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# Three new species of glass sponges Pheronematidae (Porifera: Hexactinellida) from the deep-sea of the northwestern Pacific Ocean

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## Abstract

Three new glass sponge species of the family Pheronematidae are described in this study. Specimens were sampled in the northwestern Pacific Ocean during cruise DY125–35I expedition (July–August, 2014) conducted by the China Ocean Mineral Resources R&D Association. All samples were collected by the Chinese manned submersible Jiaolong HOV at a depth of 1627–2897 m. The three species belonging to three genera of the same family were observed, i.e., *Platylistrum subviridum* **sp. nov.** *Poliopogon canaliculatus* **sp. nov.** and *Semperella retrospinella* **sp. nov.** An unique form of the pinular ray of pinular pentactins with reclined spines is described for *S. retrospinella* **sp. nov.** This is also the first record of *Platylistrum* in the Pacific Ocean.

**Key words**: Porifera, Hexactinellida, Pheronematidae, northwestern Pacific Ocean, new species, taxonomy

## Introduction

The family Pheronematidae is characterized as the following: the choanosomal skeletons consist predominantly of pentactins and uncinates (diactins seem to be absent); dermalia and atrialia are pinular pentactins and rarely hexactins; amphidiscs usually include three types (Tabachnick & Menshenina, 2002). The 42 described species can be allocated into six genera. Most of the genera contain no more than 6 species; the two genera *Platylistrum* Schulze, 1904 and *Schulzeviella* Tabachnick, 1990 are monospecific (van Soest *et al*, 2015). More than half of the 42 species were found in the Pacific Ocean as new species (Ijima, 1896; Reiswig, 1999; Tabachnick, 1988; Tabachnick & Lévi, 2000; Thomson, 1878). However, *Platylistrum* has only been found in the Indian Ocean previously. In this study, we describe three new species belonging to the genera *Semperella*, *Poliopogon* and *Platylistrum.* All specimens were collected by the Jiaolong HOV in the northwestern Pacific Ocean.

## Materials and methods

The specimens were collected from the northwestern Pacific Ocean (154.92°E to 155.34°E and 15.51°N to 15.93°N) by Chinese manned submersible Jiaolong HOV on July 17$^{th}$–25$^{th}$, 2014. They were all collected from the deep sea (1627–2897 m) and preserved in 85% ethanol immediately after brought on deck. All the samples were deposited in the Sample Repository of SIO (catalogue number: JL–Dive 81 sponge 02; JL–Dive 79 sponge 01; JL–Dive 76 sponge 02), Hangzhou, China. Spicules and sections for light microscopy were prepared and examined following Reiswig (2014) and deposited in the Museum of Marine Science and Technology, Xiamen University (catalogue number: XMU02000 676; XMU02000 668; XMU02000 658). Each spicule category was measured per specimen using a light microscope. Diameter and length data were obtained through software Image-Pro Plus 6.0.

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Measurements of spicules are given in millimeters (mm), arranged in the following format: minimum–maximum (average). The "diameter of pentactine pinular ray" refers to the widest part of the pinular ray, including the spines. Abbreviations used throughout the text are COMRA (China Ocean Mineral Resources R&D Association), HOV (Human Occupied vehicle), SIO (Second Institute of Oceanography, China), XMU (Museum of Marine Science and Technology, Xiamen University), and SRSIO (Sample Repository of SIO).

## Systematic description

### Class Hexactinellida Schmidt, 1870

### Subclass Amphidiscophora Schulze, 1886

### Order Amphidiscosida Schrammen, 1924

### Family Pheronematidae Gray, 1870

### Genus *Platylistrum* Schulze, 1904

**Diagnosis.** Pheronematidae stalked with a spoon-like body and a single rather compact tuft of basalia (Tabachnick & Menshenina, 2002).

### *Platylistrum subviridum* sp. nov.

Figure 1A–Q; Table 1.

**Type material**. Holotype: JL–Dive 81 sponge 02, SRSIO (spicules and sections were deposited in XMU: XMU02000 676), northwestern Pacific Ocean (Lat. 15.6829°N, Long. 154.9236°E), depth 1627 m, Jiaolong HOV, coll. Chunsheng Wang (25/7/2014). Deposited, 85% ethanol, SRSIO, Hangzhou, China.

**Diagnosis.** The microuncinates lack spines, but have well developed brackets. The prostalia basalia are two-tooth anchors. The rays of the anchors are smooth and without spines. The microscleres include two types of amphidiscs, monactin and strong micropentactins and few microstauractins. Without sceptres.

**Description.** The holotype is spoon-like and light green in color (Fig. 1A, B), even in ethanol for two months, with a length of 270 mm, width of 85 mm, and thickness of the sponge center of 6–8 mm. The compact stalk is 44 mm long and 24 mm in diameter. The lower part of the atrial surface is rolled inward and forms a small deep groove (Fig. 1B arrow indicated). The atrialia support a fine sieve situated on the concave surface, with a sieve size of 0.3–0.4 mm (Fig. 1C). The dermalia are situated on the stalk and on the prominent convex surface. The exhalant canals covered by the sieve are 1.0–2.5 mm in diameter. The lowest part of the body has turned into a developed root system, of which possess much longer and stronger horizontal basalia as well as shorter, villose but vertically protruding basalia. The horizontal basalia are approximately 20–80 mm long on the marginal layer, whereas the shorter ones concentrate in the bottom center. This sponge is basiphytic for the vertical basalia of the holotype implanting to cobalt-rich crust beneath thin sediment while the horizontal basalia just attaching to the sediment surface (Fig. 1A).

**Spicules.** Choanosomal, hypodermal and hypoatrial spicules are mainly smooth pentactins with the same wide range of sizes. For choanosomal pentactine (Fig. 1D ) paired ray the length is from 0.2 mm up to 4.8 mm, with diameter ranging 0.0053–0.0449 (0.0201) mm. Only one type of uncinate was found (Fig. 1E). Microuncinates are 0.4060–0.9494 (0.7277) mm long and 0.0170–0.0059 (0.0035) mm in diameter. Under a light microscope, microuncinates resemble smooth diactine spicules (amphioxes), but in SEM, no barbs could be found on them, although small dents (brackets) are noted. No sceptres are found throughout all the spicules under microscope. Basalia are two-tooth anchors (Fig. 1F). Anchors have smooth shafts up to 5.2 mm long. Prostalia are absent. Dermal and atrial pinular pentactins (Fig. 1G) are almost the same size and shape in this species. Most of the atrial pinular pentactins arranged in line on pretty long pentactine ray (Fig. 1H).The termination of the pinular ray is conically pointed and as long as the last spine. The spines of the pinular ray are long and compact, and protrude forward. Tangential rays are raised in the middle making each pair of rays resemble a "toxa" (Fig. 1G), i.e., tangential rays curve in the vertical direction unlike common pinular pentactins which curve in the horizontal direction. Terminations of tangential rays are conically pointed, with few tiny spines on the tip. The atrial pentactine pinular ray is 0.2653–0.7003 (0.4403) mm long and tangential rays are 0.0539–0.0994 (0.0820) mm in length. For dermal pinular pentactines, the pinular ray is 0.2946–0.6345 (0.4390) mm in length and 0.0259–0.0483 (0.0381) mm in diameter. Tangential rays are 0.0631–0.1096 (0.0835) mm long and 0.0032–0.0086 (0.0055) mm in diameter. Micropentactins and microstauractins have the same size but the number of micropentactins is much more than microstauractins (Fig. 1I, J). The rays of micropentactins and microstauractins are strong and straight, and covered with numerous relatively long spines. Micropentactins have ray lengths of 0.0824–0.1566 (0.1251) mm and ray diameters of 0.0053–0.0150 (0.0098) mm. Microstauractins are much fewer in contrast to micropentactins. Both of these two spicules look exactly the same in size and shape. It seems the microstauractin might be the deformation of micropentactin. No microhexactins are found in this holotype. Micromonactins are few, with length of 0.2242–0.3228 (0.2581) mm (Fig. 1K). Two types of amphidiscs correspond to mesamphidiscs and macramphidiscs in size. Mesamphidiscs (Fig.1L, M) have wide size ranges, 0.0403–0.1263 (0.0716) mm in length, 0.0084–0.0399 (0.0259) mm in umbel length, and 0.0081–0.0407 (0.0190) mm in umbel diameter. They have spiny shafts and a relatively uniform shape (the same proportion of umbel to shaft). Macramphidiscs (Fig. 1N, O) are rare and are shaped differently compared with mesamphidiscs. The umbel is wider and the thickness of the umbel teeth are thinner (side view). The gap between the two umbels teeth is shorter than one third of the whole macramphidisc. The two amphidisc classes are sorted not only by size but also by shape thereby producing a considerable overlap (Tab. 1). Some peculiar and immature spicules are presented in this species (Fig. 1P, Q).

**TABLE 1.** Spicule dimensions of *Platylistrum subviridum* **sp. nov.**, holotype, JL-Dive 76 sponge 02 (Spicules and sections: XMU02000 676). All measurements are in mm.

| Parameter | | Mean | SD | Range | No. |
|---|---|---|---|---|---|
| Diameter of choanosomal pentactin paired ray | | 0.0201 | 0.0118 | 0.0053–0.0449 | 27 |
| Length of choanosomal pentactin paired ray | | 2.0984 | 1.6324 | 0.2754–4.8784 | 4 |
| Dermal pinular pentactin | Length of pinular ray | 0.4390 | 0.0716 | 0.2946–0.6345 | 50 |
| | Diameter of pinular ray (spine part) | 0.0381 | 0.0050 | 0.0259–0.0483 | 50 |
| | Diameter of pinular ray (rod part) | 0.0082 | 0.0022 | 0.0053–0.0151 | 50 |
| | Length of tangential ray | 0.0835 | 0.0110 | 0.0631–0.1096 | 50 |
| | Diameter of tangential ray | 0.0055 | 0.0013 | 0.0032–0.0086 | 50 |
| Atrial pinular pentactin | Length of pinular ray | 0.4403 | 0.0809 | 0.2653–0.7003 | 34 |
| | Diameter of pinular ray (spine part) | 0.0354 | 0.0033 | 0.0233–0.0402 | 34 |
| | Diameter of pinular ray (rod part) | 0.0080 | 0.0020 | 0.0055–0.0125 | 34 |
| | Length of tangential ray | 0.0820 | 0.0119 | 0.0539–0.0994 | 34 |
| | Diameter of tangential ray | 0.0053 | 0.0012 | 0.0038–0.0077 | 34 |
| macramphidisc | Length of macramphidisc | 0.1205 | 0.0138 | 0.1078–0.1495 | 10 |
| | Length of umbel | 0.0477 | 0.0047 | 0.0419–0.0568 | 10 |
| | Diameter of umbel | 0.0387 | 0.0083 | 0.0289–0.0525 | 10 |
| mesamphidisc | Length of mesamphidisc | 0.0716 | 0.0162 | 0.0403–0.1263 | 119 |
| | Length of umbel | 0.0259 | 0.0078 | 0.0084–0.0399 | 119 |
| | Diameter of umbel | 0.0190 | 0.0056 | 0.0081–0.0407 | 119 |
| micropentactin | Length of pinular ray | 0.1251 | 0.019 | 0.0824–0.1566 | 34 |
| | Length of tangential ray | 0.1240 | 0.0193 | 0.0843–0.1813 | 34 |
| | Diameter of pinular ray | 0.0098 | 0.0028 | 0.0053–0.0150 | 34 |
| Length of microuncinate | | 0.7277 | 0.3307 | 0.4060–0.9494 | 25 |
| Diameter of microuncinate | | 0.0035 | 0.0015 | 0.0017–0.0059 | 25 |
| Length of micromonactine | | 0.2581 | 0.0533 | 0.2242–0.3228 | 4 |

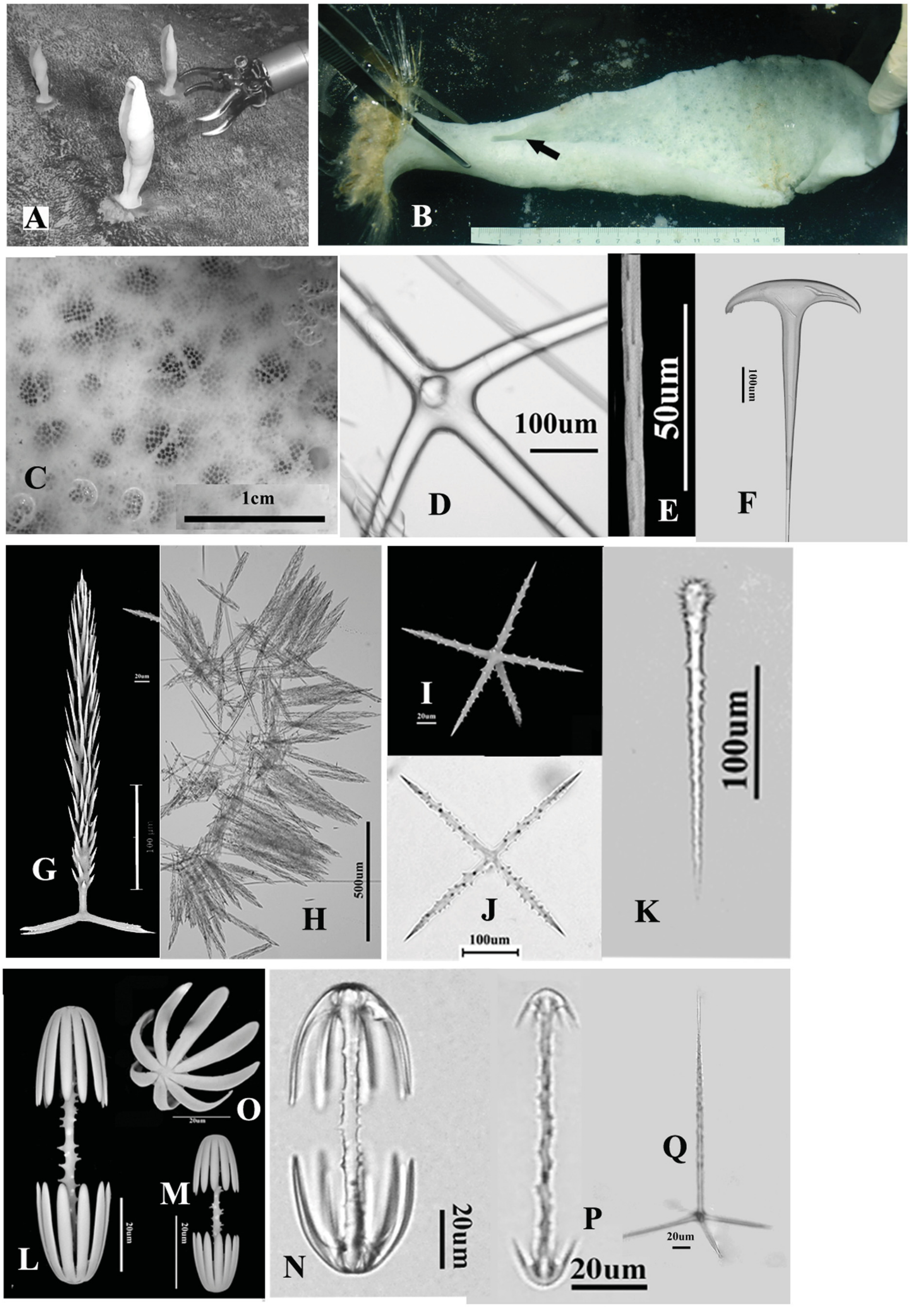


**FIGURE 1.** *Platylistrum subviridum* **sp. nov.** A, specimen *in situ*, only the upright specimen was collected; B, atrial view of holotype stored in ethanol for two months, it still has light green color; arrow shows the groove; scale bar in cm; C, details of atrial surface showing the sieve plate; D, choanosomal pentactin; E, microuncinate segment; F, two-toothed anchorate basalium; G, atrial pinular pentactin; H, atrial pinular pentactins arranged in line; I, micropentactin; J, microstauractin; K, micromonactin; L, mesamphidisc; M, microamphidisc; N, macramphidisc under light microscope; O, umbel of macramphidisc in SEM; P, immature amphidisc; Q, curious pinular pentactin.

**Ecology.** Northwestern Pacific Ocean, depth 1627 m. The vertical basalia of the holotype implant on the cobalt-rich crust beneath a thin sediment while the horizontal basalia just attach to the sediment surface.

**Etymology.** The name *subviridum* refers to the light green color of the specimens.

**Remarks.** The genus *Platylistrum* contains only one species *Platylistrum platessa* Schulze, 1904 which is distributed in the West Indian Ocean. *Platylistrum subviridum* **sp. nov.** has a typical spoon-like appearance and similar spicules types as *P. platessa*. However, clear differences can be found as follows: *P. subviridum* **sp. nov.** has two-tooth anchors and the whole shaft is smooth, whereas *P. platessa* has four-tooth anchors that are partly smooth and partly covered with spines. The tangential rays of dermal and atrial pentactin of *P. subviridum* **sp. nov.** are relatively short and bent in the vertical direction, whereas *P. platessa* has longer and straight tangential rays. The proportion of pinular rays compared with tangential rays is quite different between these two species. *Platylistrum subviridum* **sp. nov.** has two types of amphidiscs, while *P. platessa* has only one type. Moreover, micropentactins and microstauractins of *P. subviridum* **sp. nov.** are strong and the whole rays are covered with numerous long spines, whereas the microscleres of *P. platessa* are slender and with few spines on the rays. *Platylistrum subviridum* **sp. nov.** has no sceptre while *P. platessa* has those with the usual shape for Pheronematidae. *Platylistrum subviridum* **sp. nov.** was collected in the northwestern Pacific Ocean, whereas *P. platessa* has only been found in the West Indian Ocean.

## Genus *Poliopogon* Thomson, 1873

**Diagnosis.** Pheronematidae with a fan-like body in which the concave side represents the atrial cavity. Basalia are in relatively broad tufts and include some monaxons with clavate distal ends and two-toothed anchors (Tabachnick & Menshenina, 2002).

### *Poliopogon canaliculatus* sp. nov.

Figure 2A–U; Table 2.

**Type material.** Holotype: JL–Dive 79 sponge 01 (Spicules and sections: XMU02000 668), northwestern Pacific (Lat. 15.9236°N, Long. 155.1874°E), depth 2897 m, Jiaolong HOV, coll. Yonggang Liu (22/7/2014). Deposited, 85% ethanol, SRSIO, Hangzhou, China.

**Diagnosis.** A few large oscula covered with sieve plates are present on the top of the sponge. The termination of the dermal pentactine pinular ray is conically pointed and projects far beyond the last spines. Prostalia are two types of sceptres and the basalia include some monaxons with clavate distal ends in addition to two-toothed anchors.

**Description.** The holotype is cucumber-like and curved in the middle, approximately 390 mm long with a central part that is 110 mm in diameter. A large groove can be seen on sponges when attached to hard substrate (Fig. 2A), but the groove was diminished (or closed) when brought back to deck (Fig. 2B). The upper part of the sponge is conical and the oscula are covered with sieve plates (Fig. 2C). The mesh diameter is not uniform, ranging from 0.3 mm to 1.1 mm. Four round large pores (6–10 mm in diameter) are located under the middle of the sieve plate (Fig. 2C). Numerous canals covered by sieve plates occur on atrial and dermal surfaces (Fig. 2D).

**Spicules.** The choanosomal skeleton is composed of conically pointed pentactins (Fig. 2E) as well as hypodermal and hypoatrial pentactins. The smooth and often curved rays are 0.6253 to 6.2293 (3.0233) mm in length and 0.0072–0.0440 (0.0197) mm in diameter. Some rays of choanosomal pentactins are slender and very long. Uncinates may include two types: macrouncinate (Fig. 2 F) is length 1.0238–3.2384 (2.0328) mm long and 0.0065–0.0182 (0.0135) mm in diameter, which is long and easy to be broken. Microuncinate (Fig. 2G) with 0.0952–0.2726 (0.1820) mm in length and 0.0024–0.0032 (0.0030) mm in diameter. The basalia are two-toothed anchor (Fig. 2H) with smooth shaft (Fig. 2I) which is 0.0339–0.0627 (0.0483) mm in diameter and 0.9876–4.4322 (2.7099) mm in length; the tooth-like rays are 0.1928–0.3764 (0.2846) mm long and 0.0294–0.0712 (0.0503) mm diameter. The prostalia consist of short sceptres (Fig. 2J, K), which have a similar shape to those of Pheronematidae and are 1.1206–2.2710 (1.9095) mm in length and 0.0129–0.0382 (0.0271) mm in diameter. Pinular pentactins with curved tangential rays are always lined side by side along their hypodermal or hypoatrial

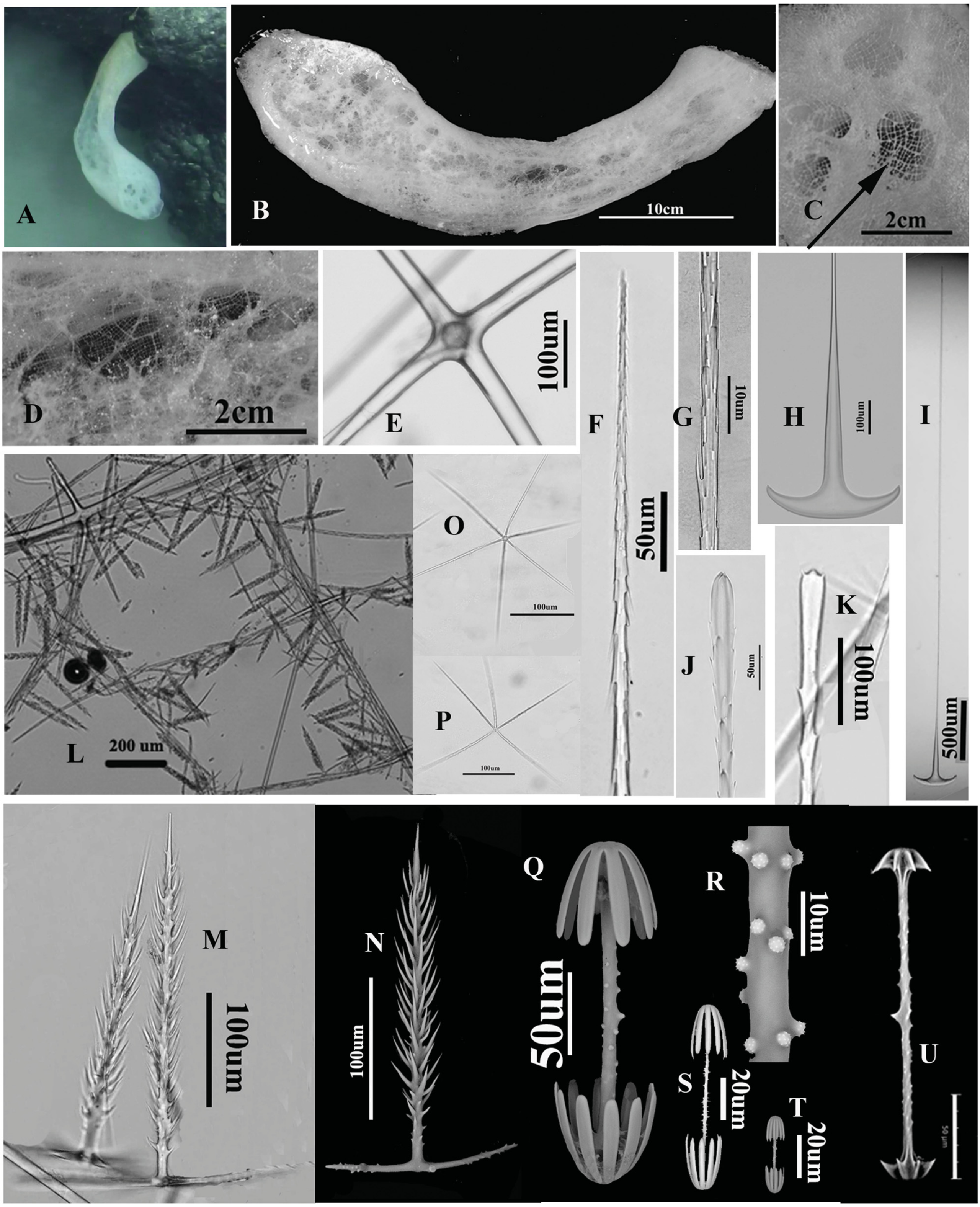


**FIGURE 2.** *Poliopogon canaliculatus* **sp. nov.** A, specimen *in situ*; B, preserved specimen; C, top view of holotype, arrow showing round pores; D, sieve plates on atrial groove; E, choanosomal pentactin; F, top of macrouncinate segment; G, microuncinate segment; H, two-toothed anchor; I, two-toothed anchor and its smooth ray end; J–K, sceptres; L, details of sieve plate, showing pentactins arranged in line; M, dermal pinular pentactin; N, atrial pinular pentactin; O, micohexactin; P, micropentactin; Q-R, macramphidisc and details of tuberculated shaft; S, mesamphidisc; T, micramphidisc; U, immature amphidisc.

**TABLE 2.** Spicule dimensions of *Poliopogon canaliculatus* **sp. nov.**, holotype, JL-Dive 76 sponge 02 (Spicules and sections: XMU02000 668). All measurements are in mm.

| Parameter | | Mean | SD | Range | No. |
|---|---|---|---|---|---|
| Diameter of choanosomal pentactin ray | | 0.0197 | 0.0072 | 0.0072–0.0440 | 55 |
| Length of choanosomal pentactin ray | | 3.0233 | 2.0511 | 0.6253–6.2293 | 12 |
| Dermal pinular pentactin | Length of pinular ray | 0.2934 | 0.0524 | 0.2000–0.4209 | 52 |
| | Diameter of pinular ray (spine part) | 0.0299 | 0.0076 | 0.0076–0.0419 | 52 |
| | Diameter of pinular ray (rod part) | 0.0082 | 0.0026 | 0.0039–0.0151 | 52 |
| | Length of tangential ray | 0.1143 | 0.0329 | 0.0462–0.1634 | 50 |
| | Diameter of tangential ray | 0.0062 | 0.0016 | 0.0030–0.0107 | 50 |
| Atrial pinular pentactin | Length of pinular ray | 0.2675 | 0.0317 | 0.2342–0.4147 | 38 |
| | Diameter of pinular ray (spine part) | 0.0289 | 0.0081 | 0.0076–0.0407 | 38 |
| | Diameter of pinular ray (rod part) | 0.0074 | 0.0022 | 0.0049–0.0132 | 38 |
| | Length of tangential ray | 0.1071 | 0.0297 | 0.0492–0.1553 | 38 |
| | Diameter of tangential ray | 0.0060 | 0.0016 | 0.0038–0.0091 | 38 |
| micramphidisc | Length of micramphidisc | 0.0844 | 0.0170 | 0.0625–0.1180 | 19 |
| | Length of umbel | 0.0248 | 0.0050 | 0.0130–0.0364 | 19 |
| | Diameter of umbel | 0.0202 | 0.0046 | 0.0125–0.0302 | 19 |
| mesamphidisc | Length of mesamphidisc | 0.1556 | 0.0123 | 0.1368–0.1659 | 6 |
| | Length of umbel | 0.0443 | 0.0070 | 0.0351–0.0556 | 6 |
| | Diameter of umbel | 0.0337 | 0.0057 | 0.0264–0.0397 | 6 |
| macramphidisc | Length of macramphidisc | 0.2409 | 0.0241 | 0.2054–0.2998 | 43 |
| | Length of umbel | 0.0696 | 0.0062 | 0.0602–0.0863 | 43 |
| | Diameter of umbel | 0.0718 | 0.0086 | 0.0498–0.0893 | 43 |
| basal anchor | Length of ray | 2.7099 | 2.4357 | 0.9876–4.4321 | 2 |
| | Diameter of ray | 0.0483 | 0.0204 | 0.0339–0.0627 | 2 |
| | Length of anchor | 0.2846 | 0.1298 | 0.1928–0.3764 | 2 |
| | Diameter of anchor | 0.0503 | 0.0295 | 0.0294–0.0712 | 2 |
| Length of micropentactin unpaired ray | | 0.1524 | 0.0979 | 0.0842–0.8475 | 57 |
| Length of micropentactin paired ray | | 0.1367 | 0.0312 | 0.0727–0.2299 | 57 |
| Length of microhexactin ray | | 0.0811 | 0.0251 | 0.0422–0.1429 | 41 |
| Diameter of microhexactin ray | | 0.0038 | 0.0011 | 0.0021–0.0080 | 41 |
| Length of microuncinate | | 0.1820 | 0.0879 | 0.0952–0.2726 | 24 |
| Diameter of microuncinate | | 0.0030 | 0.0004 | 0.0024–0.0032 | 24 |
| Length of macrouncinate | | 2.0328 | 1.3862 | 1.0238–3.2384 | 5 |
| Diameter of macrouncinate | | 0.0135 | 0.0051 | 0.0065–0.0182 | 14 |
| Length of sceptre | | 1.9095 | 0.2635 | 1.1206–2.2710 | 35 |
| Diameter of sceptre | | 0.0271 | 0.0065 | 0.0128–0.0382 | 35 |

pentactin rays (Fig. 2L). There are no significant differences between atrial and dermal pinular pentactins in shape and size (Fig. 2M, N). The tangential rays of pentactins are smooth, but the conical terminations are usually covered with a few short vertical spines. The termination of the pinular ray is conically pointed and projects far beyond the last spines. It looks very sharp and occupies 1/6–1/5 of the length of the pinular ray (Fig. 2M, N). The dermal pinular ray is 0.2000–0.4209 (0.2934) mm in length and 0.0076–0.0419 (0.0299) mm in diameter; the tangential rays are 0.0462–0.1634 (0.1143) mm in length and 0.0030–0.0107 (0.0062) mm in diameter. The atrial pinular ray is 0.2342–0.4147 (0.2675) mm in length and 0.0076–0.0407 (0.0289) mm in diameter; the tangential rays are 0.0492–0.1553 (0.1071) mm in length and 0.0038–0.0091 (0.0060) mm in diameter. The number of microhexactins (Fig. 2O) is considerably more than micropentactins (Fig. 2P). Both of them have spiny and curved rays. The rays of microhexactins are 0.0422–0.1429 (0.0811) mm long and 0.0021–0.0080 (0.0038) mm diameter. Amphidiscs can be divided into three categories. The total length of macramphidiscs (Fig. 2Q) is 0.2054–0.2998 (0.2409) mm, with an umbel length of 0.0602–0.0863 (0.0696) mm, and an umbel diameter of 0.0498–0.0893 (0.0718) mm. Macramphidiscs have tuberculated shafts (Fig. 2R). Both micramphidiscs and mesamphidiscs have shafts covered with dense spines. Mesamphidiscs (Fig. 2S) are 0.1368–0.1659 (0.1556) mm in length, with an umbel length of 0.0351–0.0556 (0.0443) mm, and an umbel diameter of 0.0264–0.0397 (0.0337) mm. Micramphidiscs (Fig. 2T) are 0.0625–0.1180 (0.0844) mm in length, with an umbel length of 0.0130–0.0364 (0.0248) mm, and an umbel diameter of 0.0125–0.0302 (0.0202) mm. Some peculiar spicules are present in this species which are probably immature macramphidiscs (Fig. 1U).

**Ecology.** The holotype was found adhered to rock in an upside-down position. The groove of the sponge was open (inflated) when it was collected at a depth of 2897 m.

**Etymology.** The species name *canaliculatus* refers to the large groove on the lateral part of the sponge.

**Remarks.** There are six valid species of *Poliopogon* according to van Soest *et al*. (2015) and Tabachnick & Menshenina (2002). All of the six species are be found in the Pacific Ocean. Most are anchored to soft substratum, but the holotype of the new species was found attached to a rock surface. Compared with other species of *Poliopogon*, its basalia are less developed. *Poliopogon canaliculatus* **sp. nov.** has the same spicule pattern and size range as *Poliopogon amadou* Thomson, 1878 (Tabachnick, 1988; Thomson, 1878; van Soest *et al.* 2015), except for the terminal pinular ray of dermalia. *Poliopogon canaliculatus* **sp. nov.** has a very sharp pinular ray termination. It is conically pointed and protrudes forward far beyond the last spines. More important is the fact that there is a round and well developed sieve plate covering the oscula on the columnar top of the holotype, which is different from *P. amadou pacifica* Tabachnick, 1988 and *P. amadou amadou* Thomson, 1878. The atrial surface located on the lateral surface of the sponge, which forms a large groove, is 260 mm in length and 80 mm in width. This groove was open when the Jiaolong HOV attempted to collect the specimen and closed when it was brought back to deck. Compared with *Poliopogon mendocino* Reiswig, 1999, *P. canaliculatus* **sp. nov.** is devoid of mesohexactins, spiny mesomonactins and microhexadiscs, and differs from *P. mendocino* drastically in shape. *Poliopogon mendocino* has a broad-flaring-funnel-like atrial cavity with robust marginal fringe which extends continuously around the distal edge, while *P. canaliculatus* **sp. nov.** is cucumber-like sponge with inconspicuous atrial cavity. Compared with *P. micropentactinus* Tabachnick and Lévi, 2000, *P. canaliculatus* **sp. nov.** has neither strong micropentactins nor microstauractins. What's more, the smooth shaft of anchorate basalia is another distinction of *P. canaliculatus* **sp. nov.** The proportion of macramphidiscs of *P. canaliculatus* **sp. nov.** is obviously different from that of *P. claviculus* Tabachnick and Lévi, 2000, and basal monaxons are absent in *P. canaliculatus* **sp. nov.** In comparison with *P. zonecus* Tabachnick and Lévi, 2000, the microscleres of the new holotype are not that "spiny" and the specimen lacks microtriactins, micromonactins and microorthodiactins. At last, compared with *P. maitai* Tabachnick 1988, *P. canaliculatus* **sp. nov.** has longer pentactine pinular rays and possesses micropentactins. Also unlike *P. maitai* with strong microhexactins with spiny rays, *P. canaliculatus* **sp. nov** has slender microhexactins with few spines on the rays. Based on these differences, it is difficult to assign this new specimen to any valid species, thus we recognize it as a new species and erect it as *Poliopogon canaliculatus* **sp. nov.**

## Genus *Semperella* Gray, 1868

**Diagnosis.** The body is cucumber-like in shape without a single obvious atrial cavity. The everted atrial areas are represented by several units separated from each other by dermalia. Basalia are gathered in a compact short tuft. The atrial cavities are covered by sieve plates. Choanosomal spicules are mainly pentactins. Amphidiscs and uncinates have one to three types (modified from Tabachnick &Menshenina, 2002).

***Semperella retrospinella* sp. nov.**
Figure 3A–R; Table 3

**Type material.** Holotype: JL–Dive 76 sponge 02 (Spicules and sections: XMU02000 658), Northwestern Pacific (Lat. 15.5101°N, Long. 155.3398°E), depth 2741 m, Jiaolong HOV, coll. Chunsheng Wang (17/7/2014); Deposited, 85% ethanol, Sample Repository of SIO, Hangzhou, China.

**Diagnosis.** The new *Semperella* species has two types of pinular pentactins. The pinular ray of the atrial pinular pentactine spicule differs from the dermal in having short vertical or reclined spines.

**Description.** The sponge is elongated and cucumber-like in shape (Fig. 3A, B). Both sides are slightly concave and the middle part is convex. The holotype is 315 mm in length and 42 mm in diameter. The width of the conical top is 18 mm. The stem is composed of long spicules and is 16 mm in diameter. Basalia and lateralia prostalia can be seen on the surface easily. Round to oval atrial areas are arranged in 2–4 lines and are separated by dermal areas. The dermal areas are covered with a uniformly fine-meshed lattice (0.8–1.0 mm); the oscular areas are covered with larger-meshed lattice (1.5–2.0 mm).

**Spicules.** The choanosomal skeleton consists of pentactins with smooth rays (Fig. 3C). They often have curved rays of different lengths 1.0342–2.6295 (1.5349) mm, with diameters of 0.0086–0.0564 (0.0246) mm. There are two types of uncinates. The macrouncinates (Fig. 3D) are 22.29–41.23 (32.26) mm in length and 0.0460–0.0866 (0.0642) mm in diameter, while the microuncinates (Fig. 3E) are 0.1741–0.4503 (0.3122) mm long and 0.0021–0.0080 (0.0040) mm diameter. Few monactins are found, with length of 0.1062–0.1892 (0.1422) mm (Fig. 3F). Basalia are four-equal-toothed anchors with long spines on the shaft (Fig. 3G). The length of toothed-like rays are 0.0680–0.1316 (0.0998) mm long and 0.0600–0.1363 (0.0981) mm diameter. The axial cross site is one third up the anchor length (Fig. 3G, as indicated by arrow). There are two types of sceptres as prostalia which differ at the distal end (Fig. 3H, I). Dermal and atrial spicules are different, but due to the closed position of dermal and atrial surfaces the corresponding spicules are often mixed. Most dermal spicules (Fig. 3J) are common pinular pentactins with pinular rays 0.1584–0.2741 (0.2186) mm in length. The diameter of the dermal pinular pentactine rays ranges from 0.0297 to 0.0619 (0.0525) mm; the tangential rays are curved and smooth, with spined ends, and 0.0479–0.1482 (0.1160) mm in length. Another type of pentactin which is predominately observed in atrial part has special pinular rays (Fig. 3K, L, M), with lengths of 0.2111–0.5728 (0.3925) mm and diameters of 0.0068–0.0342 (0.0188) mm. The pinular ray has short spines protruding vertically or slightly reclined. The tangential rays are straight and smooth, with outer ends covered with short spines, 0.0442–0.2314 (0.1374) mm in length. A few spicules have two pinular rays (Fig. 3N). Unpaired rays of micropentactins (Fig. 3O) are smooth with short spines at the end as well as microhexactins (Fig. 3P), 0.0555–0.3638 (0.1490) mm in length. The paired rays are smooth with short spines at the end, 0.0534–0.2406 (0.1201) mm in length. Amphidiscs occur as only one type, mesamphidiscs (Fig. 3Q), and the length is consistent. The total length is 0.1246–0.1829 (0.1530) mm, with an umbel length of 0.0337–0.0553 (0.0451) mm, and an umbel diameter of 0.0289–0.0455 (0.0376) mm. Amphidiscs are scattered around the choanosomal skeleton in large numbers (Fig. 3R).

**Ecology**. The holotype was found adhered to a nodular substrate and some basalia protruded into the sediment below them as well. Distributed in Northwestern Pacific Ocean. Depth 2741 m.

**Etymology.** The species name *retrospinella* refers to the backward spines on the pinular rays of atrial pinular pentactins.

**Remark.** This species differs from other species of *Semperella* in the following ways. Firstly, two types of pinular pentactins are found in this species. One is the common pinular pentactin with long spines at the end of the pinular ray; all of the spines protrude out in the same direction of the pinular ray. The pinular ray is spindle-like in shape with developed spines. The other type of pinular pentactin has long pinular ray with short spines. All the spines protrude out vertically or slightly backward. The shape of the pinular rays is clavate. These pinular pentactins have many deformations, e.g., a short smooth ray opposite the pinular ray, or one of the tangential rays developed as a second pinular ray. The length of the pinular ray ranged from 0.190 mm to 0.572 mm, larger than *Semperella abyssalis* Tabachnick & Levi, 2000 (mean length 0.180 mm). Secondly, it has been reported that there are 2–3 types of amphidiscs in other *Semperella*, whereas there is only one type of amphidisc in this holotype. Moreover, the lengths of the mesamphidiscs are quite similar, i.e., 0.1246–0.1829 (0.1530±0.0138) mm. Finally, prostalia basalia of *S. retrospinella* **sp. nov.** are four-equal-toothed anchors, while *Semperella alba* Tabachnick, 1988 possesses two-toothed anchors. *Semperella schultzei* (Semper, 1868) has two-toothed or four-toothed anchors

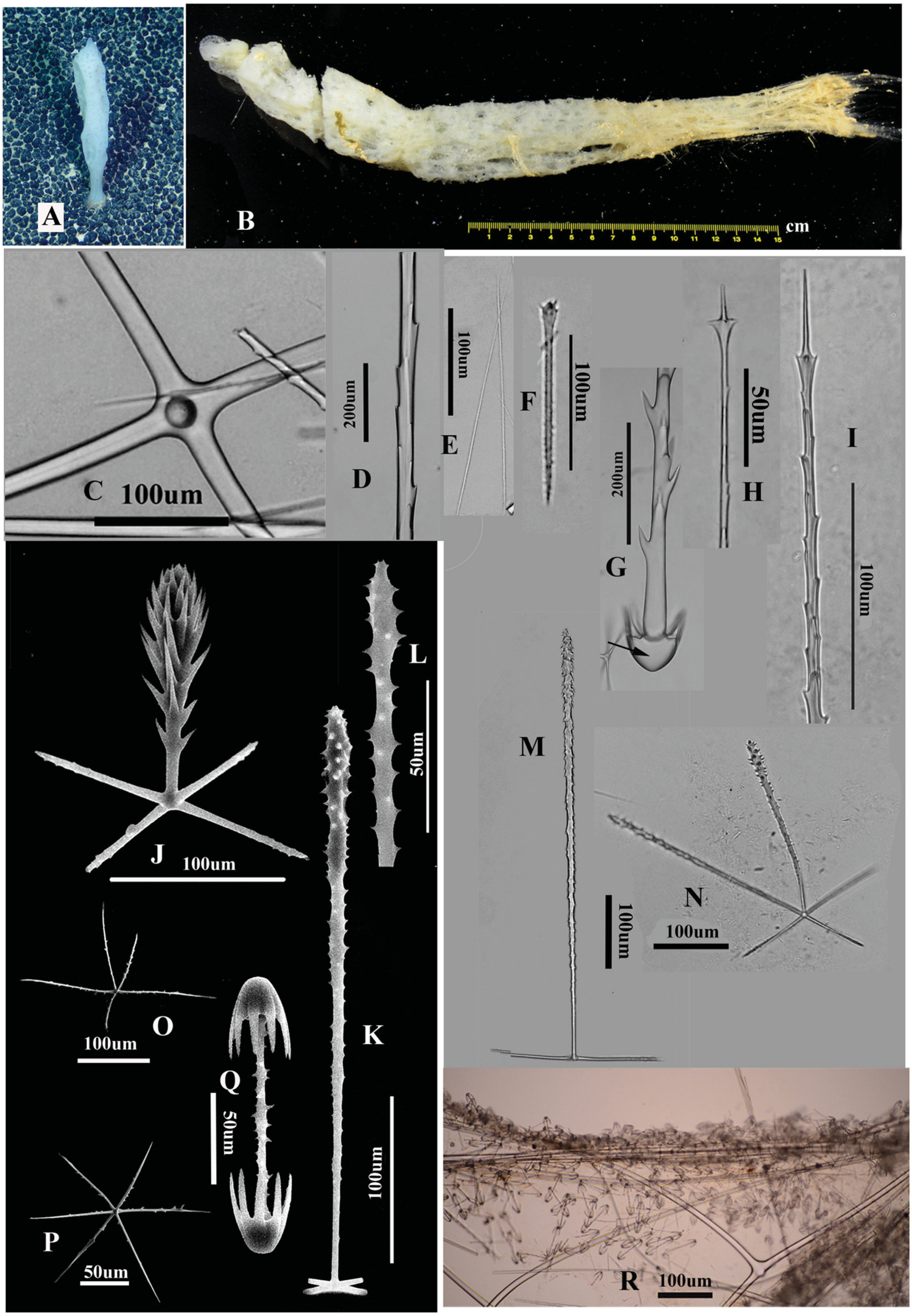


**FIGURE 3.** *Semperella retrospinella* **sp. nov.** A, holotype *in situ*; B, lab image of holotype; C, choanosomal pentactin; D, macrouncinate segment; E, microuncinates; F, micromonactin; G, four-toothed anchor, arrow indicates axial cross; H–I, sceptre distal end; J, dermal pinular pentactin; K, atrial pinular pentactin with spines protruding vertically (tangential rays were broken); L, details of pinular ray; M, integrated atrial pinular pentactin; N, pentactin with two pinular rays; O, micropentactin; P, micohexactin; Q, mesamphidisc; R, amphidiscs arranged around the dermal pentactins.

(two large and two rudimentary; Tabachnick & Menshenina, 2002), *Semperella megaloxea* Vinod, George, Thomas, & Manisseri, 2012 has 2-, 3- or even 4-toothed anchors. The other species are not discussed in greater detail.

**TABLE 3.** Spicule dimensions of *Semperella retrospinella* **sp. nov.**, holotype, JL-Dive 76 sponge 02 (Spicules and sections: XMU02000 658). All measurements are in mm.

| Parameter | | Mean | SD | Range | No. |
|---|---|---|---|---|---|
| Diameter of choanosomal pentactine ray | | 0.0246 | 0.0097 | 0.0086–0.0564 | 67 |
| Length of choanosomal pentactine paired ray | | 1.5349 | 0.8823 | 1.0342–2.6295 | 12 |
| Length of monactins | | 0.1422 | 0.0381 | 0.1062–0.1892 | 6 |
| Dermal pinular pentactin | Length of pinular ray | 0.2186 | 0.0216 | 0.1584–0.2741 | 72 |
| | Diameter of pinular ray (spine part) | 0.0525 | 0.0059 | 0.0297–0.0619 | 72 |
| | Diameter of pinular ray (rod part) | 0.00952 | 0.00483 | 0.0055–0.0281 | 21 |
| | Length of tangential ray | 0.1160 | 0.0227 | 0.0479–0.1482 | 60 |
| | Diameter of tangential ray | 0.00679 | 0.00380 | 0.003–0.0177 | 14 |
| Atrial pinular pentactin | Length of pinular ray | 0.3925 | 0.1075 | 0.2111–0.5728 | 43 |
| | Diameter of pinular ray (spine part) | 0.0188 | 0.0057 | 0.0068–0.0342 | 43 |
| | Diameter of pinular ray (rod part) | 0.00908 | 0.00620 | 0.0035–0.0317 | 19 |
| | Length of tangential ray | 0.1374 | 0.0442 | 0.0442–0.2314 | 41 |
| | Diameter of tangential ray | 0.00607 | 0.00301 | 0.0034–0.017 | 18 |
| mesamphid isc | Length of mesamphidisc | 0.1530 | 0.0138 | 0.1246–0.1829 | 52 |
| | Length of umbel | 0.0451 | 0.0044 | 0.0337–0.0553 | 52 |
| | Diameter of umbel | 0.0376 | 0.0033 | 0.0289–0.0455 | 52 |
| Anchor diameter | | 0.0998 | 0.0450 | 0.0680–0.1316 | 2 |
| Anchor length | | 0.0981 | 0.0540 | 0.0600–0.1363 | 2 |
| Diameter of ray | | 0.0384 | 0.0234 | 0.0218–0.0549 | 2 |
| Length of micropentactin unpaired ray | | 0.1490 | 0.0726 | 0.0555–0.3638 | 31 |
| Length of micropentactin paired ray | | 0.1201 | 0.0406 | 0.0534–0.2406 | 31 |
| Length of microuncinates | | 0.3122 | 0.0691 | 0.1741–0.4503 | 30 |
| Diameter of microuncinates | | 0.0040 | 0.0015 | 0.0021–0.0080 | 30 |
| Length of macrouncinates | | 32.26 | 10.17 | 22.29–41.23 | 8 |
| Diameter of macrouncinates | | 0.0642 | 0.0099 | 0.0460–0.0866 | 30 |
| Length of sceptres | | 1.4877 | 0.3470 | 1.2614–1.8872 | 3 |
| Diameter of sceptres | | 0.0159 | 0.0065 | 0.0106–0.0231 | 3 |

## Discussion

The discovery of new species is commonly associated with great expeditions and inventions of advanced instruments, as well as the presence of taxonomical expertise. Taking the family Pheronematidae as an example, there are two distinct periods of new species discovery. The first was during the period of an upsurge in nautical investigation during 1880 to 1932, which was driven by the rapid development of global navigation technology and the urgent exploration of new resources. Several large-scale voyages, such as Challenger, Tiefsee and Siboga, brought the family Pheronematidae into awareness of scientists. Nineteen new species out of a total of 42 species found were published at this time. In the following 50 years after this golden period, due to the lack of oceanographic expeditions and professionals in deep sea sponge taxonomy and classification, which might have been caused by the severe impact of World War II, only two species were added to the family Pheronematidae. The second period occurred after 1982 when scientists started to show renewed enthusiasm in biodiversity. Along with the development of the economy and new instruments (e.g. the ROV), an increasing number of new species were found, e.g. from French expedition MUSORSTOM and the use of the Jiaolong HOV from China. Another reason for this bloom was also directly correlated to the publication of *Systema Porifera: A Guide to the Classification of Sponges*, a book that clarified the systematic arrangement of species in the phylum Porifera. Taking China as an example, before 2002, only one taxonomist studied sponge classification and only one new species of Hexactinellida, *Monorhaphis intermedia* Li, 1987 (now accepted as *Monoraphis chuni*) was published. After 2002, an increasing number of young scientists from China have overcome language barriers to engage in sponge taxonomy. When the first Jiaolong HOV was launched, increasingly more deep sea samples were collected. Some of the species obtained were new to science, e.g., *Semperella jiaolongae* Gong, Li & Qiu, 2015, *Saccocalyx microhexactin* Gong, Li & Qiu, 2015 and *Lophophysema eversa* Gong, Li, & Qiu, 2014, in addition to three new species reported in this paper. For the COMRA–35 expedition, a total of 23 sponge specimens were collected. Most of them belong to the family Pheronematidae, Euplectellidae and Rossellidae, which need to be examined more carefully before publication. Only Pheronematidae sponges with distinguishing features were presented in this paper. In the near future, there should be further progress reported by Chinese scientists.

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## References

Gong, L., Li, X.Z. & Qiu, J.W. (2014) A new species of Lophophysema (Porifera, Hexactinellida, Hyalonematidae) from the South China Sea. *Zootaxa*, 3884 (6), 553–560.
http://dx.doi.org/10.11646/zootaxa.3884.6.3

Gong, L., Li, X.Z. & Qiu, J.W. (2015) Two new species of Hexactinellida (Porifera) from the South China Sea. *Zootaxa*, 4034 (1), 182–192.
http://dx.doi.org/10.11646/zootaxa.4034.1.9

Ijima, I. (1896) Notice of New Hexactinellida from Sagami Bay. *Zoologischer Anzeiger*, 19, 6.

Ijima, I. (1927) The Hexactinellida of the Siboga Expedition *In:* Weber, M. (Ed.), *Siboga-Expeditie. Uitkomsten op zoologisch, botanisch, oceanographisch en geologisch gebied verzameld in Nederlandsch Oost-lndië 1899- 1900 aan boord H.M.'Siboga' onder commando van Luitenant ter zee 1e kl. G.F. Tydemann. 106 (Monographie VI).* E.J. Brill, Leiden, viii + 383 pp., XXVI pls.

Li, J. (1987) *Monorhaphis intermedia*–a new species of Hexactinellida. *Oceanologia et Limnologia Sinica*, 18, 130–137.

Reiswig, H.M. (1999) New hexactinellid sponges from the Mendocino Ridge, Northern California, USA. *Memoirs of the Queensland Museum*, 44, 499–508.

Reiswig, H.M. (2014) Six new species of glass sponges (Porifera: Hexactinellida) from the north-eastern Pacific Ocean. *Journal of the Marine Biological Association of the United Kingdom*, 94, 267–284.
http://dx.doi.org/10.1017/S0025315413000210

Schulze, F.E. (1904) Hexactinellida. *Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf der Dampfer 'Valdivia' 1898-1899*, 4, 1–266, separated atlas: LII pls., 1 map.
http://dx.doi.org/10.5962/bhl.title.85181

Semper, C. (1868) Über neue Kieselschwämme der Philippinen. *Verhandlungen der physikalisch-medizinische Gesellschaft Würzburg*, 1, 29–30.

Tabachnick, K.R. (1988) Hexactinellid sponges from the mountains of the West Pacific. *In:* Shirshov, P. (Ed.), *Structural and Functional Researches of the Marine Benthos*. Academy of Sciences of the USSR, Moscow, pp. 49–64, 123.

Tabachnick, K.R. & Lévi, C. (2000) Porifera Hexactinellida: Amphidiscophora off New Caledonia. *In*: Crosnier, A. (Ed.), Résultats des Campagnes MUSORSTOM. Vol. 21. *Mémoires du Muséum national d'Histoire naturelle*, Série A, Zoologie, 184, 53–140.

Tabachnick, K.R. & Menshenina, L.L. (2002) Family Pheronematidae Gray,1870. *In:* Hooper, J.N.A. & van Soest, R.W.M. (Eds.), *Systema Porifera. Vol. 1. A guide to the classification of sponges*. Kluwer Academic/Plenum Publishers, New York, Boston, Dordrecht, London, Moscow, pp. 1267–1280.
http://dx.doi.org/10.1007/978-1-4615-0747-5_129

Thomson, C.W. (1878) *The voyage of the "Challenger." The Atlantic; a preliminary account of the general results of the exploring voyage of H.M.S. "Challenger" during the year 1873 and the early part of the year 1876. Vol. 1*. Macmillan and Co., London, xxix + 424 pp.

van Soest, R.W.M., Boury-Esnault, N., Hooper, J.N.A., Rützler, K., de Voogd, N.J., Alvarez de Glasby, B., Hajdu, E., Pisera, A.B., Manconi, R., Schoenberg, C., Janussen, D., Tabachnick, K.R., Klautau, M., Picton, B., Kelly, M., Vacelet, J., Dohrmann, M., Díaz, M.-C. & Cárdenas, P. (2015) World Porifera Database. Available from: http://www.marinespecies.org/porifera (accessed 5 December 2015)

Vinod, K., George, R.M., Thomas, P.A. & Manisseri, M.K. (2012) *Semperella megaloxea* sp. nov. (Family: Pheronematidae): A new hexactinellid sponge from Andaman waters, India. *Indian Journal of Fisheries*, 59, 33–36.