046; C. Details of radiolar lobe bearing operculum, stn.G229, **AM** W.42069; D. *Vermiliopsis labiata*, live animal in tube, stn.G244 **SAM**. Photo: A, B—A. Semenov, C, D—G. Rouse. Scale bars: A–D = 1 mm.

Material examined. SAM stn.G244, south of South Island, coll. G. Rouse & E. Kupriyanova, 2 Nov 2005; **ZMA** V.Pol. 4690, stn.16, North Point, sloping reef, mainly dead, slightly silted corals, 3–17 m, coll. H. ten Hove, P. Hutchings & M. Reid, 1 Mar 1986; **ZMA** V.Pol. 4691, stn.21, south of South Island, 14°42'S, 145°28'E, sloping silty reef, little coral cover, 18–20 m, coll. H. ten Hove & P. Hutchings, 6 Mar 1986.

Diagnosis. Chitinous endplate of the operculum concave, reinforced distally with calcareous matter like a coral-theca. Robust tube with several longitudinal ridges and thick transverse former peristomes.

Remarks. This is another species originally described from the Mediterranean. The tube and operculum are really distinguishing, but DNA might, probably will, show them to be different from the Mediterranean species.

Distribution. Mediterranean, tropical Atlantic, Indo-West Pacific.

Key to serpulids from Lizard Island

1.	Body symmetrical, tubes not coiled into flat spirals	2
-	Body asymmetrical, tubes coiled into flat spirals	spirorbins
2. (1)	Tube (semi) transparent, collar region with a band of reddish ocelli.	*Placostegus* sp. (Fig. 14B, C)
-	Tube opaque, collar region without reniform band of reddish ocelli.	3
3. (2)	Operculum present	4
-	Operculum absent	38
4. (3)	Stylodes on radioles present.	*Dasynema chrysogyrus* (Fig. 1C)
-	Stylodes on radioles absent	5
5. (4)	Tubes only about 0.1 mm wide, operculum delicate membranous cup with a flat distal surface surmounted by a marginal crown of fine teeth joined by a transparent membrane; borne on normal pinnulated radioles	*Josephella marenzelleri* (Fig. 12)
-	Tubes 0.1–7 mm in diameter, operculum otherwise, borne on smooth (lacking pinnules) peduncle	6
6. (5)	Tubes no more than 0.1 mm, operculum pear-shaped, laterally compressed, bearing chitinous (infolded) plate with multiple spines	*Rhodopsis pusilla* (Fig. 18A)
-	Tubes maybe more than 0.1 mm, operculum otherwise	7
7. (6)	Peduncle flat, ribbon-like.	*Metavermilia* 8
-	Peduncle cylindrical.	10
8. (7)	Operculum simple globular, covered with simple chitinous convex distal cap; tube with 5–7 longitudinal keels and some transverse annuli	*M. multicristata*
-	Operculum complex, distal part composed of 4–10 parallel tiers or disks fringed by simple or bifurcated spines	9
9. (8)	Distal chitinous part of the operculum terminates with unadorned disk; tube with 5–9 longitudinal keels	*M. nates* (Fig. 13C, D)
-	Distal chitinous part of the operculum terminates with a single distal spine or hook; tube with one or three irregular longitudinal keels	*M. acanthophora* (Fig. 13A, B)
10. (7)	Peduncle without well-developed membranous distal lateral wings	11
-	Peduncle with well-developed membranous distal lateral wings	24
11. (10)	Pseudoperculum (rudimentary operculum) present, functional operculum consisting of basal funnel of fused radii with or without distal verticil (crown) of chitinous spines.	12
-	Pseudoperculum (rudimentary operculum) absent, functional operculum otherwise	32
12. (11)	Operculum two-tiered, with proximal funnel of fused radii and distal verticil (crown) of chitinous spines.	*Hydroides* 13
-	Operculum a simple funnel made of fused radii	20
13 (12)	Spines of opercular verticil all similar in size and shape, no special dorsal spines	14
-	Spines of opercular verticil dissimilar, one or two dorsal spines distinctly different	15
14. (13)	13–15 verticil spines with straight tips, each with 4–6 lateral spinules and 4–6 internal spinules; central tooth short	*H. longispinosa* (Fig. 6)
-	7–8 verticil spines with tips curved outwards, each with a pair of outwardly curved lateral spinules and an internal spinule, central tooth absent	*H. tambalagamensis* (Fig. 9)
15. (13)	Large dorsal spine raising above other verticil spines and ending in a hook incurving over other spines	16
-	Large dorsal spine straight or slightly curved inwards, not ending in an incurving hook	17
16. (15)	Distal hook of dorsal spine with two distal lateral spinules, length of other verticil spines about 1/4 of that of dorsal spine, internal spinules on other verticil spines absent	*H. minax* (Fig. 7)
-	Distal hook of dorsal spine with two distal lateral spinules, length of other verticil spines about 1/2 of that of dorsal spine, all other verticil spines with an internal spinule at about mid-length each.	*H. lirs* n. sp. (Figs 4, 5)
17. (15)	Dorsal spine more or less bulbous, thicker than other verticil spines	18
-	Dorsal spine narrow, with pointed tip	*H.* cf. *recta* (Fig. 8)
18. (17)	Bulbous dorsal verticil spine exceptionally large	*H. trivesiculosa* (Fig. 10)
-	Bulbous dorsal verticil spine slightly larger than other spines	19
19. (18)	Dorsal verticil spine straight	*H. albiceps* (Fig. 2)

- Dorsal verticil spine curved over remaining verticil spines. . . . . *H. tuberculata* (Fig. 11)
20. (12) Basal processes below opercular funnel absent 21
- Basal processes below opercular funnel present . . . . . *Crucigera tricornis* (Fig. 1A, B)
21. (20) Tube white with or without brown stripes, without internal structures . . . . . *Serpula* 23
- Tube rose, bright red or mustard, with internal structures . . . . . *Spiraserpula* 22
22. (21) Tube rose or brigh red . . . . . *Spiraserpula iugoconvexa* (Fig. 25)
- Tube mustard-coloured . . . . . *Spiraserpula snelli*
23. (21) Tube white with brown (to orange) transverse stripes, operculum simple grooved bulb or opercular funnel relatively short . . . . . *Serpula vittata* (Fig. 24A)
- Tube white without brown stripes, long opercular funnel . . . . . *Serpula watsoni* (Fig. 24B)
24. (10) Operculum with chitinous column bearing several serrated disks. . . . . *Pomatostegus actinoceras* (Fig. 14D)
- Operculum with calcareous endplate, sometimes with non-movable spines. . . . . *Spirobranchus* 25
25. (24) Branchiae spiral, tubes mostly embedded into corals, operculum with calcareous distal plate bearing spines 26
- Non-spiral branchiae, tubed may not be embedded into corals; spines present or absent. 28
26. (25) Three-four antler-like spines of opercular plate originating from a long common central stem 27
- No long common stem, opercular spines (ventral and dorsal) originate from the central knob on opercular distal plate . . . . . *Sp. corniculatus* (Fig. 26)
27. (26) All spines facing forward. . . . . *Sp. gardineri* (Fig. 28A, B)
- Some spines facing backward . . . . . *Sp. richardsmithi* (Fig. 28C)
28. (25) Inter-radiolar membrane with lappets between radioles, operculum with spines 29
- Inter-radiolar membrane without lappets or frills between radioles, opercular distal plate without spines 30
29. (28) Four groups of 2 major spines each with numerous spinules . . . . . *Sp. tetraceros* (Fig. 30C, D)
- Five major spines each branching at least 2 times resulting in 20 main spines bearing 5–7 pairs of lateral spinules each . . . . . *Sp. decoratus*
- Eight or more almost erect and almost separate spines . . . . . *Sp. coronatus* (Fig. 27A)
30. (28) Tube white, opercular distal plate with 10–20 ridges radiating from the center and ending in as many marginal teeth. . . . . *Sp. corrugatus* (Fig. 27B–D)
- Tube pink, opercular distal plate without radiating ridges. 31
31. (30) Peduncular wings not branching, single or multiple disks on opercular plates. . . . . *Sp. latiscapus* (Fig. 29A, B)
- Peduncular wings branching, often opercular distal plate with 2 rounded knobs . . . . . *Sp.* cf. *polytrema* (Fig. 30A, B)
32. (11) Thoracic membranes ending at chaetiger 3 or 4; anterior tooth of thoracic uncini simple . . . . . *Vermiliopsis* 33
- Thoracic membranes ending at chaetiger 2; anterior tooth of thoracic uncini gouged 34
33. (32) Operculum with elongated brown chinous distal cap subdivided by numerous partitions . . . . . *Vermiliopis glandigera/pygidialis*-complex (Fig. 31A–C)
- Operculum covered with simple concave endplate additionaly enforced with calcareous deposits . . . . . *Vermiliopsis labiata* (Fig. 31D)
34. (33) Operculum with simple distal plate/cap, flat or concave. 35
- Operculum with elongated endcap subdivided by numerous partitions 36
35. (34) Operculum simple transparent inverted cone covered with semi-transparent flat distal plate, paired elongated chambers along the distal end of tube present . . . . . *Semivermilia annehoggettae* n. sp. (Figs 18, 19)
- Operculum with simple asymmetrical convex endpcap; paired elongated chambers along the distal end of tube absent . . . . . *Semivermilia lylevaili* n. sp. (Figs 20, 21)
36. (34) Tube triangular, with single smooth keel; thoracic uncini saw-shaped . . . . . *Pseudovermilia pacifica* (Fig. 16)
- Tube with three keels; thoracic uncini saw-to-rasp shaped 37
37. (36) Tube triangular in cross section, with a well-defined median ridge, two lateral longitudinal ridges, and broad lateral flanges. . . . . *Semivermilia pomatostegoides* (Figs 22A, 23)
- Tube trapezoidal in cross section, with one erect and two oblique irregularly serrated longitudinal keels and at most with narrow lateral flanges . . . . . *Semivermilia uchidai* (Fig. 22B)
38. (3) Collar chaetae simple only, special chaetae absent 39
- Collar chaetae simple and special 41
39. (38) *Apomatus* chaetae absent; thoracic membranes narrow; brooding appendage in branchial crown. . . . . *Paraprotis dendrova* (Fig. 14A)
- *Apomatus* chaetae present, thoracic membranes wide; no brooding appendages in branchial crown. . . . . *Protula* 40
40. (39) Large animals, with radioles arranged in two spires of up to 6 whorls, up to 4 cm across and 4.5 cm high. . . . . *Protula bispiralis* (Fig. 15D)
- Much smaller animals, radioles arranged in semicircles . . . . . *Protula* spp. (Fig. 15A–C)
41. (38) Special collar chaetae bayonet-type, mustard-coloured tubes with internal tube structures present. . . . . *Spiraserpula snellii*
- Special collar chaetae fin-and-blade, tubes forming pseudocolonies consisting of large number of tiny white tubes . . . . . *Salmacina* sp. (Fig. 17B, C)
- Special collar chaetae *Spirobranchus*-type; yellow spiral radioles, tubes embedded into corals . . *Spirobranchus nigranucha* (Fig. 29C, D)

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