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Ten new species of families Suberitidae and Polymastiidae (Demospongia: Heteroscleromorpha) from Korea

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Ten new species of two families (Suberitidae and Polymastidae) are described from Korea. Six new species in Suberitidae: *Plicatellopsis ramosa* n. sp., *Pseudosuberites anheungensis* n. sp. *P. youngilensis* n. sp., *Suberites hwasunensis* n. sp., *S. chujaensis* n. sp. and *S. rugosa* n. sp. are compared with other similar reported species. All new species differ from previously reported species in morphology, texture, color, skeletal structure, and spicule type. Four new species in Polymastidae: *Polymastia fistula* n. sp., *P. sasuensis* n. sp., *P. viridis* n. sp., and *Weberella haengwonensis* n. sp. are different from previously reported species in the growth form of papillaes and fistules, color and spicule types. For example, *Weberella haengwonensis* is similar to *Weberella verrucosa* in shape, but differs based on surface papillaes and spicule sizes.

Keywords: Korea, new species, Polymastiidae, Suberitidae

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Introduction

The family Suberitidae is characterized by lacking cortex and microscleres, and presence of microrhabds. Tylostyles and styles are arranged in brushes or palisade in the peripheral region (Hooper *et al*., 2002). In this study three genera was identified for this family. Genus *Plicatellopsis*, with only six species reported worldwide (Carter, 1876; Thiele, 1905; Burton, 1932; Koltun, 1966; Lehnert and Stone, 2017), is characterized by ramose shape and a condensed axially tylostyle skeleton at the central axis. Genus *Pseudosuberites* has a tangential ectosomal tylostyles skeleton that may be confused with the choanosomeal skeleton of the tylostyles bundle and individual spicules. Tylostyles are variable in length and there is no localized size category. About 20 species are described worldwide (Bowerbank, 1866; Ridley and Dendy, 1887; Thiele, 1898; 1905; Kirkpatrick, 1900; Sollas, 1902; Tanita, 1965; Koltun, 1966; Hoshino, 1981; Desqueyroux-Faúndez, 1990). Genus *Suberites* has an ectosomal skeleton consisting of bouquets of small tylostyles. If present, microscleres are spined centrotylote microstrongyles. Over 80 species are reported worldwide (Johnston, 1842; Duchassaing de Fonbressin and Michelotti, 1864; Ridley and Dendy, 1887; Thiele, 1898; 1905; Burton, 1930; Sim and Kim, 1994; Shim and Sim, 2008).

In this study, two genera are reported for the family Polymistidae. Genus *Polymastia*, is spherical or cushion shaped, always with papillae or long fistules, and skeleton composed of radial tracts of principal spicules. About 73 species of *Polymastia* are described worldwide (Thiele, 1898; 1905; Bergquist, 1961; Koltun, 1966; Pulitzer-Finali, 1983; 1986; Boury-Esnault *et al*., 1994; Kelly and Bergquist, 1997; Lehnert *et al*., 2005; Boury-Esnault and Bezac, 2007; Plotkin *et al*., 2018). Genus *Weberella* has small aquiferous papillae. Only two categories of tylostyles are present. Four species are reported worldwide (Vacelet, 1960; Samaai and Gibbons, 2005; Austin *et al*., 2014).

Materials and Methods

Sponge collections were made from Yeongilman (Gyeongsangbuk-do), Anheung (Taean-gun, Chungcheongnam-do), and Jeju-do, Korea. Specimens were taken from intertidal zone to depth of 5−45 m using SCUBA during the 1967, 1986, 2005 and 2010−2013. Collected specimens were preserved in 95% ethyl alcohol and identified based on their morphological characteristics. The external feature of sponges was observed with a stereo microscope (Stemi SV. 6, Carl Zeiss, Germany). Spicules

were observed by light microscope (Axioskop 2, Carl Zeiss, Germany) and scanning electron microscope (SEM, HITACHI S-3000N). The type specimens were deposited in the National Institute of Biological Resources (NIBR), Incheon, Korea.

Systematic Accounts

Phylum Porifera Grant, 1836
Class Demospongiae Sollas, 1885
Order Suberitida Chombard & Boury-Esnault, 1999
Family Suberitidae Schmidt, 1870
Genus *Plicatellopsis* Burton, 1932

1. *Plicatellopsis ramosa* n. sp. (Fig. 1)
가지프리카텔로프해면 (신칭)

Type specimen. Holotype (NIBRIV0000881725), Korea: Hangaechang, Seogwi-dong, Seogwipo-si, Jeju-do, 21 Oct 2013, by SCUBA, depth 45 m, deposited in NIBR.

Description. Thickly ramose sponge, dichotomously divided into a three-dimensional branches. Size up to 21 cm height and 12 cm wide. End of branches are not sharp but rather blunt, 5–8 mm in diameter. Thick short stalk attached to the substrate. Surface smooth and velvety with spicules. Oscules open out of branches, 0.5–1 mm in diameter. Color in life orange red, yellowish beige in alcohol. Texture firm and not easy to cut because central axial skeleton has bundle of large tylostyles, forming the central core of the each branch of the sponge (Fig. 1G, H).

Skeleton: Ectosomal skeleton, a dense palisade of small and large tylostyles, 300–500 × 5–10 μm. Central axial skeleton, a dense of mass of aligned spicules bundles, 2.5 mm in diameter. Axial large tylostyles, 800–1200 × 20–30 μm.

Etymology. The species name, ramosa, is named after the branch shape of the sponge.

Remarks. This new species is similar to *Plicatellapsis arborescens* Burton in the ramose shape of sponge, but differs in the size of spicules. Large tylotyles in central axial of this new species are thicker than *P. arborescens*.

Genus *Pseudosuberites* Topsent, 1896

2. *Pseudosuberites anheungensis* n. sp. (Fig. 2)
안흥의코르크해면 (신칭)

Type specimen. Holotype (NIBRIV0000879329), Korea: Anheung Harbor, Geunheung-myeon, Taean-gun, Chungcheongnam-do, Mar 1986, Sim, C. J., by fishing net, deposited in NIBR.

Description. Long body sponge, spirit with several parts at the top of the sponge, size 17 × 4 × 2 cm. Surface smooth, ectoderm hard due to thick tangential arrangement of spicules. Oscules very rare, 1.2 mm in diameter. Color dirty grayish yellow. Texture very hard and compressible.

Skeleton: Thick tylostrongyles, 200–340 × 8–10 μm, thin tylostrongyles, 260–350 × 2–5 μm, and tylostyles, 150–350 × 2–10 μm. Microrhabds, 20–45 μm.

Etymology. The species name, anheung, is named after the type locality of Anheung Harbor, Chungcheongnam-do.

Remarks. This new species is similar to *Suberites virgultosa* in growth form, but differs in texture and spicules types. The new species has mostly tylostrongyles, as opposed to tylostylesin *S. virgultosa*. Texture of new species is very hard like stone because the surface skeleton is covered with a thick tangential arrangement of spicules and choanosome is slightly compressible. *S. virgultosais* softer than this new species.

3. *Pseudosuberites youngilensis* n. sp. (Figs. 3, 4)
영일의코르크해면 (신칭)

Suberites ficus; Tanita S., 1965: 95–97.
Kim, Rho and Sim, 1968: 40, pl. 2, fig. 9, text-fig. 10.
Rho, Kim and Sim, 1969: 156, pl. 2, fig. 7.

Type specimen. Holotype (NIBRIV0000879327), Korea: Yeongilman, Guman-ri, Homigot-myeon, Pohang-si, Gyeongsangbuk-do, 25 July 1967, Rho BJ, by fishing net, deposited in NIBR.

Description. Irregular elliptical mass sponge, size up to 9 × 4.5 × 3 cm. Upper surface with lobate projections and underside smooth with a large hole, 1.5 × 1 cm in diameter. *Pagurus pectinatus*, a crustacean (hermit crab), resides in the hole. Oscules rare, 0.7–1 mm in diameter. Color in life orange red. Texture firm and compressible.

Skeleton: Small tylostyles and microrhabds arranged tangentially at the surface. Large tylostyles showed at subsurface (Fig. 3C). Mostly small and large tylostrongyles appeared at the underside of the sponge near the hole (Fig. 4B). Numerous microrhabds appear at inside wall of the sponge hole. Spicules. Tylostrongyles, 70–110–350 × 5–15 μm and tylostyles, 110–340 × 8–10 μm. Microrhabds, 20–35 μm.

Etymology. The species name, youngilensis, is named after the type locality of Youngilman, Gyeongsangbuk-do.

Remarks. This new species is easily distinguished from *Suberites ficus* Johnston (1842) in shape and spicules. *Suberites ficus* has a pear shape, surface even, without hole containing hermit crab, and also spicules without microscleres. This new species is not sessile, but independent

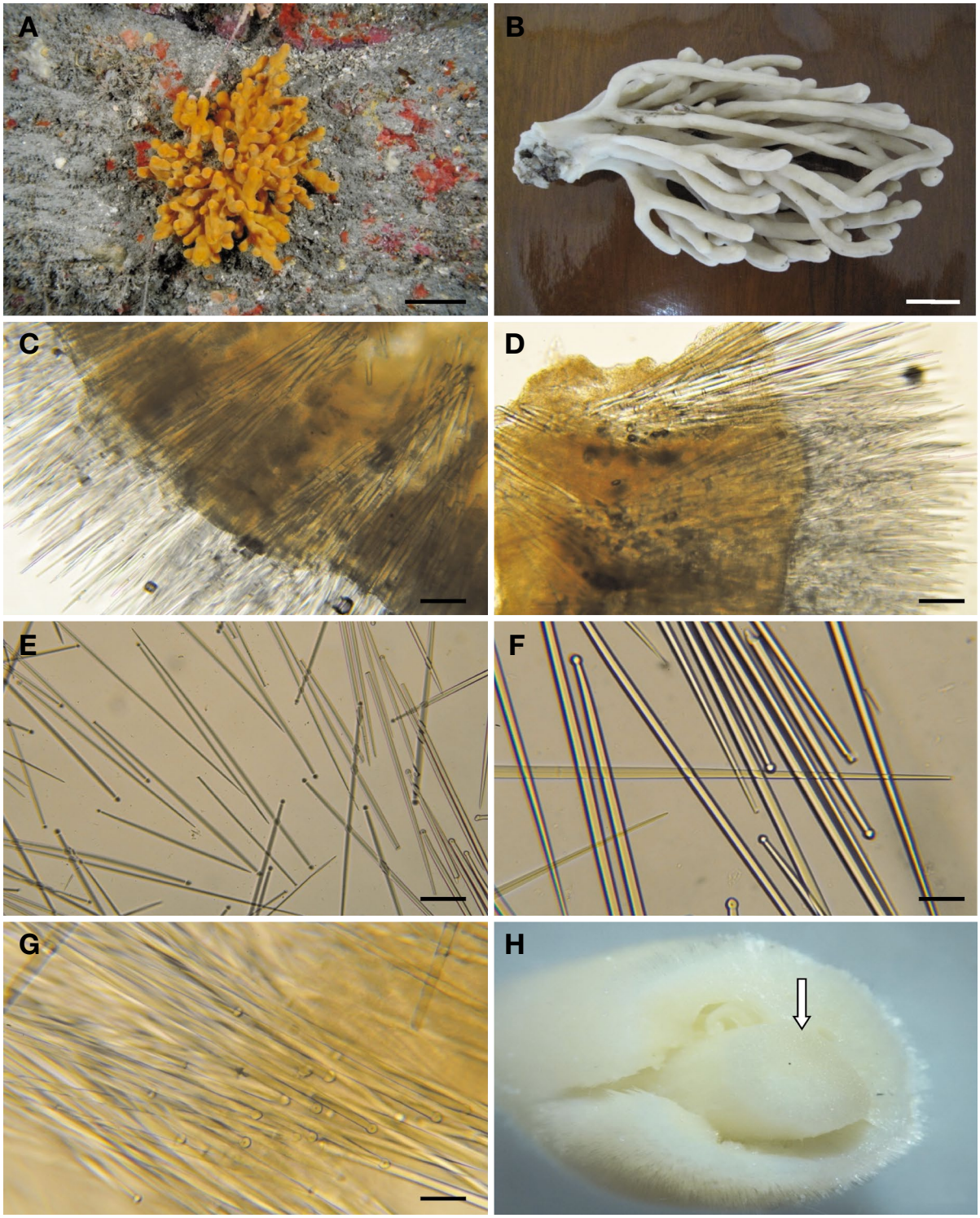

Fig. 1. *Plicatellopsis ramosa* n. sp. A, external morphology in situ; B, external morphology; C, D, surface and subsurface spicules; E, F, tylostyles; G, bundle of spicuels; H, spicules bundle in center of branch. Scale bars: A = 3 cm, B = 2.5 cm, C–E = 100 μm, F, G = 50 μm.

because no part is attached to the substrate. There is no trace of any kind of shell in and out of the sponge. Tanita (1965) observed that specimens occupied by hermit crabs are very rare, however, most of our specimens contained hermit crabs in the underside hole. Lobate projection of the upper part of sponge is variable, some few large lobes

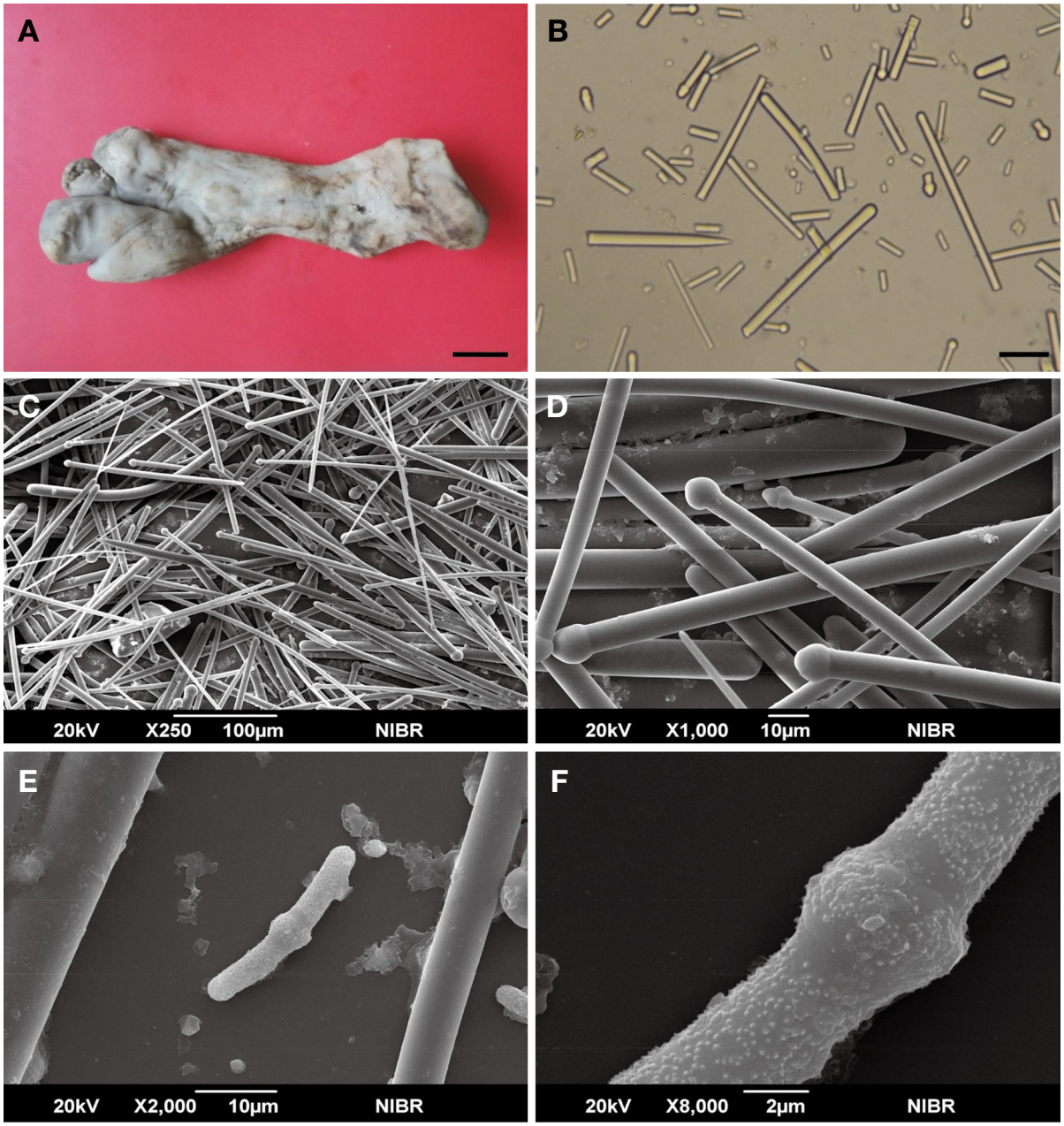

Fig. 2. *Pseudosuberites anheungensis* n. sp. A, external morphology; B, tylostrongyles closed up; C, tylostyles; D, closed head of tylostrongyles; E, microrhabd; F, microrhabd closed up. Scale bars: A = 2 cm, B = 25 μm, C = 100 μm, D, E = 10 μm, F = 2 μm.

or many small lobes.

Genus *Suberites* Nardo, 1833

4. *Suberites hwasunensis* n. sp. (Fig. 5)
화순코르크해면(신칭)

Type specimen. Holotype (NIBRIV0000881726), Korea: Hwasun Harbor, Andunk-myeon, Seogwipo-si, Jeju-do, 23 April 2005, by SCUBA, depth 45 m, deposited in NIBR.

Description. Thickly ramose or irregularly flabellate sponge, size up to 10 × 4 cm. Thick branches, 1.5 cm in diameter. Surface smooth and velvety with numerous thin and short spicules. Oscules not distinct. Color in life orange red, yellowish beige in spirit. Texture firm but are easily cut off.

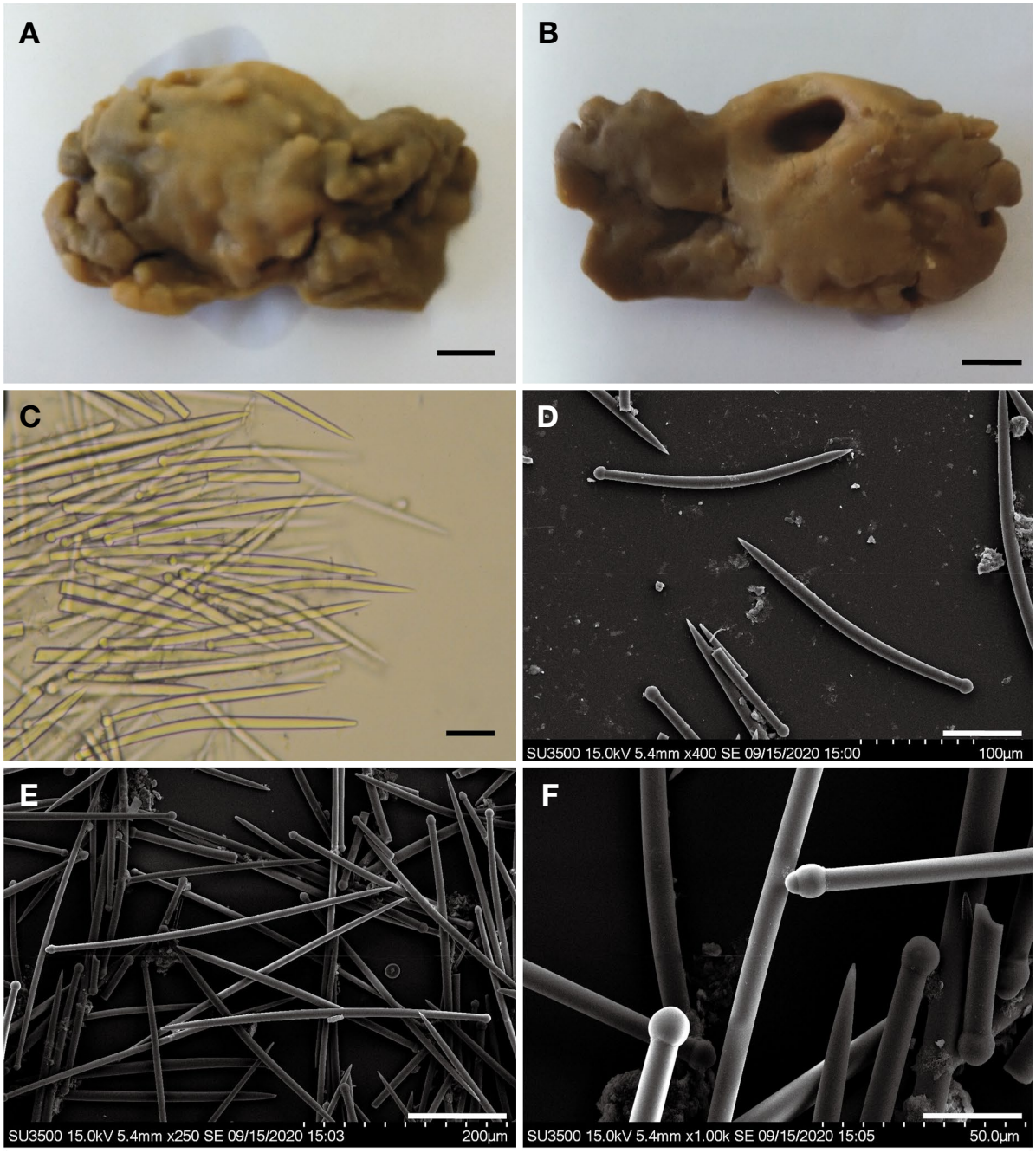

Fig. 3. *Pseudosuberites youngilensis* n. sp. A, external morphology; B, underside of sponge with hole; C, bundle of tylostyles (upper part); D, tylostyles; E, spicules (upper part); F, head of tylostyle. Scale bars: A, B = 1 cm, C, D = 100 μm, E = 200 μm, F = 50 μm.

Skeleton: Ectosomal, brush like skeletal structure (Fig. 5C, D). Large tylostyles, 800−1000 × 20−30 μm and small tylostyles, 450 × 10 μm.

Etymology. The species name, hwasunensis, is named after type locality of Hwasun Harbor, Seogwipo-si, Jeju-do.

Remarks. This new species is similar to *Suberites vergultosa* in skeletal structure but differs in sponge shape and texture. This new species has no tylostrongyles or microscleres.

5. *Suberites chujaensis* n. sp. (Fig. 6)
추자코르크해면 (신칭)

Type specimen. Holotype (NIBRIV0000879328), Korea: Chujado, Chuja-myeon, Jeju-si, Jeju-do, 9 Oct 2012, Kim

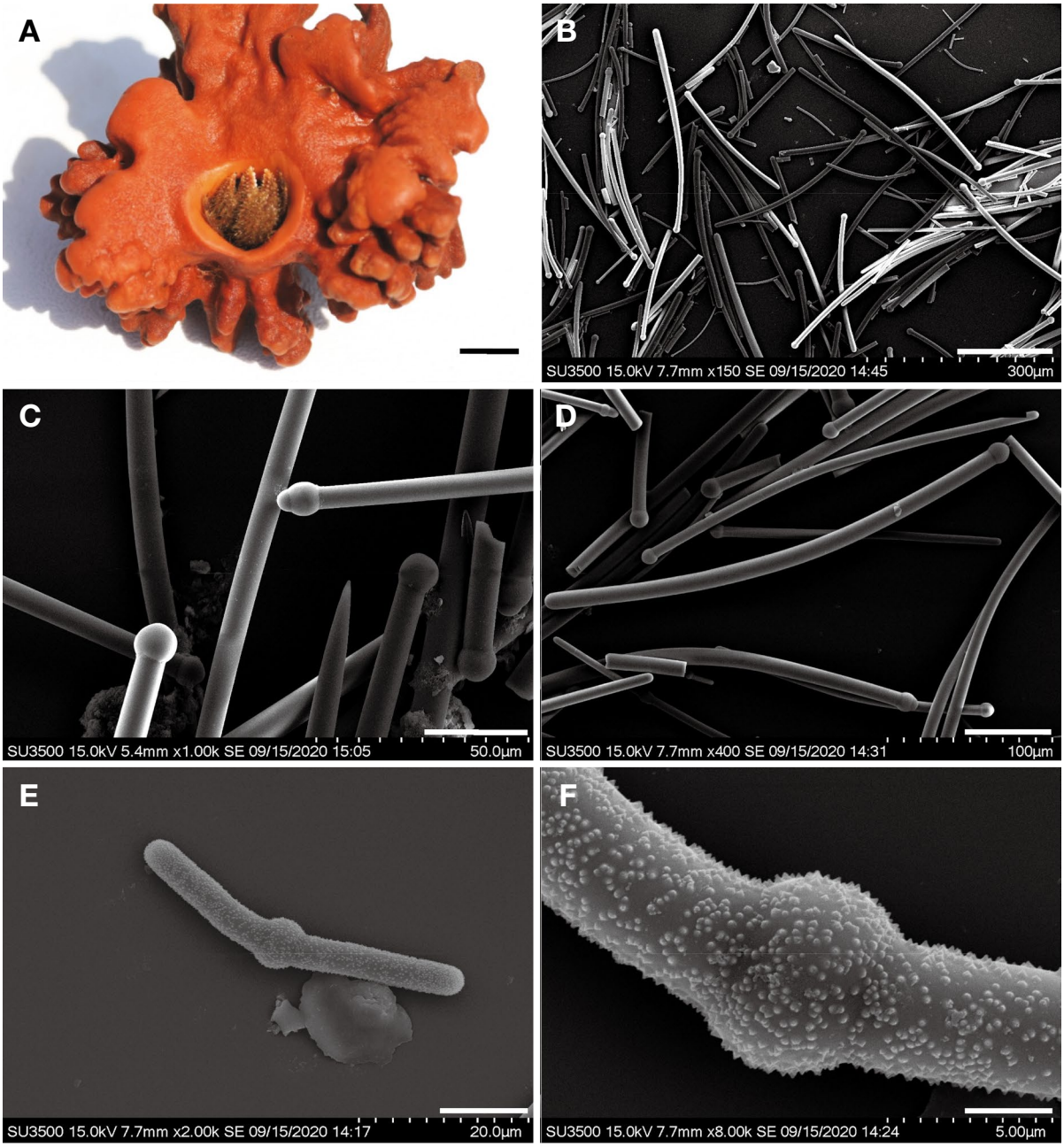

Fig. 4. *Pseudosuberites youngilensis* n. sp. A, hermit crab live in hole (under side); B, spicules; C, head of spicules; D, tylostrongyles; E, microrhabd; F, microrhabd closed up. Scale bars: A = 1.3 cm, B = 300 µm, C = 50 µm, D = 100 µm, E = 20 µm, F = 500 µm.

HS, by SCUBA, depth 25 m, deposited in NIBR.

Description. Thick, irregular elliptical mass sponge, size up to 13 × 6 × 2.5 cm. Surface with numerous protruding small bumps, not papillae. Oscules open on the surface, 1–2 mm in diameter. Color in life orange red. Texture firm and incompressible.

Skeleton: Irregular arrangement of spicules mixed with dense collagen. Tylostyles, 500–700 µm and long tylostyles, partly curved or flexuous shape.

Etymology. The species name, chujaensis, is named after the type locality of Chujado, Jeju-si, Jeju-do.

Remarks. The plate-like shape of this new species is similar to *Suberites hataedoensis* Shim and Sim 2008, but differs in thickness of sponge body and roughness of surface. *S. hataedoensis* has numerous oscules at the surface and the body thickness is less than the new species.

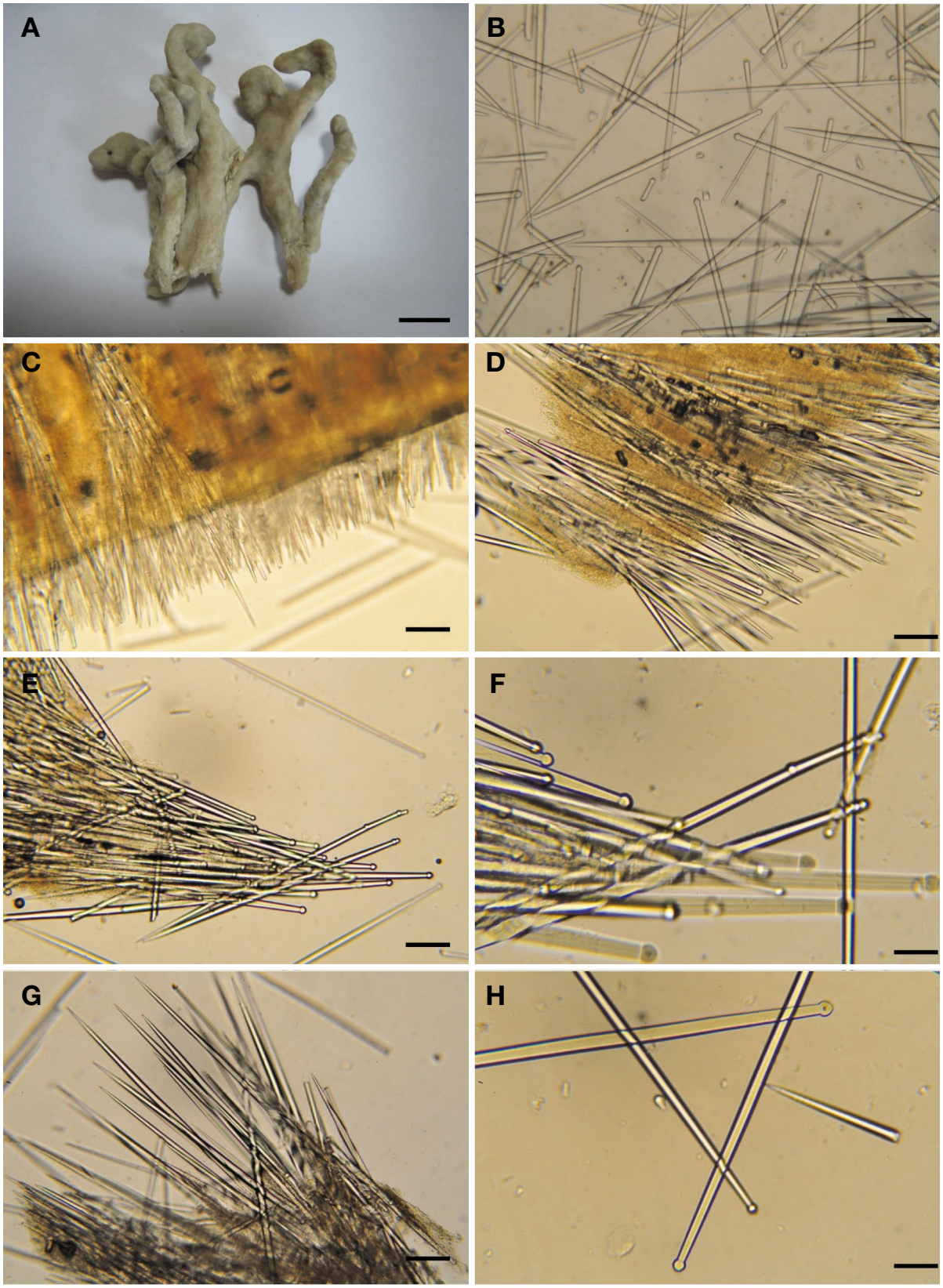

Fig. 5. *Suberites hwasunensis* n. sp. A, external morphology; B, spicules; C, D, brush-like surface spicules; E, F, bundle of spicules at choanosome; G, H, tylostyles. Scale bars: A = 1 cm, B, C = 100 μm, D, E = 50 μm, F–H = 25 μm.

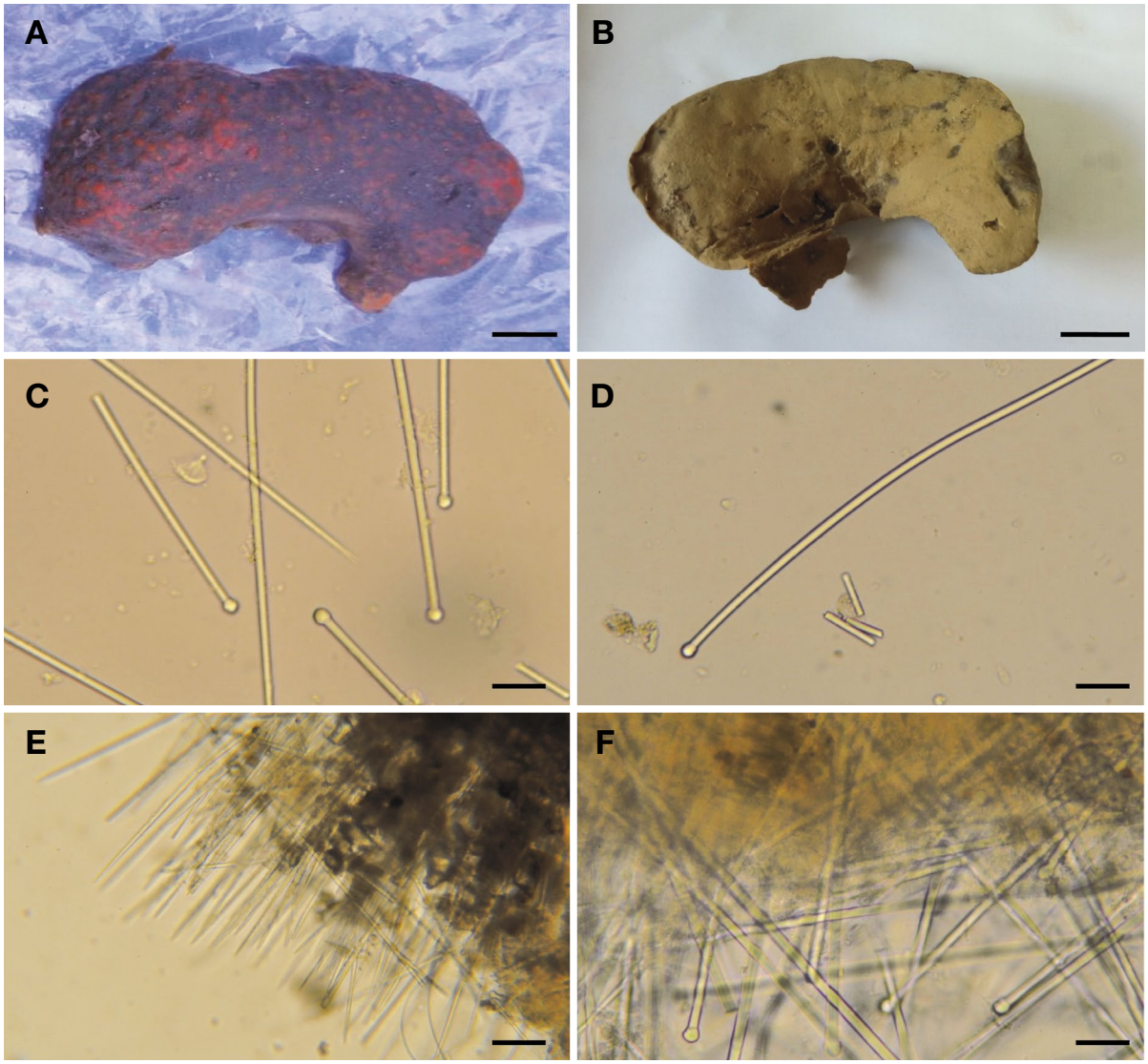

Fig. 6. *Suberites chujaensis* n. sp. A, external morphology; B, underside of sponge; C, tylostyles; D, flexus spicules; E, velvety brush-like surface spicules; F, choanosome spicules. Scale bars: A = 1.6 cm, B = 2 cm, C, D, F = 50 μm, E = 100 μm.

6. *Suberites rugosa* n. sp. (Fig. 7)
주름코르크해면 (신칭)

Type specimen. Holotype (NIBRIV0000881727), Korea: Sasudo, Chuja-myeon, Jeju-si, Jeju-do, 2 Jun 2013, by SCUBA, depth 30–35 m, deposited in NIBR.

Description. Round or cushion shape sponge, size up to 9 × 6 × 4 cm. Surface, not smooth due to thin wrinkles and bundle of spicules with spongin membrane. Oscules open on the top of the surface, 2–3 mm in diameter. Color in life grayish red. Texture firm.

Skeleton: Large and small tylostyles are not easily differentiated. Spicules in choanosomal skeleton arranged irregularly. Sponge has heavy collagen and spicules are not easily separated. Large tylostyles, 650–800 × 5–10 μm and small tylostyles, 150–250–400 × 5 μm.

Etymology. The species name, rugosa, is named after the shape of sponge with wrinkles on the surface.

Remarks. This new species is similar to *Suberites waedoensis* Shim and Sim 2008 in sponge shape and spicules composition, but differs in surface, texture and color. This new species has grayish red color, and texture firm with extremely rough surface.

Order Polymastiida, Morrow & Cárdenas, 2015
Family Polymastiidae Gray, 1867
Genus *Polymastia* Bowerbank, 1862

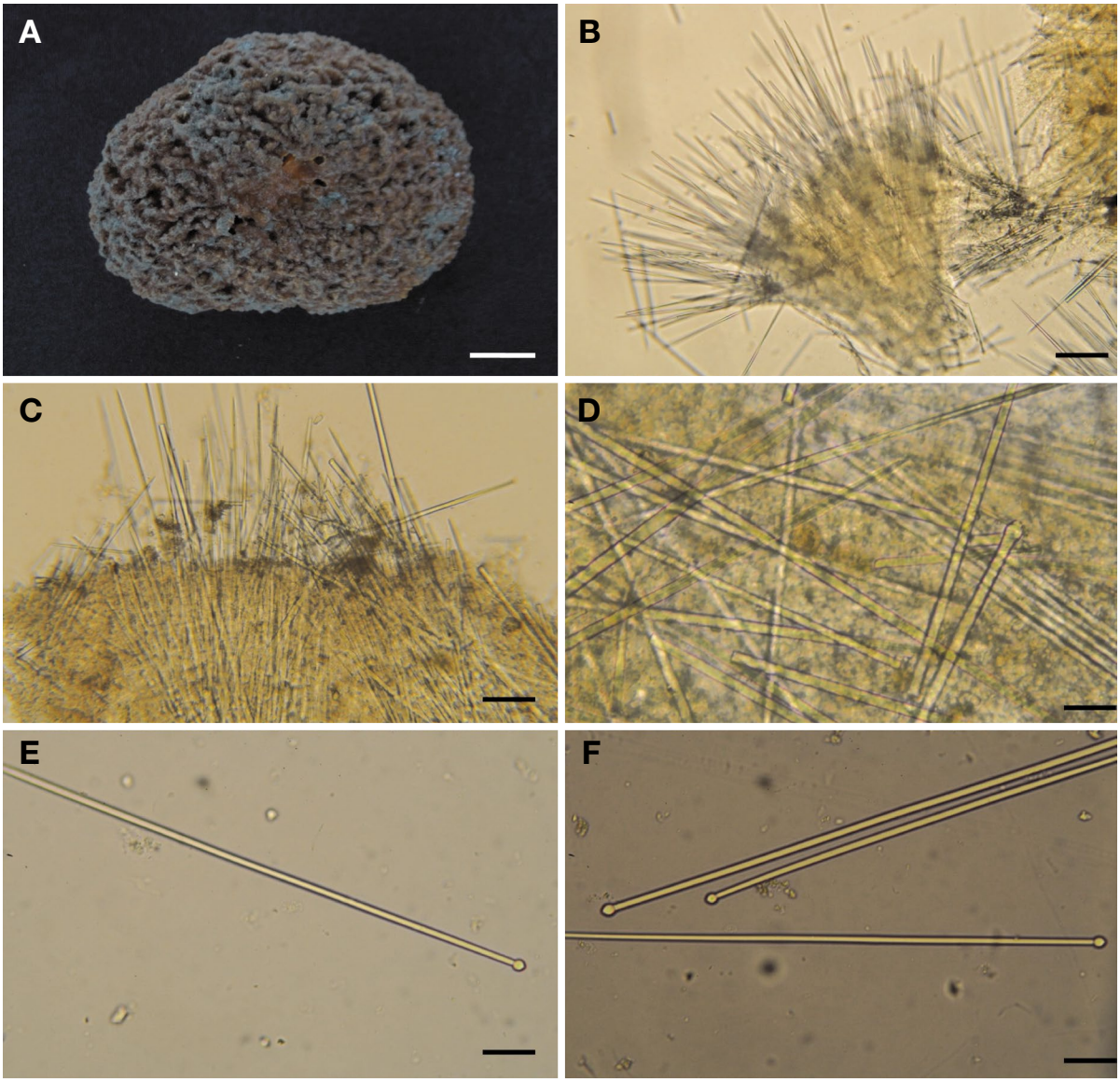

Fig. 7. *Suberite srugosa* n. sp. A, external morphology; B, C, brush-like surface spicules; D, spicules; E, F, tylostyles. Scale bars: A = 1.5 cm, B = 100 μm, C–F = 50 μm.

7. *Polymastia fistula* n. sp. (Figs. 8, 9)
국수다공해면 (신칭)

Type specimen. Holotype (NIBRIV0000881728), Korea: Sasudo, Chuja-myeon, Jeju-si, Jeju-do, 2 Jun 2013, by SCUBA, depth 30–35 m, deposited in NIBR.

Description. Thick encrusting sponge, size up to 7 × 6 × 0.5 cm. Surface with numerous protruding long and thin noodle-like fistulae, 1–4 cm long, 1.5–2 mm thick, number of fistulae in small sponge 40 and large sponge over 80. Surface between papillae rough due to pieces of shell and sand. Oscules not clear. Color in life yellow. Texture firm, almost incompressible.

Skeleton: Surface of fistulae has small tylostyles and centrotylote microxeas and inside has thick large tylostyles (Fig. 8D). Large tylostyles, 1,100–1,400 × 15–20 μm, medium tylostyles, 500–700 × 10 μm and small tylostyles, 150–170 × 3–7 μm. Ectoderm of sponge, 2 mm thick, usually radial arrangement of tylostyles (Fig. 8C). Centrotylote microxeas, 70–100 μm.

Etymology. The species name, fistula, is named after sponge shape with numerous long fistulae at the surface.

Remarks. This species has numerous long and thin fistulae at the surface numbering 40–80. The shape of fistulae is very similar to *P. lorum*. *Polymastia lorum*

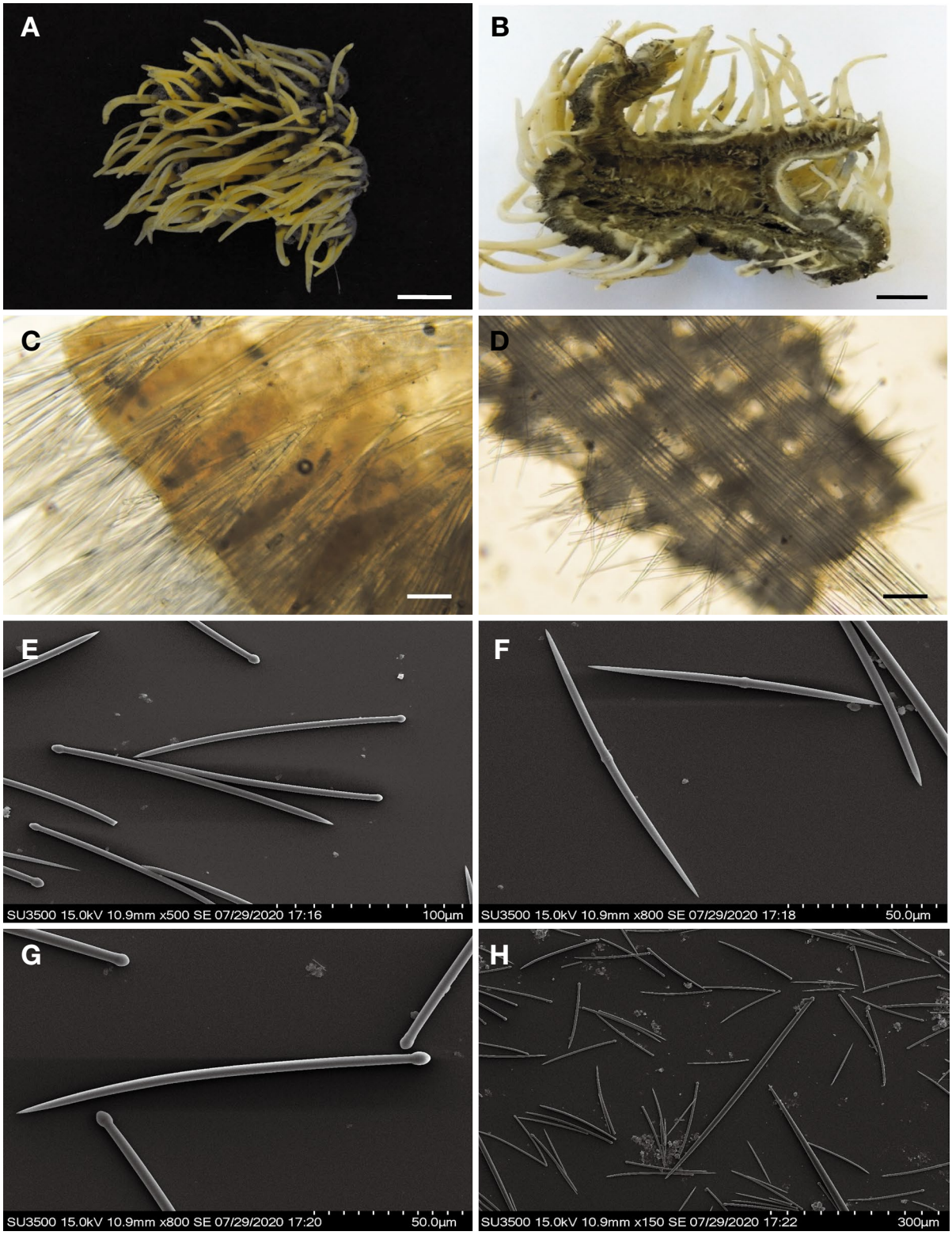

Fig. 8. *Polymastia fistula* n. sp. A, external morphology; B, underside of sponge; C, subsurface skeletal structure; D, skeletal structure of fistulae (large spicules inside, small tylostylesat the surface); E, tylostyles; F, centrotylote microxeas; G, tylostyles; H, large tylostyles and centrotylote microxeas. Scale bars: A = 1.4 cm, B = 1 cm, C–E = 100 µm, F, G = 50 µm, H = 300 µm.

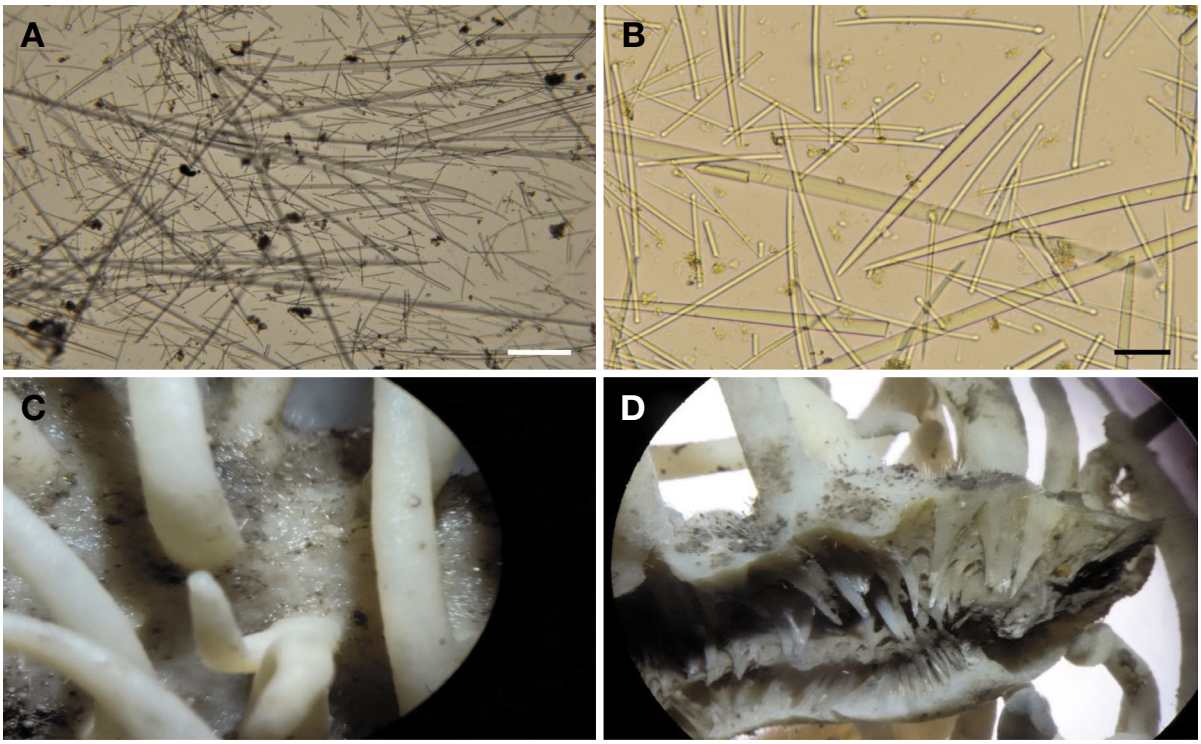

Fig. 9. *Polymastia fistula* n. sp. A, B, large and small spicules; C, surface between papillae under the dissecting microscope; D, bundle of large spicules underside of sponge the dissecting microscope. Scale bars: A = 100 μm, B = 50 μm.

has a small number of long papillae (12) and their size of papillae is longer than the new species. In *P. lorum*, ectodermal layer is common in centrotylote microxeas while in the new species is common through fistulae.

8. *Polymastia sasuensis* n. sp. (Fig. 10)
사수다공해면 (신칭)

Type specimen. Holotype (NIBRIV0000881729), Korea: Sasudo, Chuja-myeon, Jeju-si, Jeju-do, 2 Jun 2013, by SCUBA, depth 30−35 m, deposited in NIBR.

Description. Cushion shape sponge, size up to 7 × 6.5 × 4 cm. Surface with numerous protruding small papillae. Oscules open at apical of each conical papillae, 0.5 mm in diameter. Color is grayish green. Texture firm.

Skeleton: Ectosome 1 mm thick and densely packed with spicules and collagen. Thin long tylostyles brushed out to the surface in combination with medium and small sized spicules. In choanosome, long spicules around 900 μm, mix with medium and small sized spicules. Large tylostyles, 700−1,100 × 8−15 μm, medium tylostyles, 500−600 × 10 μm and small tylostyles, 150−350 × 3−7 μm.

Etymology. The species name, sasuensis, is named after type locality Sasudo, Chuja-myeon, Jeju-do.

Remarks. This new species is similar to *P. viridis* in sponge shape but differs in thickness of spicules. In *P. viridis*, large and small tylostyles are thicker than *P. sasuensis*.

9. *Polymastia viridis* n. sp. (Fig. 11)
연두다공해면 (신칭)

Type specimen. Holotype (NIBRIV0000881730), Korea: Sasudo, Chuja-myeon, Jeju-si, Jeju-do, 2 Jun 2013, by SCUBA, depth 30−35 m, deposited in NIBR.

Description. Hemispherical cushion shape sponge, size up to 6.5 × 4.5 × 3 cm. Surface with numerous tubercula papillae. Ectosome, 2−3 mm thick. Oscules, 0.5−1 mm in diameter are barely visible at the end of papillae. Color in life greenish yellow. Texture hard.

Skeleton: Ectosomal skeleton consists of small tylostyles on the sponge surface with mixture of large and small tylostyles pointing outward. Choanosomal skeleton densely packed with large tylostyles. Spicules. Large tylostyles, 700−950 × 10−15 μm, medium tylostyles, 350−560 × 10−15 μm and small tylostyles, 170−245 × 5−7 μm.

Etymology. This species name, viridis, is named after the sponge green color in life.

Remarks. This new species is similar to *P. sasuensis*,

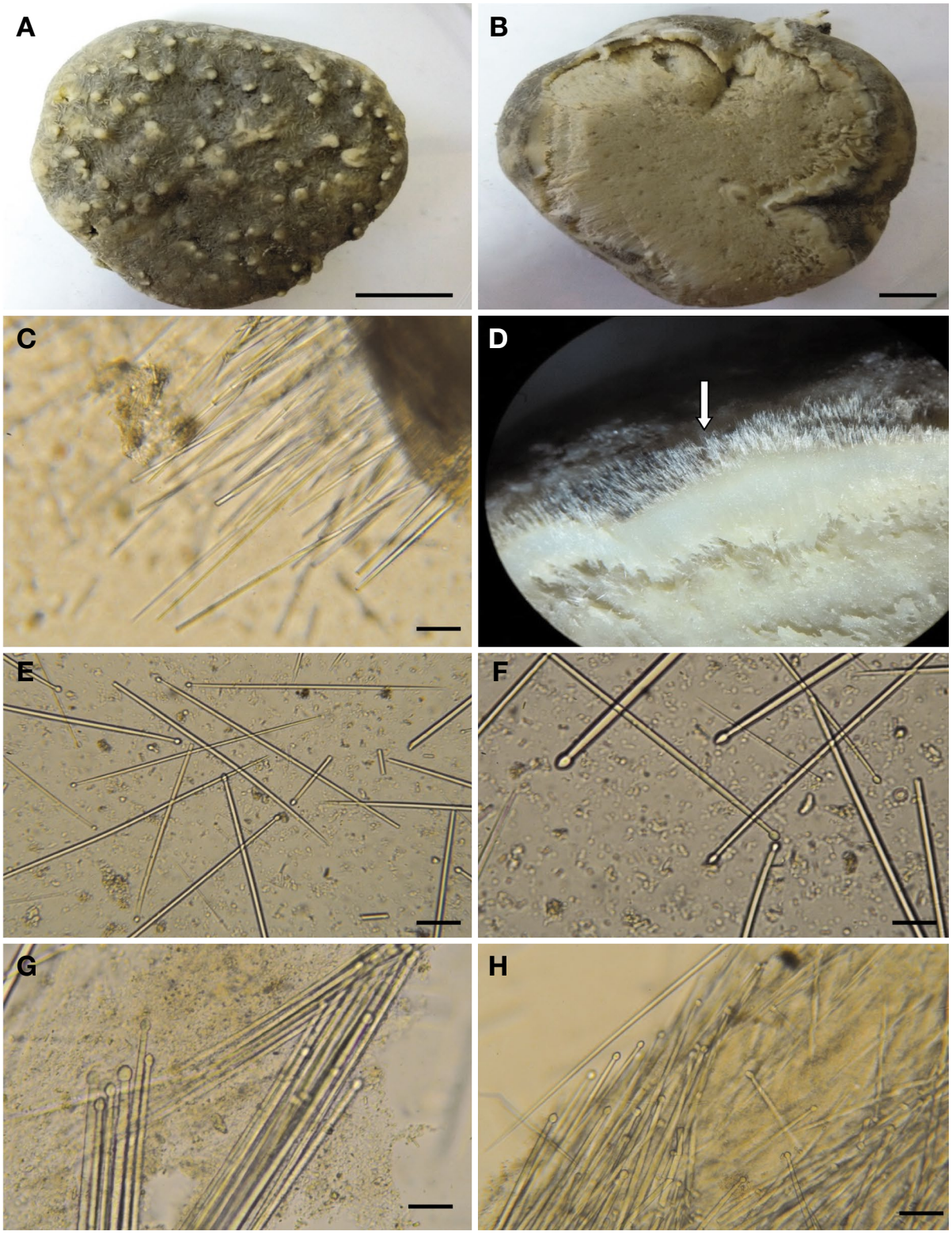

Fig. 10. *Polymastia sasuensis* n. sp. A, external morphology; B, underside of sponge; C, spicules with ectoderm; D, hair-like surface spicules under the dissecting microscope; E, F, tylostyles; G, bundle of tylostyles; H, tylostyles with spongin. Scale bars: A = 2 cm, B = 1 cm, C, F–H = 50 μm, E = 100 μm.

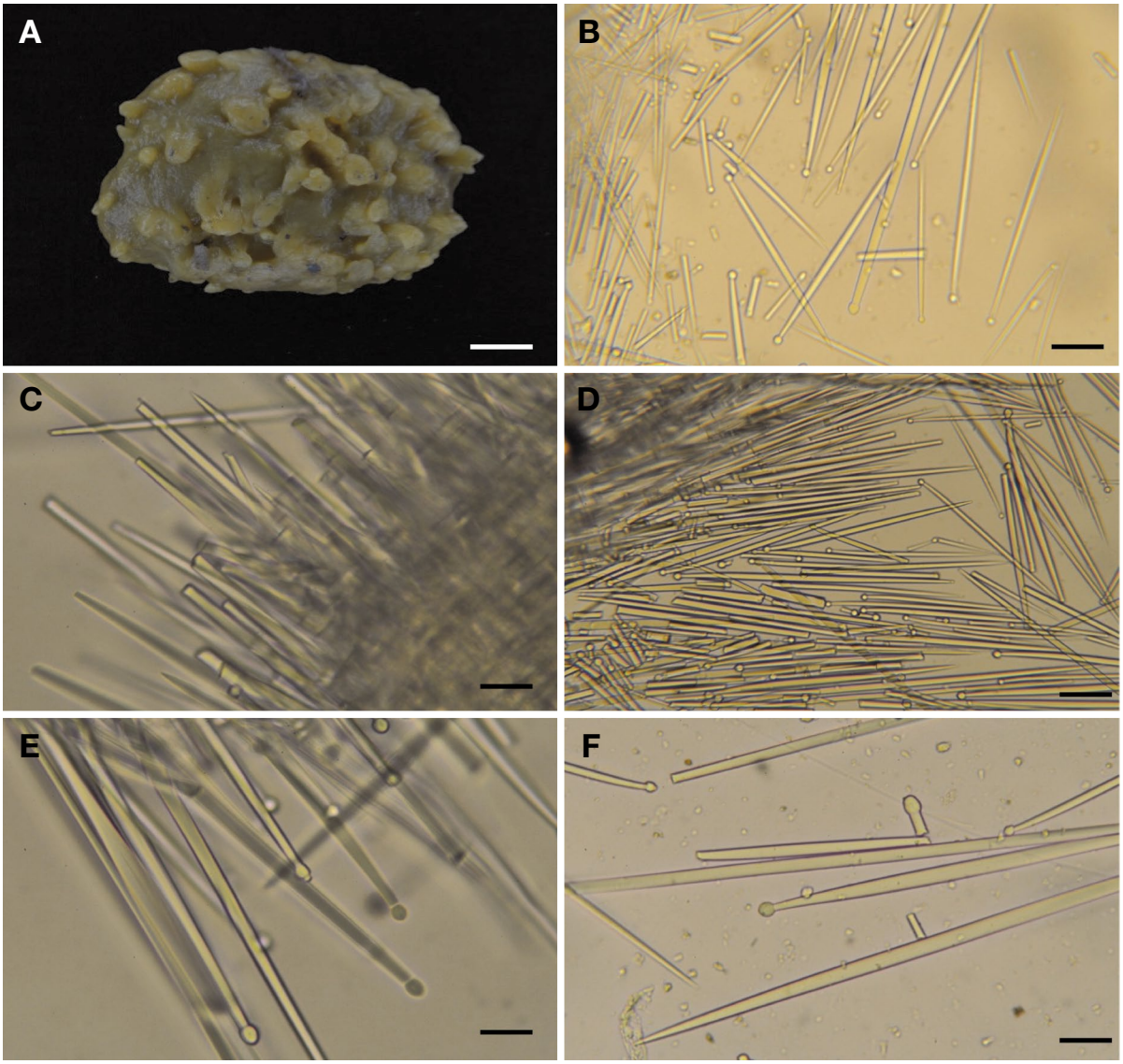

Fig. 11. *Polymastia viridis* n. sp. A, external morphology; B, spicules; C, D, brush-like spicules at the ectodome; E, head of tylostyles; F, sharp end of spicules. Scale bars: A = 1 cm, B = 50 μm, C–F = 25 μm.

but differs in surface papillaes. This species has large tube-like papillae, but *P. sasuensis* has numerous small papillae. This species is similar to *P. offinis* Thiele in size of spicules, but differs in papillae shape. *Polymastia offinis* has conical shape of papillae, but papillae of this species are large tubercular shape.

Genus *Weberella* Vosmaer, 1885

10. *Weberella haengwonensis* n. sp. (Fig. 12)
행원갈고리해면 (신칭)

Type specimen. Holotype (NIBRIV0000879330), Korea: Haengwon-ro, Gujwa-eup, Jeju-si, Jeju-do, 16 May 2010, Kim BI, by SCUBA, depth 25 m, deposited in NIBR.

Description. Flabellate shape with thick and short stalk. Size up to 5.5 × 3 × 1 cm. Surface smooth covered by short conical papillae which are semi-transparent in life and when preserved, papillae become highly contractile and invisible on the surface. Oscules opened at apical of each papilla. Texture firm and elastic. Color orange in life, beige in alcohol.

Skeleton: Cortex, 0.5 mm thick, consists of a dense palisade of small tylostyles. Choanosome irregularly reticulated with medium size tylostyles. Large tylostyles cover part of the stalk. Heavy collagen mixed with spicules. Spicules. Large subtylostyles, 1,000–1,100 × 10–

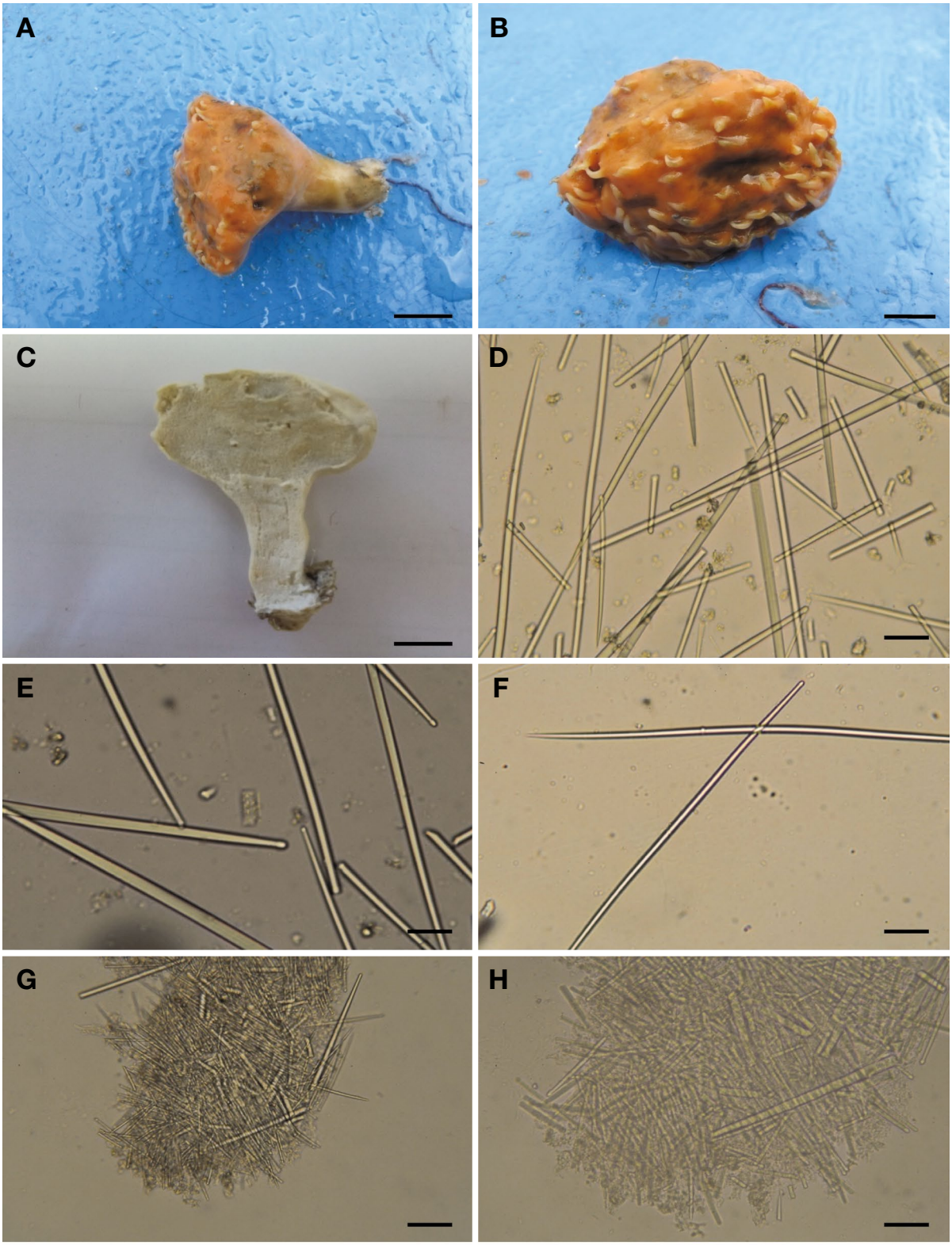

Fig. 12. *Weberella haeungwonensis* n. sp. A, external morphology; B, surface with conical papillae; C, half section of sponge in vertical cut; D, large and small tylostyles; E, tylostyles; F, flexus tylostyles; G, H, small stylostyles at the surface. Scale bars: A = 1.4 cm, B = 2 cm, C = 1 cm, D, F, G = 50 μm, E, H = 25 μm.

15 μm at the center of stalk, medium tylostyles, 400–500 × 10 μm and small tylostyles, 115–150 × 3–4 μm.

Etymology. The species name, haengwonensis, is named after the type locality of Haengwon, Jeju-si, Jeju-do.

Remarks. This new species is similar to *W. verrucosa* in shape with thick stalk, but differs vastly in surface papillae and spicule size. This new species has more thin and sharp papillae, which are semitransparent and sometimes resemble hooks. Spicules are longer than those of *W. verrucosa* (Vacelet, 1960).

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