

Research article

urn:lsid:zoobank.org:pub:C8750724-2EDB-4F2D-9068-68302E413FA5

New species of deep-sea *Heteropolypus* soft corals (Anthozoa: Octocorallia) from the Kurile Islands, Sea of Okhotsk (Northwest Pacific), with summary data on distinctive characters of the known species of the genus

Tatiana N. DAUTOVA

A.V. Zhirmunsky National Scientific Center of Marine Biology, Far Eastern Branch,
Russian Academy of Sciences, Vladivostok 690041, Russia.
Email: tndaut@mail.ru

urn:lsid:zoobank.org:author:76084673-E4B7-4BF6-88E3-66B297CB3E22

Abstract. The present paper records two new species of deep-sea soft corals, *Heteropolypus annae* sp. nov. and *H. roseus* sp. nov., from the area of the Kurile Islands, Sea of Okhotsk, Northwest Pacific. Distinctive characters for each new species are provided and depicted with scanning electron microscopy imaging. The present finding of previously undescribed species emphasizes the need for further surveys, particularly in deeper waters in the area to improve knowledge of the deep-sea Octocorallia fauna in the Far East seas. The distribution of species of *Heteropolypus* in the temperate Northwest Pacific and their taxonomy characters are discussed based on the published literature and own data. A modified diagnosis of the genus is proposed.

Keywords. Octocorallia, *Heteropolypus annae* sp. nov., *Heteropolypus roseus* sp. nov., deep-sea corals, Northwest Pacific.

Dautova T.N. 2022. New species of deep-sea *Heteropolypus* soft corals (Anthozoa: Octocorallia) from the Kurile Islands, Sea of Okhotsk (Northwest Pacific), with summary data on distinctive characters of the known species of the genus. *European Journal of Taxonomy* 806: 128–147. <https://doi.org/10.5852/ejt.2022.806.1711>

Introduction

Octocorallia Haeckel, 1866 (gorgonians and soft corals) is one of the most essential components of marine ecosystems, spreading from the littoral to great depths. Gorgonian corals (representatives of the order Alcyonacea Lamouroux, 1812) being long-lived species reach large sizes and provide important habitat for a variety of taxa in deep-sea ecosystems. Settlements of the deep-sea gorgonians, i.e., ‘coral gardens’, on seamounts and guyots create feeding habitats, refuge and structural complexity leading to the development of the diverse and rich marine communities including fish, echinoderms, crustaceans and many other invertebrates (Auster *et al.* 2005; Baco & Shank 2005; Roberts *et al.* 2006; Stone & Shotwell 2007; Buhl-Mortensen *et al.* 2016). Soft corals (alcyonaceans without consolidated axial supporting structures) are also an important component of the benthic communities, making a significant contribution to biodiversity in deep-sea ecosystems in the Northern Pacific. At least five genera and six species of soft

corals were recorded near western coast of North America, Alaska and Hawaii including mushroom corals *Heteropolypus japonicus* (Nutting, 1912) and *H. ritteri* (Nutting, 1909) (Cairns & Hourigan 2017). Two species of the genus, *Heteropolypus* cf. *japonicus* (Nutting, 1912) and *Heteropolypus* sp., were recorded in the Aleutian Islands region (Stone Cairns 2017). Remarkable corals with a mushroom-shaped colony body belonging to the genera *Anthomastus* Verrill, 1878, *Pseudoanthomastus* Tixier-Durivault & d'Hondt, 1974 and *Heteropolypus* Tixier-Durivault, 1964 are distributed in the deep-sea regions of the ocean from 130 to 2567 m and may be considered as deep-water (d'Hondt & d'Hondt 2020).

Data on Alcyonacea corals of the Sea of Okhotsk, including the Kurile Islands, are scarce because only a few researches of soft corals have focused on this area (Dautova 2018). Mushroom soft corals were first documented for this area from the Shikotan Island (Kurile Islands, 1430 m depth) where a new species *Anthomastus rylovi* Naumov, 1952 was found and described using the material from the 1948 expedition of the Russian Academy of Science (Naumov 1952). Later the species was moved to the genus *Heteropolypus* based on its morphology (Molodtsova 2013: 506).

The present paper provides new data on the species composition of *Heteropolypus* Tixier-Durivault, 1964 and a second finding of the mushroom-like deep-water corals for the Far East seas. Both new species *Heteropolypus annae* sp. nov. and *Heteropolypus roseus* sp. nov. are described and depicted here. These new findings are based on the material collected by Institutions of the Russian Academy of Sciences in a series of expeditions to the Kurile Islands area and expand the area of the genus distribution in the Northern Pacific. The taxonomic importance of some characters is discussed.

Material and methods

The samples were collected during field expeditions of the Pacific Institute of Bioorganic Chemistry (PIBOC FEB RAS) and the National Scientific Centre of Marine Biology (NSCMB FEB RAS, formerly Institute of Marine Biology) of the Far Eastern Branch of the Russian Academy of Sciences (2005, 2019, RV *Akademik Oparin*) by trawling and dredging. The specimens (fixed in 70%–96% ethanol) are registered in MIMB (Museum of the Institute of Marine Biology, National Scientific Center of Marine Biology FEB RAS, Vladivostok, Russia, in the following text they are labeled as MIMB). The tissue samples of different colony parts (tentacles, polyp body wall, surface, and interior of capitulum and stalk of colony) were examined separately with an optical microscope (200×) after the organic matter was dissolved with sodium hypochlorite. For SEM, sclerites were washed from hypochlorite with distilled water, air-dried, mounted on carbon double adhesive tape, and carbon coated. Detailed images of the sclerites were obtained with SEM with a Zeiss Evo 40 (Far East Center of Electron Microscopy, Vladivostok, Russia) and optimum magnification for each sclerite type. The sclerite types are distinguished and named in accordance with Bayer *et al.* (1983).

Results

Phylum Cnidaria Verrill, 1865
Class Anthozoa Ehrenberg, 1834
Subclass Octocorallia Haeckel, 1866
Order Alcyonacea Lamouroux, 1812

Genus *Heteropolypus* Tixier-Durivault, 1964

Heteropolypus Tixier-Durivault, 1964: 49-57, figs 15-28. Type species: *Heteropolypus insolitus* Tixier-Durivault, 1964, by monotypy.

Diagnosis

Colonies are mushroom-shaped to obconic, distinctly separated into capitulum and sterile stalk. Polyps are dimorphic or trimorphic and have sclerites. Autozooids are few in number, large, sterile and retractile, arranged evenly over the capitulum or only at the margin. Anthocodial armature is often asymmetrically developed with ridges of sclerites more developed at dorsal side of autozooid. Siphonozooids are fertile, numerous, strongly armored, and densely set between autozooids. Mesozooids when present possess feebly developed tentacles and are retractile and scattered among siphonozooids or arranged mostly along the margin of the capitulum. Sclerites are rods, radiates, clubs, plates, spindles, and needles. Pharyngeal sclerites are predominately platelets, but rods may be also present. Tentacular sclerites are rods, clubs, spindles, plates, crosses, and capstans (6-, 7- and 8-radiate). Colour of alcohol-preserved specimens ranges from white to red and purple red.

Remarks

The diagnosis follows that published by Molodtsova (2013) and d'Hondt & d'Hondt (2020). A new morphological character regarding the arrangement of the mesozooids mostly along the margin of the capitulum was added to the genus diagnosis as this character was observed in the *Heteropolypus roseus* sp. nov.

Heteropolypus annae sp. nov.

urn:lsid:zoobank.org:act:788BD2D1-27C8-4164-8F54-778D3E288674

Figs 1–3, Table 1

Diagnosis

Mushroom-shaped *Heteropolypus* colonies with dome-shaped capitulum and distinct wrinkled stalk. The anthocodiae of autozooids in alcohol-preserved material are up to 12 mm high and up to 10 mm wide, completely retractile, evenly distributed on the surface of the capitulum. Anthocodia wall is cylindrical in shape and with smooth surface with some transverse folds; anthocodial armature is evenly distributed in it. Siphonozooids are small, slightly raised above the surface of the capitulum. Mesozooids are arranged chaotically between the autozooids. Sclerites of autozooid tentacles are vesiculate plates, warty and flanged spindles, clubs, rounded 6-radiate capstans and oval capstans. Anthocodia walls contain 6-radiate or 7-radiate round capstans. Pharynx has plates with rounded edges and narrow tapered rods, all these are tuberculate and with a narrow median waist. Surface of the capitulum and the stalk contains 6-radiate capstans; colony interior contains long, slender needles with a smooth median part and spiny trihedral ends. Specimens preserved in alcohol are white, sclerites colourless.

Etymology

The specific epithet is given in honor of Dr Anna Skriptsova, Head of the Laboratory of Autotrophic Organisms (National Scientific Centre of Marine Biology FEB RAS, Vladivostok), enthusiastic researcher of marine biodiversity, who saved the holotype specimen during the field expedition of the PIBOC and NSCMB (RV *Akademik Oparin*, cruise No 56, 2019).

Type material

Holotype

SEA OF OKHOTSK – **Kurile Islands** • colony 74 × 88.5 mm wide, 42 mm high; Simushir Is.; expedition of PIBOC FEB RAS and NSCMB FEB RAS on RV *Akademik Oparin*, station 20; 46°56.9' N, 152°16.7' E; depth 455–447 m; 2 Jul. 2019; Anna Skriptsova leg.; dredged; MIMB 42493.

Paratype

SEA OF OKHOTSK – **Kurile Islands** • colony 107.7 mm wide and 107.7 mm high; Simushir Is.; expedition of PIBOC FEB RAS and NSCMB FEB RAS on RV *Akademik Oparin*, station 22; 47°15.4' N, 152°10' E; depth 205–222 m; 2 Jul. 2019; Daria Demidkoiva leg.; dredged; MIMB 42494.

Additional material

SEA OF OKHOTSK – **Kurile Islands** • 2 specimens; same collection data as for paratype; MIMB 42496.

Description**Holotype**

The specimen is about 42 mm tall (Fig. 1A–B). The capitulum is rounded, flattened from the top and elliptical in the cross section, 73 × 83 mm across and 28 mm high. The capitulum is slightly concaved in the central area (Fig. 1A). The stalk is 33 mm in diameter; its lower part was torn away during the dredging. Anthocodiae of the autozooids are partially retractile into calyces which have slightly sunk rims. In contraction, the upper part of the anthocodiae project from the bottom of crater-like pits in the capitulum. Between the autozooids, numerous siphonozooids occur; these are seen as small verrucae, slightly raised above the capitulum surface and densely crowded giving to the surface of capitulum granulated appearance (Fig. 1A). About 60 siphonozooids occur in an area of 5 mm².

Mesozooids (Fig. 1F, arrow 1) are distributed chaotically between the autozooids (Fig. 1F, arrow 2) and fully retracted; only small pits 1–1.5 mm in diameter are visible at the capitulum surface (Fig. 1G, arrows 1).

Autozoid tentacles contain vesiculated plates, warty and flanged spindles, clubs, rounded 6-radiate capstans and elongated capstans. Vesiculated plates, up to 0.12 mm long, have a narrow median waist (Fig. 2A); some plates are without the waist (Fig. 2B). Flanged spindles, up to 0.16 mm long, have one narrow spiny end (Fig. 2C); warty spindles, up to 0.14 mm long, have blunt ends (Fig. 2D). Club-like spindles, up to 0.12 mm long, not numerous, have one end densely covered by vesicles (Fig. 2E). Clubs, up to 0.15 mm long, have warty or denticulate heads and thick or slender blunt-ended handles (Fig. 2F). Capstans (6-rayed) are usually up to 0.08 mm long and have round outlines (Fig. 2G). Some well calcified capstans, up to 0.08 mm long, are elongated and have oval outlines (Fig. 2F). These elongated capstans bear densely crowded warts or dents on the ends.

Pharynx contains vesiculated sclerites with a narrow median constriction; some of these are plates with rounded edges, up to 0.07 mm long (Fig. 3A), the others are like rods with conical ends, up to 0.10 mm long (Fig. 3B). Anthocodial walls contain 6-radiate or 7-radiate rounded capstans, up to 0.08 mm across (Fig. 3C).

Surface of capitulum and stalk contains 6-radiate and 7-radiate capstans, up to 0.08 mm long (Fig. 3D–E); colony interior contains long, slender needles with a smooth median part and spiny trihedral ends. The interior needles, up to 0.65 mm long (Fig. 3F), have a smooth cylindrical median part, but trihedral ends (Fig. 3G). Each ridge at the needle end bears spines or dents.

Paratype and variation

The paratype colony (MIMB 42494) has a shape similar to that of the holotype; it is 1100 mm high and 1070 mm wide (Fig. 1E). Anthocodiae wall is smooth and cylindrical when visible; tentacles are folded over the polyp. Anthocodiae are mostly retracted to the inside. Sclerites composition (Figs 4–5) coincides with that in the holotype (Figs 2–3). Clubs in the autozoid tentacles of the paratype are slightly shorter up to 0.13 mm (Fig. 4F) vs 0.15 mm in the holotype (Fig. 2F). Some capstans of the paratype surface may be less calcified and smaller (Fig. 5C) in comparison with those of the holotype (Fig. 3C).



Fig. 1. *Heteropolypus annae* sp. nov. **A.** Holotype (MIMB 42493), Kurile Islands, Sea of Okhotsk. View from above. **B.** Holotype (MIMB 42493), Kurile Islands, Sea of Okhotsk. View from below. **C.** One specimen, Kurile Islands, Sea of Okhotsk (MIMB 42496). **D.** One specimen, Kurile Islands, Sea of Okhotsk (MIMB 42496). **E.** Paratype (MIMB 42494), Kurile Islands, Sea of Okhotsk. **F.** Holotype (MIMB 42493); section of the capitulum; 1 = autozooid, 2 = mesozooid. **G.** Holotype (MIMB 42493); surface of the capitulum; 1 = mesozooids. Scale bars: A–E = 10 mm; F–G = not to scale.

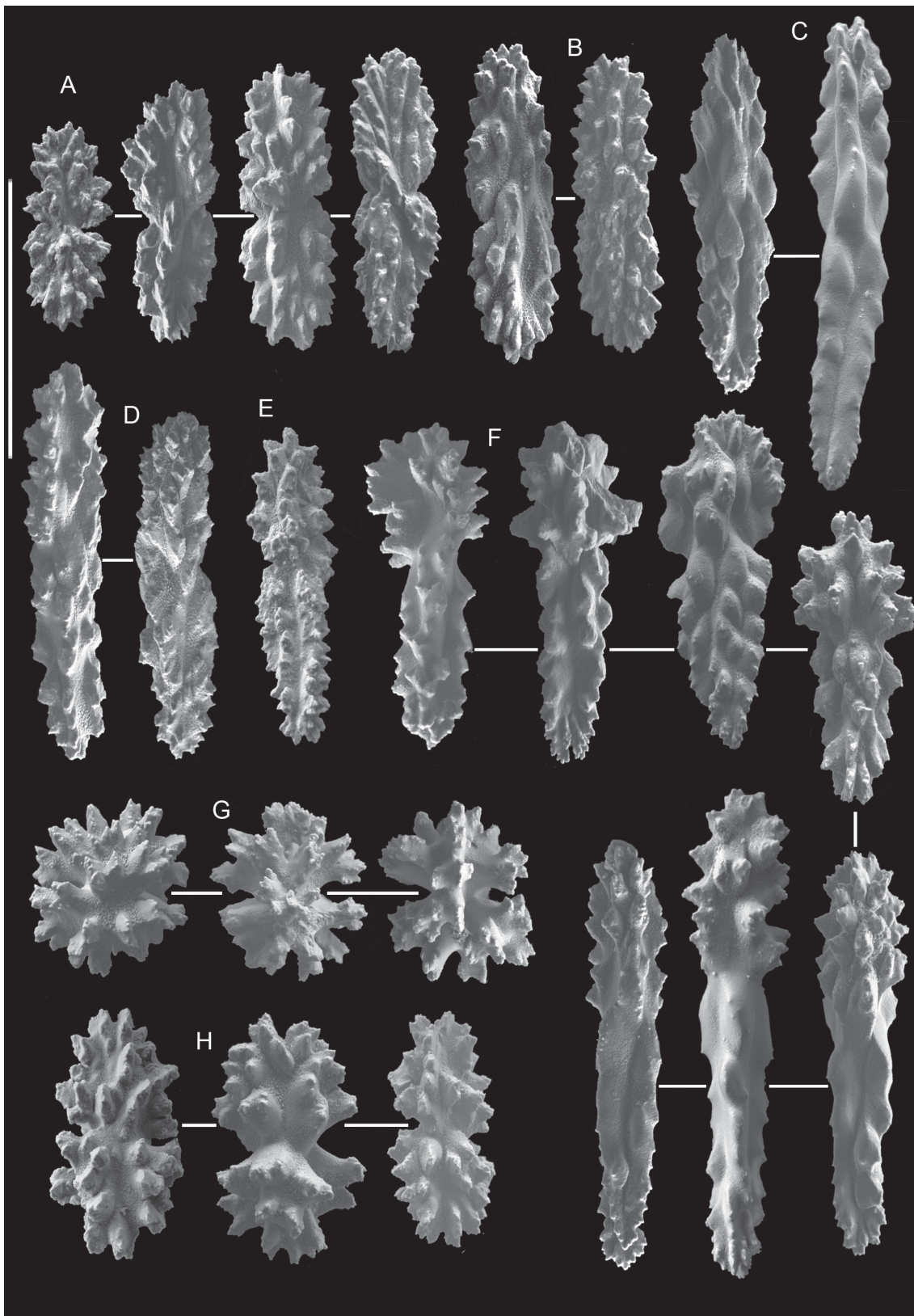


Fig. 2. *Heteropolypus annae* sp. nov., holotype (MIMB 42493); sclerites from the autozooid tentacles. A. Waisted plates. B. Plates. C. Flanged spindles. D. Warty spindles. E. Club-like spindle. F. Clubs. G. Capstans. H. Slender capstans. Scale bar = 0.1 mm.



Fig. 3. *Heteropolypus annae* sp. nov., holotype (MIMB 42493); sclerites from the autozoid pharynx, anthocodiae, and colony body. **A.** Waisted plates. **B.** Waisted rods. **C.** Anthocodiae capstans. **D.** Capitulum surface capstans. **E.** Stalk surface capstans. **F.** Needles. **G.** Ends of the same needle. Scale bars: A–F = 0.1 mm; G = 0.02 mm.

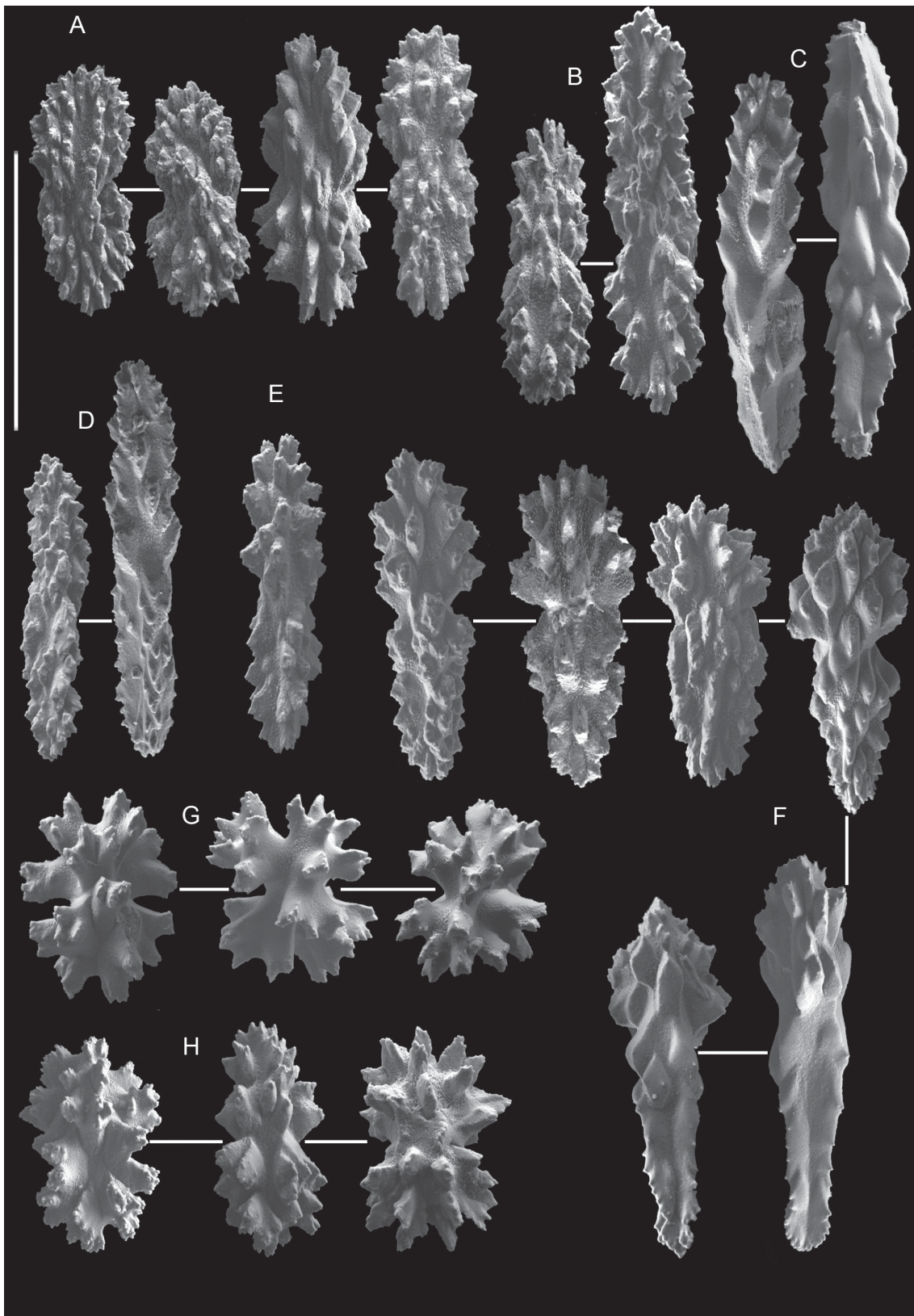


Fig. 4. *Heteropolypus annae* sp. nov., paratype (MIMB 42494); sclerites from the autozooid tentacles. **A.** Waisted plates. **B.** Plates. **C.** Flanged spindles. **D.** Warty spindles. **E.** Club-like spindle. **F.** Clubs. **G.** Capstans. **H.** Slender capstans. Scale bar = 0.1 mm.

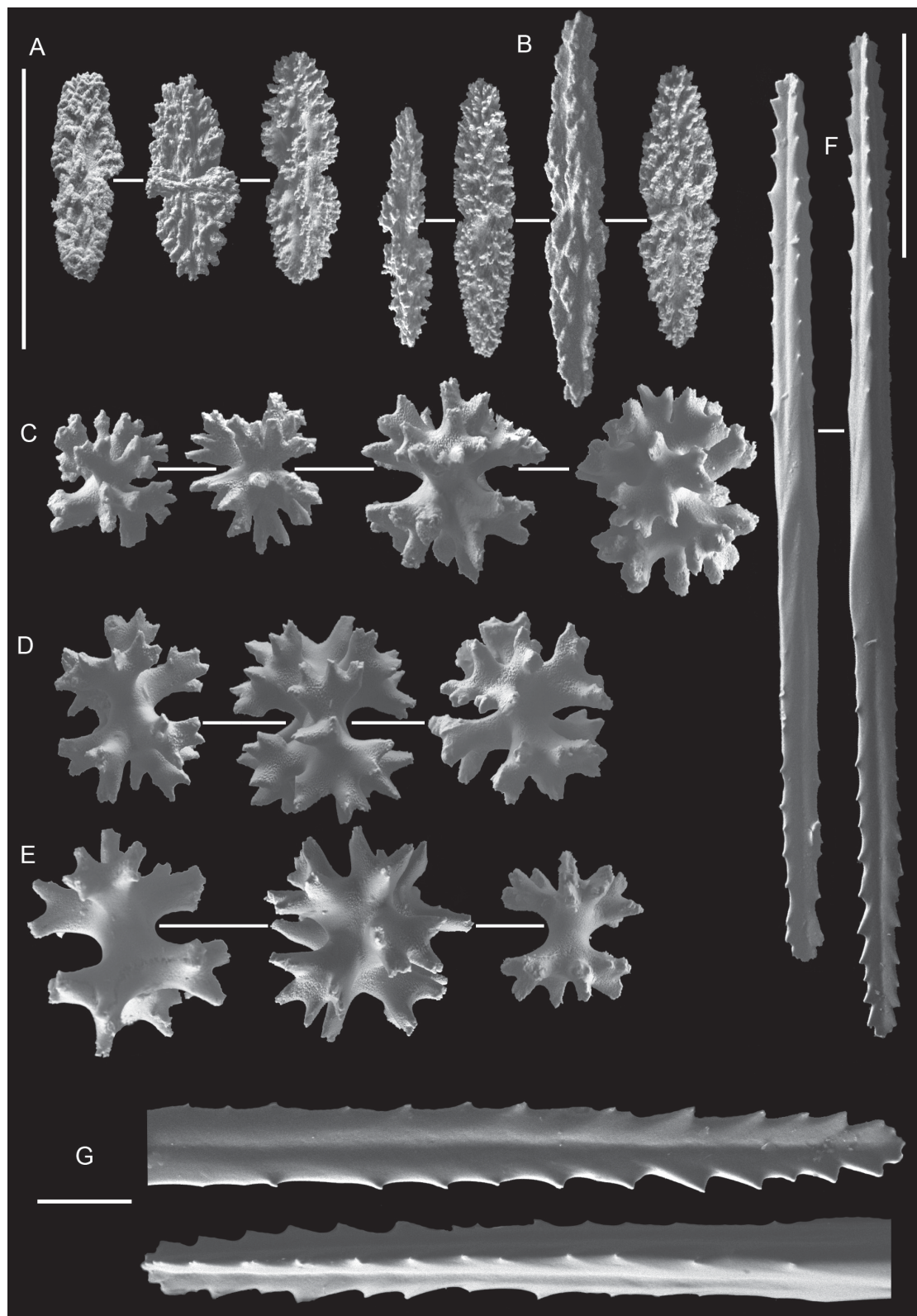


Fig. 5. *Heteropolypus annae* sp. nov., paratype (MIMB 42494); sclerites from the autozoid pharynx, anthocodiae, and the colony body. **A.** Waisted plates. **B.** Waisted rods. **C.** Anthocodiae capstans. **D.** Capitulum surface capstans. **E.** Stalk surface capstans. **F.** Needles. **G.** Ends of the same needle. Scale bars: A–F = 0.1 mm; G = 0.02 mm.

The smallest of the additional specimens (MIMB 42496) is about 15 mm across (Fig 1C). It has 6 autozooids. The siphonozooids are of the same size as in the holotype and paratype, but the mesozooids are not visible.

The other additional specimen (MIMB 42496) is about 65 mm across the capitulum and 37 mm tall (Fig. 1D). The mesozooids are scattered chaotically between the autozooids and crowded near the margin of the capitulum.

Colour

Colonies preserved in alcohol are white, sclerites are colourless.

Remarks

The most remarkable characters of *Heteropolypus annae* sp. nov. are its white colouration (due to its colourless sclerites) and the remarkably diverse sclerites, including clubs, in its autozooid tentacles. At present the genus *Heteropolypus* includes six known species (Table 1). Among them, only two species, *Heteropolypus rylovi* from Kurile Islands and *Heteropolypus sol* Molodtsova, 2013 from Atlantic, have clubs in their tentacles. However, *H. rylovi* differs from *H. annae* sp. nov. in having needles up to 0.5 mm long in its autozooid tentacles and anthocodia wall and the absence of the waisted plates in its pharynx. *Heteropolypus sol* differs from *H. annae* sp. nov. by the occurrence of the girdled spindles and longer flanged rods (0.31–0.38 mm long) in the autozooid tentacles. *Heteropolypus annae* sp. nov. can further be distinguished from *H. sol* by the absence of the rods with median waist in the pharynx. Furthermore, *H. sol* has different geographical distributional area. *Heteropolypus annae* sp. nov. can further be distinguished from *H. insolitus* by the absence of the needles (up to 0.6 mm long) in the anthocodial walls and the clubs in the stalk surface. *Heteropolypus annae* sp. nov. differs from *H. japonicus* by the presence of the clubs in the autozooid tentacles and capstans in the colony surface (Table 1). *Heteropolypus annae* sp. nov. differs from *H. ritteri* by the presence of the clubs and the absence of the smooth rods up to 0.24 mm long in the autozooid tentacles (Table 1). *Heteropolypus annae* sp. nov. differs from *H. steenstrupi* (Wright & Studer, 1889) by having shorter clubs and by the absence of the 4-rayed forms 0.24×0.06 mm (Table 1).

Distribution

This species is known for certain from the Kurile Islands, Sea of Okhotsk, Northwestern Pacific, between 205 and 455 m depth.

Heteropolypus roseus sp. nov.

urn:lsid:zoobank.org:act:3747DFBE-FDD1-467A-ABDC-1138E9BEDD75

Figs 6–8, Table 1

Diagnosis

Mushroom-shaped *Heteropolypus* colony with dome-shaped capitulum and distinct wrinkled stalk. The anthocodiae of autozooids in alcohol-preserved material are up to 12 mm high and up to 6 mm wide, completely retractile, evenly distributed on the surface of the capitulum. Anthocodia wall is cylindrical in shape and with a smooth surface with some transverse folds; anthocodial armature evenly distributed in it. Siphonozooids are small, slightly raised above the surface of the capitulum. Mesozooids are crowded near the margin of the capitulum. Sclerites of autozooid tentacles are vesiculate plates with dentate edges and a median constriction or a diagonal keel, elongated plates with asymmetrically developed ends, club-like spindles and clubs, vesiculate spindles, and capstans. Anthocodia walls contain 6-radiate or 8-radiate capstans. Pharynx has tuberculate plates with rounded edges and rods, all these with a narrow median waist or constriction. Surface of the capitulum and the stalk contains 6-, 7- and 8-radiate capstans; colony interior contains long, slender needles with a smooth median part and spiny trihedral ends. Alcohol-preserved specimen is pale rose, sclerites red or rose.

Table 1 (continued on next two pages). Distinctive characters of species in the genus *Heteropolypus* Tixier-Durivault, 1964. The greatest length for the different types of sclerites is provided in parentheses (in mm); ‘–’ indicates a lack of reported information; literature sources for species description are: Wright & Studer (1889), Kükenthal (1906, 1910, 1913), Nutting (1909, 1912), Naumov (1952), Tixier-Durivault (1964), Molodtsova (2013) and d’Hondt & d’Hondt (2019, 2020).

	<i>H. annae</i> sp. nov.	<i>H. insolitus</i> Tixier-Durivault, 1964	<i>H. japonicus</i> (Nutting, 1912)	<i>H. ritteri</i> (Nutting, 1909)	<i>H. roseus</i> sp. nov.	<i>H. rylovi</i> (Naumov, 1952)	<i>H. sol</i> Molodtsova, 2013	<i>H. steenstrupi</i> (Wright & Studer, 1889)
Type locality	Simushir Is., Kurile Islands, Sea of Okhotsk, 46°56.9' N, 152°16.7' E, 205–455 m	Australia, 37°28' S, 138°55' E, 1320–1340 m	Japan, 42°10'20" N, 142°15'0" E (type locality), 266–545 fathoms	off California coast, 250–1225 m	Shikotan Is., Kurile Islands, Sea of Okhotsk, 44°49' N 146°23.1' E, 550 m	off Shikotan Island, Kurile Islands, 1430 m	Mid-Atlantic Ridge, Nova Scotia, Rockall Trough, Azores, Porcupine Abyssal plain, 2132–4298 m	Japan, Philippines, 1033 m
Coral morphology	mushroom-like colony, with dome-shaped capitulum; mesozooids scattered between autozooids	mushroom-like colony, with slightly convex capitulum; mesozooids arranged at the upper part of the capitulum	mushroom-like colony, with slightly convex capitulum and narrow stalk; mesozooids scattered between autozooids	mushroom-like colony, with flattened capitulum; mesozooids scattered between autozooids	mushroom-like colony, with dome-shaped capitulum; mesozooids crowded along the margin of the capitulum	mushroom-like colony, with slightly convex capitulum and narrow stalk; mesozooids scattered between autozooids	mushroom-like colony, capitulum flattened from the top; mesozooids sparsely arranged all around the capitulum	mushroom-like colony, with slightly convex capitulum; mesozooids scattered between autozooids
Colouration of fixed specimens	white, sclerites colourless	red, sclerites red	dark red to bright scarlet	autozooids deep crimson red, capitulum purplish pink, stem livid; sclerites red	capitulum pale rose, autozooids bright rose, stalk brown-rose; sclerites red or rose	brown-red, autozooids grey-brown, tentacles bright red; sclerites wine-red	capitulum red, stem greyish red, rhizoids grey	dull red

Table 1 (continued).

	<i>H. annae</i> sp. nov.	<i>H. insolitus</i> Tixier-Durivault, 1964	<i>H. japonicus</i> (Nutting, 1912)	<i>H. ritteri</i> (Nutting, 1909)	<i>H. roseus</i> sp. nov.	<i>H. rylovi</i> (Naumov, 1952)	<i>H. sol</i> Molodtsova, 2013	<i>H. steenstrupi</i> (Wright & Studer, 1889)
Sclerites								
autozooid	vesiculated plates, some with narrow median waist (0.12); flanged spindles (0.16); warty spindles (0.14); club- like spindles (0.12); clubs (0.15); 6-radiate capstans (0.08); elongated capstans with unordered warts or dents (0.08)	vesiculate spindles, double-stars	numerous minute, smooth, bar-like spicules, minute crosses, stars, and double stars	girdled radiates (0.05 diam.), smooth blunt-ended rods (0.24), some rods with diagonal ridge	vesiculated plates with narrow median waist (0.10); slender plates with narrow median part (0.15); plates with narrow median part and diagonal keel (0.15); club-like spindles (0.15); clubs (0.11); warty spindles (0.12); 6-rayed capstans (0.06); elongated capstans (8-rayed or with unordered warts, 0.1)	needles (0.5 × 0.03), clubs (0.2)	flanged rods (0.38), girdled spindles (0.11), rods (0.21), clubs (0.14), plates (0.08), radi- ates (0.07), and crosses	long slender spiny spindles (0.5), 4-rayed forms (0.24 × 0.06), shorter spiny spindles (0.3), clubs (0.2), double crosses (0.1)
tentacles								
pharynx	vesiculated plates with rounded edges and median waist (0.07), vesiculate rods with conical ends and narrow median waist (0.10)	small rods (0.1)	–	–	vesiculated biscuit-like plates with narrow median constriction and rounded edges (0.07), vesiculate rods with blunt ends and narrow median part (0.09)	rods (0.2) with median waist	platelets (0.14)	–

Table 1 (continued).

	<i>H. annae</i> sp. nov.	<i>H. insolitus</i> Tixier-Durivault, 1964	<i>H. japonicus</i> (Nutting, 1912)	<i>H. ritteri</i> (Nutting, 1909)	<i>H. roseus</i> sp. nov.	<i>H. rylovi</i> (Naumov, 1952)	<i>H. sol</i> Molodtsova, 2013	<i>H. steenstrupi</i> (Wright & Studer, 1889)
anthocodia	6-, 7-radiate rounded capstans (0.08)	rods, double stars, pointed needles (0.6), double stars	–	rods, girdled radiates (0.05 diam.)	6-radiate or 8-radiate capstans (0.09)	needles (0.5 × 0.03), rods (0.2), 8-radiate capstans (less 0.1)	flanged rods (0.38), girdled spindles (0.16), rods (0.26), clubs (0.16), plates (0.12), radiates (0.08)	–
capitulum surface	6-, 7-radiate capstans (0.08)	pointed rods (0.5)	needle-like or bar-like forms, nearly smooth, or at least not with pronounced verrucosae	stars (colourless), double stars, blunt-ended rods (0.3) with diagonal ridge	6-, 7- and 8-radiate capstans (0.08)	needles (0.5 × 0.03)	8-radiate capstans (0.08), clubs (0.4), rods (0.3), spindles (0.1), and crosses	–
capitulum interior	needles with smooth median part and spiny trihedral dentate ends (0.65)	numerous pointed rods, a few warty clubs (0.28)	–	needles	needles with smooth median part and spiny trihedral ends (0.6)	8-radiate capstans (less 0.1)	flanged rods (0.7)	–
stalk surface		small double- stars (0.08), clubs with pointed handles (0.12)	–	stars	6-, 7- and 8- radiate capstans (0.07)	needles (0.5 × 0.03)	rods (0.4), clubs (0.13), spindles (0.12), radiates	–
stalk interior	needles with smooth median part and spiny trihedral dentate ends (0.65)	pointed needles (0.37)	–		needles with smooth median part and spiny trihedral ends (0.6)	8-radiate capstans (less 0.1)	–	–

Etymology

The specific epithet refers to the colour of the holotype anthocodia which is similar to a wild rose.

Type material**Holotype**

SEA OF OKHOTSK – **Kurile Islands** • colony 42 × 45 mm; Kunashir Is.; expedition of PIBOC FEB RAS and NSCMB FEB RAS on RV *Akademik Oparin*, station 51; 44°49' N, 146°23.1' E; depth 550 m; 24 Jul. 2005; A. Chernyshov leg.; dredged; MIMB 42495.

Description**Holotype**

The specimen is about 45 mm tall (Fig. 6A). The capitulum is rounded, dome-shaped and elliptical in the cross section, 20 × 27 mm across and 27 mm high. The stalk is 14 mm in diameter, chaotically wrinkled. Anthocodiae of autozooids are partially retractile into calyces which have sinked rims; only the tentacles are seen above the surface of the capitulum. In contraction, the upper part of the anthocodiae project from the bottom of cylindrical pits in the capitulum. Between the autozooids, numerous tiny siphonozooids occur; these are seen as small verrucae, very slightly raised above the capitulum surface and densely crowded giving to the surface of capitulum granulated appearance (Fig. 6A–B). About 100 siphonozooids occur in an area of 5 mm².

Mesozooids are crowded along the margin of the capitulum and fully retracted; only small craters 1–1.5 mm in diameter are visible at the capitulum surface (Fig. 6B–C, arrows 1).

Autozoid tentacles contain vesiculate plates with dentate edges and a median constriction or a diagonal keel, elongated plates with asymmetrically developed ends, club-like spindles and clubs, vesiculate blunt spindles, and capstans. Densely vesiculated plates, up to 0.10 mm long, have dentate edges and a narrow median waist (Fig. 7A); some plates are elongated, less denticulate, with a narrow median part, up to 0.15 mm long (Fig. 7B). Some dentate plates, up to 0.15 mm long, have a narrow median part and a diagonal keel (Fig. 7C). Some elongated plates, up to 0.15 mm long, are slightly bent and have asymmetrically developed ends (Fig. 7D). Club-like spindles are up to 0.15 mm long (Fig. 7E). Clubs have plump heads and thick handles, and are up to 0.11 mm long (Fig. 5F). Warty spindles, up to 0.12 mm long, have blunt ends (Fig. 7G). Some capstans (6-rayed), usually up to 0.06 mm long, have round outlines; another ones, up to 0.1 mm long, are elongated, 8-rayed or bear unordered warts (Fig. 7H).

Pharynx contains vesiculated biscuit-like plates with a narrow median constriction and rounded edges, up to 0.07 mm long (Fig. 8A), and rods with blunt ends and a narrow median part, up to 0.09 mm long (Fig. 8B). Anthocodial walls contain 6-radiate or 8-radiate capstans, up to 0.09 mm long (Fig. 8C).

Surface of capitulum and stalk contains 6-, 7- and 8-radiate capstans (Fig. 8D–E); colony interior contains long, slender needles with a smooth median part and spiny trihedral ends. The interior needles, up to 0.6 mm long (Fig. 8F), have a smooth cylindrical median part, but trihedral ends. Each ridge at the needle end bears spines or dents (Fig. 8G).

Colour

In alcohol-preserved material the capitulum of the colony is pale rose, the autozooids are bright rose, the stalk is brown-rose and the sclerites are red or rose.

Remarks

Heteropolypus roseus sp. nov. differs from all known species of the genus in the presence of the plates with a diagonal keel which are found in its autozooid tentacles (Table 1). Moreover, *H. roseus* sp. nov. also differs from *H. insolitus*, *H. japonicus*, *H. ritteri*, *H. rylovi* and *H. steenstrupi* in having the plates

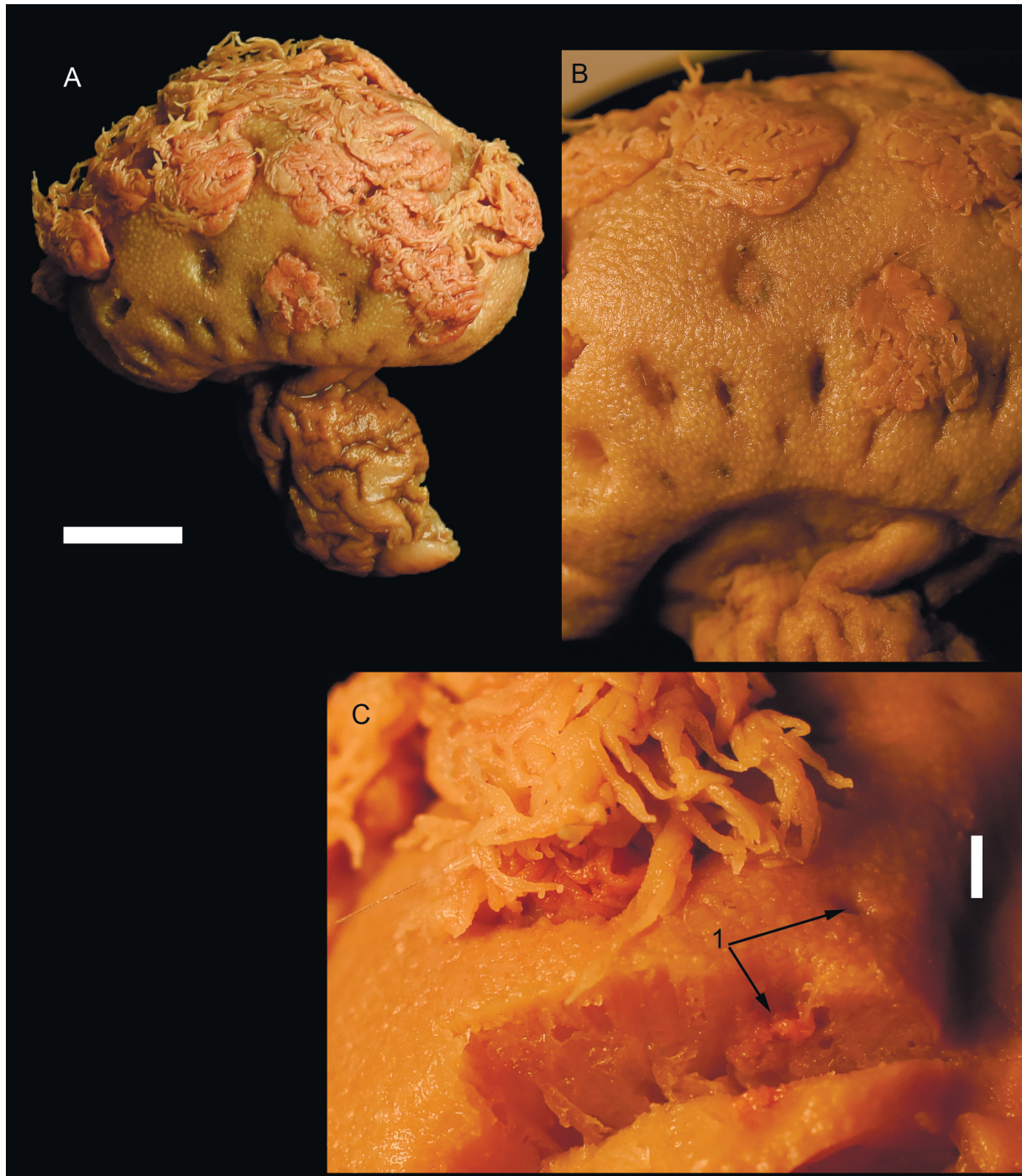


Fig. 6. *Heteropolypus roseus* sp. nov., holotype (MIMB 42495), Kurile Islands, Sea of Okhotsk. **A.** Whole specimen. **B.** Surface of the capitulum. **C.** Section of the capitulum; 1 = mesozoid. Scale bars: A = 10 mm; C = 1 mm.

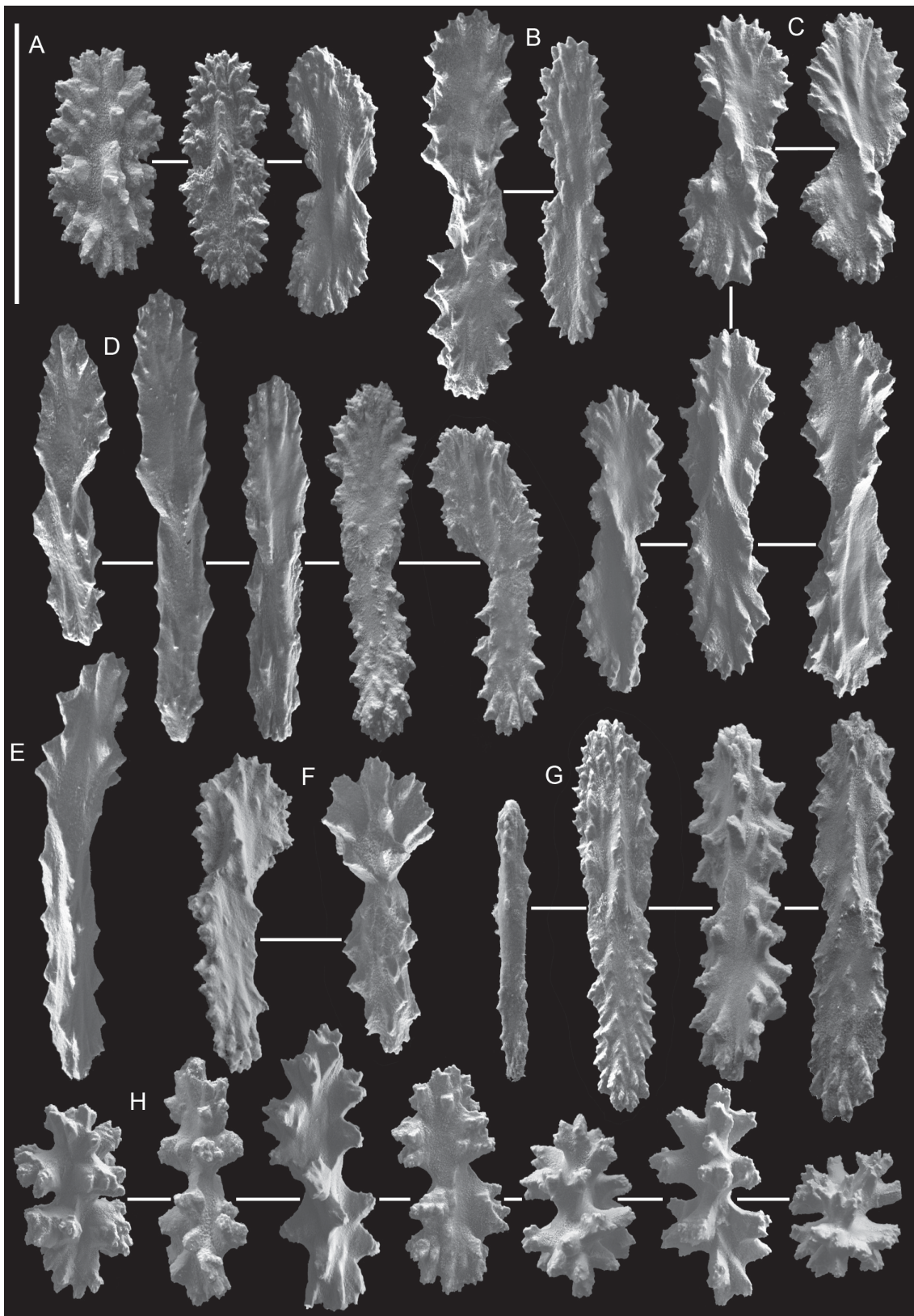


Fig. 7. *Heteropolyus roseus* sp. nov., holotype (MIMB 42495); sclerites from the autozooid tentacles. **A.** Waisted plates. **B.** Plates. **C.** Plates with diagonal keel. **D.** Asymmetrical plates. **E.** Club-like spindle. **F.** Clubs. **G.** Warty spindles. **H.** Capstans. Scale bar = 0.1 mm.

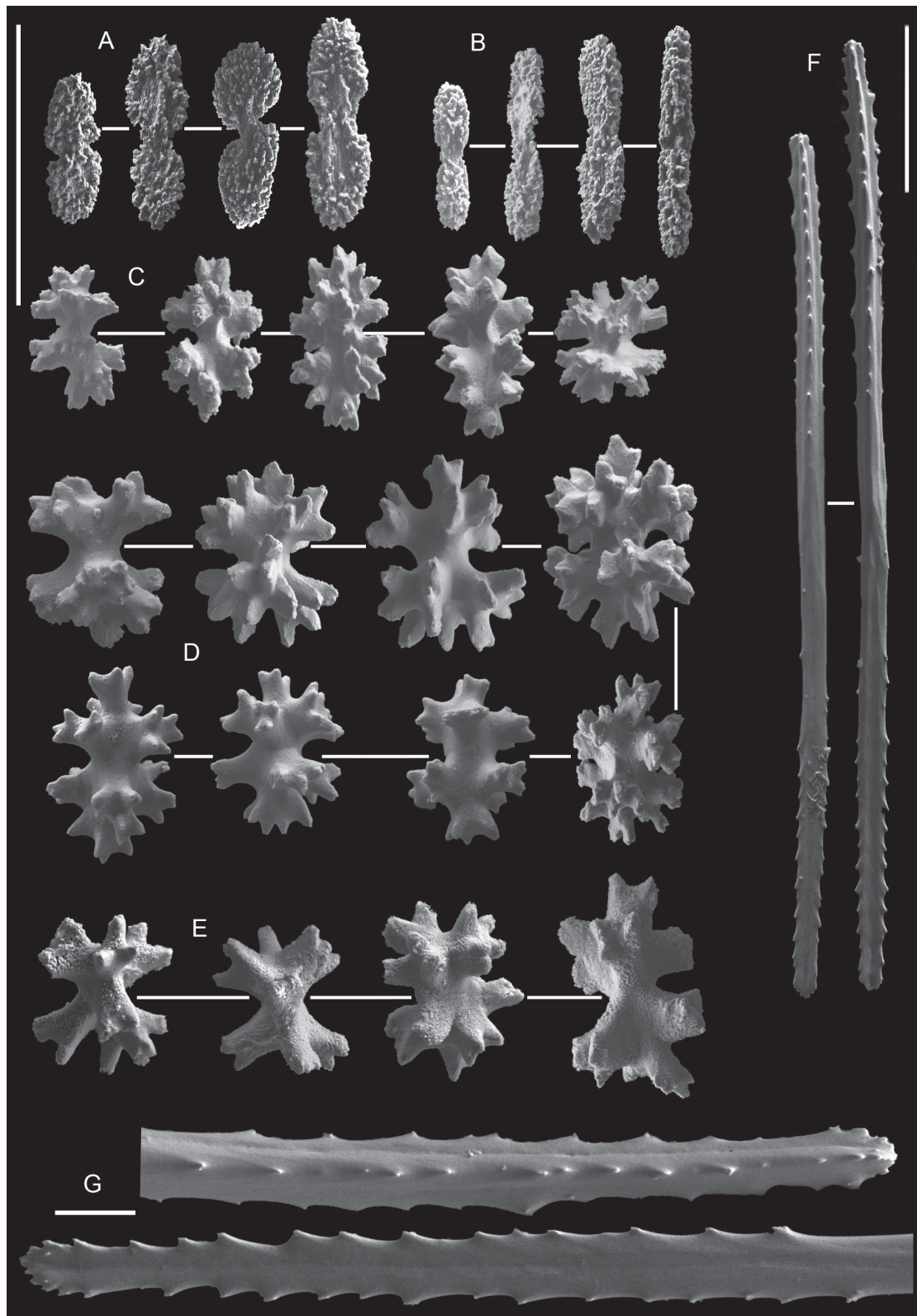


Fig. 8. *Heteropolypus roseus* sp. nov., holotype (MIMB 42495); sclerites from the autozoid pharynx, anthocodiae, and the colony body. **A.** Waisted plates. **B.** Rods. **C.** Anthocodiae capstans. **D.** Capitulum surface capstans. **E.** Stalk surface capstans. **F.** Needles. **G.** Ends of the same needle. Scale bars: A–F = 0.1 mm; G = 0.02 mm.

in the tentacles and pharynx. *Heteropolypus ritteri* also has sclerites with a diagonal ridge, but these are rods (Table 1). Only *H. sol* contains short plates in the tentacles and platelets in the pharynx, but *H. roseus* sp. nov. differs from it by having no flanged rods and girdled spindles in the tentacles (Table 1).

Distribution

This species is known for certain from the Kurile Islands, Sea of Okhotsk, Northwestern Pacific, from 550 m depth.

Discussion

The genus *Heteropolypus* Tixier-Durivault, 1964 was established to group the species of mushroom corals which contains three types of polyps – not only autozooids and siphonozooids, but also mesozooids. The presence of mesozooids was discussed as the main characteristic feature of this genus (Tixier-Durivault 1964: 56–57). However, Molodtsova (2013) pointed out that at the generic level this characteristic may be doubtful as the mesozooids may not be visible in early developmental stages (less than 4 fully developed autozooids) and in badly preserved colonies.

The material presented here supports the idea that the mesozooids appear when the colony attains a certain stage of the life cycle as they are not visible in the smallest specimen of *H. annae* sp. nov. (Fig. 1C).

The genus diagnosis is emended because new data on gross morphology regarding the localization of the mesozooids near the capitulum margin in *H. roseus* sp. nov. were obtained during the present research.

Species identification of the representatives of the genus *Heteropolypus* may be difficult due to the insufficient specific descriptions in old literature. In particular, this concerns detailed information about the location of various types of sclerites in different parts of the coral's body provided in literature for some species (*H. japonicus*, *H. ritteri* and *H. steenstrupi*, Table 1). All the specimens described and depicted in present paper have similar morphology. The mushroom-like shape of the colonies is typical for the genus. However, some characters on their sclerites, especially those of the tentacles and pharynx, are quite cogent and allow to distinguish previously known species and identify species presented here as new for science.

Six species of the *Heteropolypus* genus were known before. These were mainly recorded in the Pacific from the deep-sea ecosystems at depths ranging from 266 to 4298 m (Table 1). Finds of this deep-sea genus are very rare, which is undoubtedly associated with the difficulties in obtaining deep-sea samples. Records of *Heteropolypus annae* sp. nov. and *H. roseus* sp. nov. in the range of depths between 205 and 550 m allow us to classify these species as deep-sea inhabitants but does not exclude the possibility of further finds at even greater depths with the development of methods of searching and collecting.

Acknowledgements

The author thanks the staff of the Research Vessel *Akademik Oparin* for their valuable contribution to finding the new species described in the present paper. This work was supported by the Ministry of Science and Higher Education, Russian Federation (grant 13.1902.21.0012, contract No 075-15-2020-796).

References

Auster P.J., Moore J., Heinonen K.B. & Watling L. 2005. A habitat classification scheme for seamount landscapes: assessing the functional role of deep-water corals as fish habitat. *In*: Freiwald A.R. & Roberts J.M. (eds) *Cold-Water Corals and Ecosystems*: 761–769. Springer-Verlag, Berlin, Heidelberg. https://doi.org/10.1007/3-540-27673-4_40

- Baco A.R. & Shank T.M. 2005. Population genetic structure of the Hawaiian precious coral *Corallium lauuense* (Octocorallia: Coralliidae) using microsatellites. In: Freiwald A. & Roberts J.M. (eds) *Cold-Water Corals and Ecosystems*: 663–678. pringer-Verlag, Berlin, Heidelberg.
https://doi.org/10.1007/3-540-27673-4_33
- Bayer F.M., Grasshoff M. & Verseveldt J. 1983. *Illustrated Trilingual Glossary of Morphological and Anatomical Terms Applied to Octocorallia*. E.J. Brill/Dr. W. Backhuys, Leiden.
- Buhl-Mortensen P., Buhl-Mortensen L. & Purser A. 2016. Trophic ecology and habitat provision in cold-water coral ecosystems. In: Rossi S., Gori A. & Orejas Saco del Valle C. (eds) *Marine Animal Forests*: 1–26. Springer, Cham. https://doi.org/10.1007/978-3-319-17001-5_20-1
- Cairns S.D. & Hourigan T.F. 2017. A Comprehensive List of Known Deep-Sea Corals Occurring in the EEZ of the United States and its Possessions. Available from <https://repository.si.edu/handle/10088/35001> [accessed 14 Jun. 2019].
- Dautova T.N. 2018. Deep-water Octocorallia (Cnidaria: Anthozoa) of the temperate Northern Pacific: Notes on the distribution and new bathyal-abyssal taxa from the Sea of Okhotsk. *Deep-Sea Research Part II* 154: 74–86. <https://doi.org/10.1016/j.dsr2.2018.04.002>
- d’Hondt M.-J. & d’Hondt J.-L. 2019. Note sur quelques espèces d’*Anthomastus* et autres Anthomastinae (Octocoralliaires, Alcyoniidae); description de *Pseudoanthomastus gloriosus* n. sp. *Bulletin de la société linnéenne de Bordeaux* 154, N.S. 47 (1/2): 103–118.
- d’Hondt M.-J. & d’Hondt J.-L. 2020. Catalogue and geographical distribution of the Anthomastinae (Octocorallia, Alcyonacea, Alcyoniidae). Notes on some “capitate” Alcyoniidae. *Bulletin de la Société zoologique de France* 145 (3): 247–293.
- Kükenthal W. 1906. Alcyonacea. In: *Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898–1899 13 (1,1)*: 1–111. Gustav Fischer, Jena.
- Kükenthal W. 1910. Zur Kenntnis der Gattung *Anthomastus* Ver. In: Doflein F. (ed.) *Beiträge zur Naturgeschichte Ostasiens*. Abhandlungen der Mathematisch-Physikalischen Klasse der Königlich Bayerischen Akademie der Wissenschaften I. Suppl. 9: 1–16.
- Kükenthal W. 1913. Über die Alcyonarienfauna Californiens und ihre tiergeographischen Beziehungen. *Zoologische Jahrbücher* 35: 219–270. <https://doi.org/10.5962/bhl.part.16718>
- Molodtsova T.N. 2013. Deep-sea mushroom soft corals (Octocorallia: Alcyonacea: Alcyoniidae) of the Northern Mid-Atlantic Ridge. *Marine Biology Research* 9 (5–6): 488–515.
<https://doi.org/10.1080/17451000.2012.750427>
- Naumov D. 1952. A new representative of the genus *Anthomastus* Verrill (Alcyonaria) from the region of the Kurile Ridge. *Zoologicheskoy Zhurnal, Moscow* 31 (2): 238–243. [In Russian.]
- Nutting Ch.C. 1909. Alcyonaria of the Californian coast. *Proceedings of the United States Natural Museum* 35: 681–727. <https://doi.org/10.5479/si.00963801.35-1658.681>
- Nutting Ch.C. 1912. Descriptions of the Alcyonaria collected by the U.S. Fisheries steamer “Albatross,” mainly in Japanese waters, during 1906. *Proceedings of the United States Natural Museum* 43: 1–104. <https://doi.org/10.5962/bhl.title.49593>
- Roberts J.M., Wheeler A.J. & Freiwald A. 2006. Reefs of the deep: The biology and geology of cold-water coral ecosystems. *Science* 312: 543–547. <https://doi.org/10.1126/science.1119861>
- Stone R.P. & Cairns S.D. 2017. Deep-Sea Coral Taxa in the Alaska Region: Depth and Geographical Distribution. Available from <https://deepseacoraldata.noaa.gov/> [accessed 2017].

Stone R.P. & Shotwell S.K. 2007. State of deep coral ecosystems in the Alaska region: gulf of Alaska, Bering Sea and the Aleutian Islands. In: Lumsden S.E., Hourigan T.F., Bruckner A.W. & Dorr G. (eds) *The State of Deep Coral Ecosystems of the United States*: 65–108. NOAA Technical Memorandum CRCP-3, Silver Spring, MD. Available from https://www.coris.noaa.gov/activities/deepcoral_rpt/ [accessed 2007].

Tixier-Durivault A. 1964. Stolonifera et Alcyonacea. *Galathea Report* 7: 43–58.

Wright E.P. & Studer T. 1889. Report on the Alcyonaria collected by H.M.S. Challenger during the years 1873–76. In: *Report on the Scientific Results of the Voyage of H.M.S. Challenger During the Years 1873–76. Zoology Vol. 31*: 1–314. Neill, Edinburgh.

Manuscript received: 16 November 2021

Manuscript accepted: 10 December 2021

Published on: 28 March 2022

Topic editor: Tony Robillard

Desk editor: Radka Rosenbaumová

Printed versions of all papers are also deposited in the libraries of the institutes that are members of the *EJT* consortium: Muséum national d’histoire naturelle, Paris, France; Meise Botanic Garden, Belgium; Royal Museum for Central Africa, Tervuren, Belgium; Royal Belgian Institute of Natural Sciences, Brussels, Belgium; Natural History Museum of Denmark, Copenhagen, Denmark; Naturalis Biodiversity Center, Leiden, the Netherlands; Museo Nacional de Ciencias Naturales-CSIC, Madrid, Spain; Real Jardín Botánico de Madrid CSIC, Spain; Zoological Research Museum Alexander Koenig, Bonn, Germany; National Museum, Prague, Czech Republic.