日本初記録の4 種のソフトコーラルの記載, 及び琉球列島産浅海性ソフトコーラル類の一覧, およびホンクダヤギ属とクダヤギ属の分類に ついて

Fauna Ryukyuana

ISSN 2187-6657
http://w3.u-ryukyu.ac.jp/naruse/lab/Fauna_Ryukyuana.html

First records of four soft coral species from Japan, with a list of soft corals previously found from the shallow waters of the Ryukyu Archipelago, Japan, and an overview on the systematics of the genera *Siphonogorgia* and *Chironephthya*

Yukimitsu Imahara[1], Hiromi Yamamato[2], Hiroko Takaoka[3] & Masanori Nonaka[2]
[1]Wakayama Laboratory, Biological Institute on Kuroshio (imaharay@k.email.ne.jp)
[2]Okinawa Churashima Foundation Research Center
[3]Okinawa Churaumi Aquarium, Okinawa Churashima Foundation

Abstract. So far, 121 species (including *Briareum* of the suborder Scleraxonia) of the shallow water soft corals had been found in the waters of the Ryukyu Archipelago. During 2011–2012, we surveyed the shallow water soft coral fauna from northern Motobu Peninsula (Okinawa, Japan), and obtained a large quantity of new material. This collection contains two genera of the suborder Stolonifera, six genera of Alcyoniidae, three genera of Nephtheidae, two genera of Nidaliidae, two genera of Xeniidae, and one genus (*Briareum*) of Scleraxonia, and includes four species new to Japan; *Klyxum molle* (Thomson & Dean, 1931), *Lobophytum salvati* Tixier-Durivault, 1970, *Chironephthya hicksoni* Harrison, 1908, and *Siphonogorgia* cf. *godeffroyi* Kölliker, 1874, as well as nine possibly undescribed species. Information on the four newly recorded species from Japan is described in detail. A list of the shallow water soft corals found from the waters of the Ryukyu Archipelago, including new discoveries in this survey, is also provided. In addition, the history and problems on the systematics of the genera *Siphonogorgia* and *Chironephthya* are overviewed.

Introduction

Shallow-water soft coral fauna in the Ryukyu Archipelago has been studied by several authors (Verrill 1865; Utinomi 1976a, b, 1977a, b; Imahara 1991; Benayahu 1995, 2002, 2010; Benayahu & McFadden 2011; Iha & Yoshino 1997; Williams 1997; Ofwegen & Benayahu 2006; Miyazaki & Reimer 2014). Those studies recorded 117 soft coral species including two *Briareum* species (suborder Scleraxonia) in this region. In addition to these, the following four species have been discovered by the first author (Y. I.) from this region but have not published yet, i.e. *Carijoa* sp. (Clavulariidae), *Coelogorgia* sp. (Coelogorgiidae), *Nephthyigorgia* sp. (Nidaliinae), and *Heteroxenia elisabethae* (Xeniidae). During a survey between 2011 and 2012, a considerable amount of new material of shallow water soft corals was collected from the northern Motobu Peninsula, Okinawa Island, Japan. These materials contained four newly recorded species from Japan; *Klyxum molle* (Thomson & Dean, 1931), *Lobophytum salvati* Tixier-Durivault, 1970 (both Alcyoniidae), *Chironephthya hicksoni* Harrison, 1908, and *Siphonogorgia* cf. *godeffroyi* Kölliker, 1874 (Nidaliidae), 12 species already been reported from Japan, as well as nine probably undescribed species. This paper aims to re-describe the four newly recorded species and to list the soft coral species found from this region. The newly recorded species include one species each of genera *Siphonogorgia* and *Chironephthya*, the systematics of which have been confused for a long period of time. We also overview the history and problems on the systematics of these two genera.

Material and Methods

A list of the soft coral species from the Ryukyu Archipelago was compiled by a literature survey and recently conducted field surveys. New materials were photographed *in situ* and then collected during the 2011–2012 SCUBA diving expeditions in shallow waters (<30 m) around northern Motobu Peninsula, from Cape Bise in Motobu-cho to Sesoko Island. Sub-samples were removed from collected material and preserved in absolute alcohol for future molecular studies. The rest of the materials were then fixed in 20% formalin overnight, rinsed for over 24 h in fresh water, and then transferred to 75% ethanol. Sclerites were obtained by dissolving the tissues in kitchen bleach (10–13% sodium hypochlorite), followed by careful and repeated rinsing in distilled water. Sclerites were mounted in two series: (1) via Eukitt (ORSAtec) for permanent microscope slides, and (2) onto scanning electron microscope (SEM) stubs coated with Pt-Pd, for examination under a scanning electron microscope (Hitachi S-4300) at 10 kV. Polyp measurements were obtained from drawings made under a stereomicroscope, whereas sclerites were measured by drawings made under a biological microscope or from SEM pictures. Observations of anthocodial formula were performed under a stereomicroscope using

transparent polyps prepared with clove oil (see Imahara 2014). Sclerite terminology followed Bayer et al. (1983). All newly collected materials were deposited in the Okinawa Churashima Foundation Research Center (OCF), Japan. Materials used for comparative purpose were loaned from The Natural History Museum, London, UK (BM), Naturhistorisches Museum der Burgergemeinde Bern, Switzerland (NMBE), Zoologisches Museum der Universität Hamburg, Germany (ZMH), and the U. S. National Museum of Natural History, Smithsonian Institution, USA (USNM).

Results

The shallow water soft coral species so far found from the Ryukyu Archipelago are listed in Appendix 1. The total number of recorded species is 133, including previously recorded species (n = 117), species found by the first author (Y.I.) but unpublished (n = 4; *Carijoa* sp., *Coelogorgia* sp., *Nephthyigorgia* sp. and *Heteroxenia elisabethae*), newly recorded species found during this survey (n = 4) and probably undescribed species (n = 9).

The identified material yielded four species new

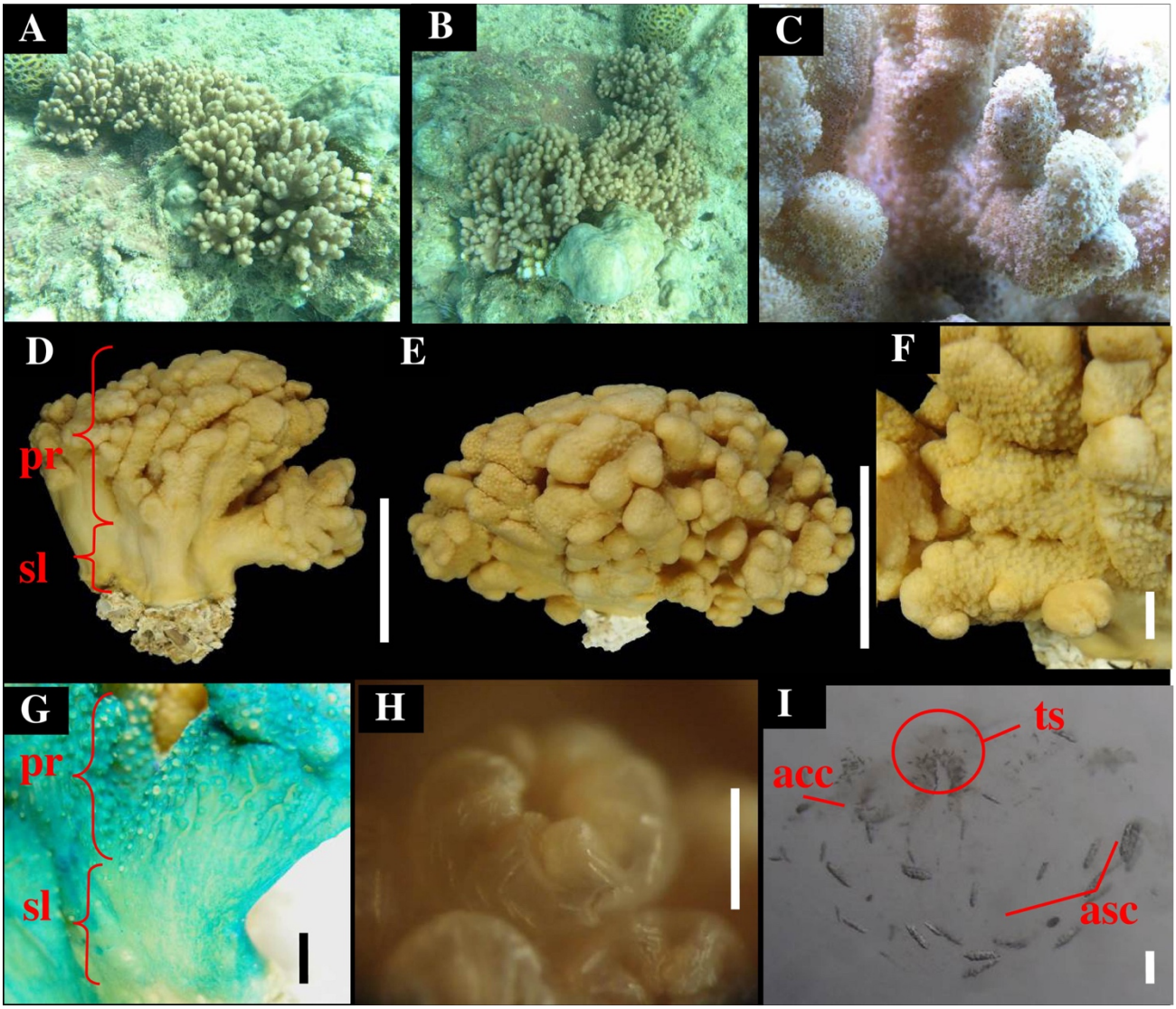

Fig. 1. *Klyxum molle* (Thomson & Dean, 1931), OCF-Cn20110929-08, (No. 62). A, B: colony *in situ*; C: enlarge photo of A; D, E: colony in ethanol; F, G: enlarge photo of E; H: merely expanding polyps; I: arrangement of sclerites of polyp. acc: sclerites of anthocodia; asc: sclerites of anthostele; pr: polypary; sl: stalk; ts: tentacle sclerites. Scale bars = 0.2 mm (I), 1 mm (H), 1 cm (F, G), 5 cm (D, E).

図 1. フトエダヤワトサカ *Klyxum molle* (Thomson & Dean, 1931), OCF-Cn20110929-08, (No. 62). A, B: 生態写真; C: A の拡大写真; D, E: エタノール標本写真; F, G: E の拡大写真; H: 少し伸長したポリプ; I: ポリプの骨片の配列. acc: 花頭の骨片; asc: 花柱の骨片; pr: 冠部; sl: 柄部; ts: 触手の骨片. スケールバー = 0.2 mm (I), 1 mm (H), 1 cm (F, G), 5 cm (D, E).

to Japan: *Klyxum molle* (Thomson & Dean, 1931), *Lobophytum salvati* Tixier-Durivault, 1970, *Chironephthya hicksoni*, Harrison, 1908, and *Siphonogorgia* cf. *godeffroyi* Kölliker, 1874. Although these four species have been described several times in the past, the present study examined and presents SEM pictures of the sclerite for the first time.

Descriptions of four species new to Japan

Class Anthozoa Ehrenberg, 1834
Subclass Octocorallia Haeckel, 1866
Order Alcyonacea Lamouroux, 1812
Family Alcyoniidae Lamouroux, 1812

Klyxum molle (Thomson & Dean, 1931)

[New Japanese name: Futoeda-yawatosaka]
(Figs. 1, 2)

Alcyonium molle Thomson & Dean 1931: 43, pl. 8, fig. 3, pl. 14, fig. 4; Tixier-Durivault 1966: 31, figs. 12, 13; 1970a: 182–183; 1970b: 120; Benayahu, Weil & Kleinman 1990: 324 (list only).
Klyxum molle — Alderslade 2000: 240 (list only).

Material examined. OCF-Cn20110929-08 (No. 62). Off Yamakawa, Motobu, Okinawa Island, 26°40′48.5″N, 127°52′45.2″, 2 m deep, September 29, 2011.

Description. *Colony*. Flabby, 75 mm high with maximum cross section of 50 × 100 mm (Fig. 1D, E). Stalk 20–40 mm high with maximum proximal cross section of 32 × 45 mm, spreading toward polypary. Polypary with four large lobes swollen upward, 45 mm high with maximum proximal cross section 25 × 30 mm, maximum distal cross section 38 × 50 mm. Lobes covered with small knobs (Fig. 1F), 3 mm high and wide, or finger-like projections, up to 26 mm high with maximum cross section of 8 × 9 mm. *Polyps*. Monomorphic, large, almost completely retractile (Fig. 1H), contracted diameter 1.4 mm, uniformly crowded over polypary except near stalk, polypary-stalk boundary indistinct (Fig. 1G). Tentacles with elongate rods, up to 0.07 mm long (Fig. 2A), arranged longitudinally on the aboral side of the rachis. These rods with a few small simple warts. Anthocodiae armed by elongated rods or spindles, up to 0.18 mm long, with a few large conical warts (Fig. 2B). Generally few sclerites, longitudinally arranged, occasionally in eight double rows (Fig. 1I). Thick spindles up to 0.24 mm long, sparsely covered with large conical warts (Fig. 2C), transversely arranged on proximate portion of anthostele.

Sclerites. Lobe surface layer with many thick spindles up to 0.26 mm long, some cross-shaped branching (Fig. 2D). Lobe interior contains thick spindles, up to 0.31 mm long, shorter spindles having blunt ends. Slender spindles up to 0.13 mm long also present, with a few conical warts, mixed (Fig. 2E). Stalk surface layer with many thick spindles, up to 0.22 mm long, often with blunt ends, rarely cross-branching (Fig. 2F). Stalk interiors contain thick spindles, up to 0.24 mm long, occasional distinct blunt ends, rarely cross-branching. Several slender rods present, up to 0.18 mm long, mixed (Fig. 2G). Thick spindles with large conical prominences in coenenchyme, several with slight indication of girdles of prominences.

Color. Pale yellowish with reddish brown tentacles in life. Pale yellowish brown in ethanol.

Remarks. *Klyxum molle* resembles *Klyxum tuberculosa* (Tixier-Durivault, 1970) in the presence of elongated rods with few conical warts in anthocodiae. However, *K. tuberculosa* differs from *K. molle* in its large sclerites of the surface layer of lobes and stalk (0.3–0.35 mm long vs. < 0.26 mm long in *K. molle*).
Three species of *Klyxum* have been recorded from the Ryukyu Archipelago, *K. simplex* (Thomson & Dean, 1931), *K. utinomii* (Verseveldt, 1971), and *K. okinawanum* (Utinomi, 1976). *Klyxum simplex* is different from *K. molle* in having sclerites with typically tapered ends in the coenenchyme (vs. blunt ended sclerites in *K. molle*). Verseveldt (1971: 8) mentioned that *K. utinomii* is characterized by the nearly smooth, fusiform sclerites. *Klyxum utinomii* is also distinguished from *K. molle* by having hexagonal sclerites in the interior the stalk (vs. spindles and rods in *K. molle*). *Klyxum okinawanum* is distinguished from other species by smooth surfaces of all sclerites in the coenenchyme.

Distribution. Okinawa Island, Indonesia, Vietnam, Australia, New Caledonia, Madagascar. 2–15 m deep. Type locality: Hainsisi, Semau Island, Indonesia (Siboga-Station 60), 3 m deep.

Lobophytum salvati Tixier-Durivault, 1970

[New Japanese name: Futoyubi-unetake]
(Figs. 3, 4)

Lobophytum salvati Tixier-Durivault 1970a: 207, 208, figs. 32–34; Verseveldt 1977: 13–15, figs. 7, 8, pl. 10, fig. 2; 1983: 86, fig. 42, pl. 28, fig. 3.

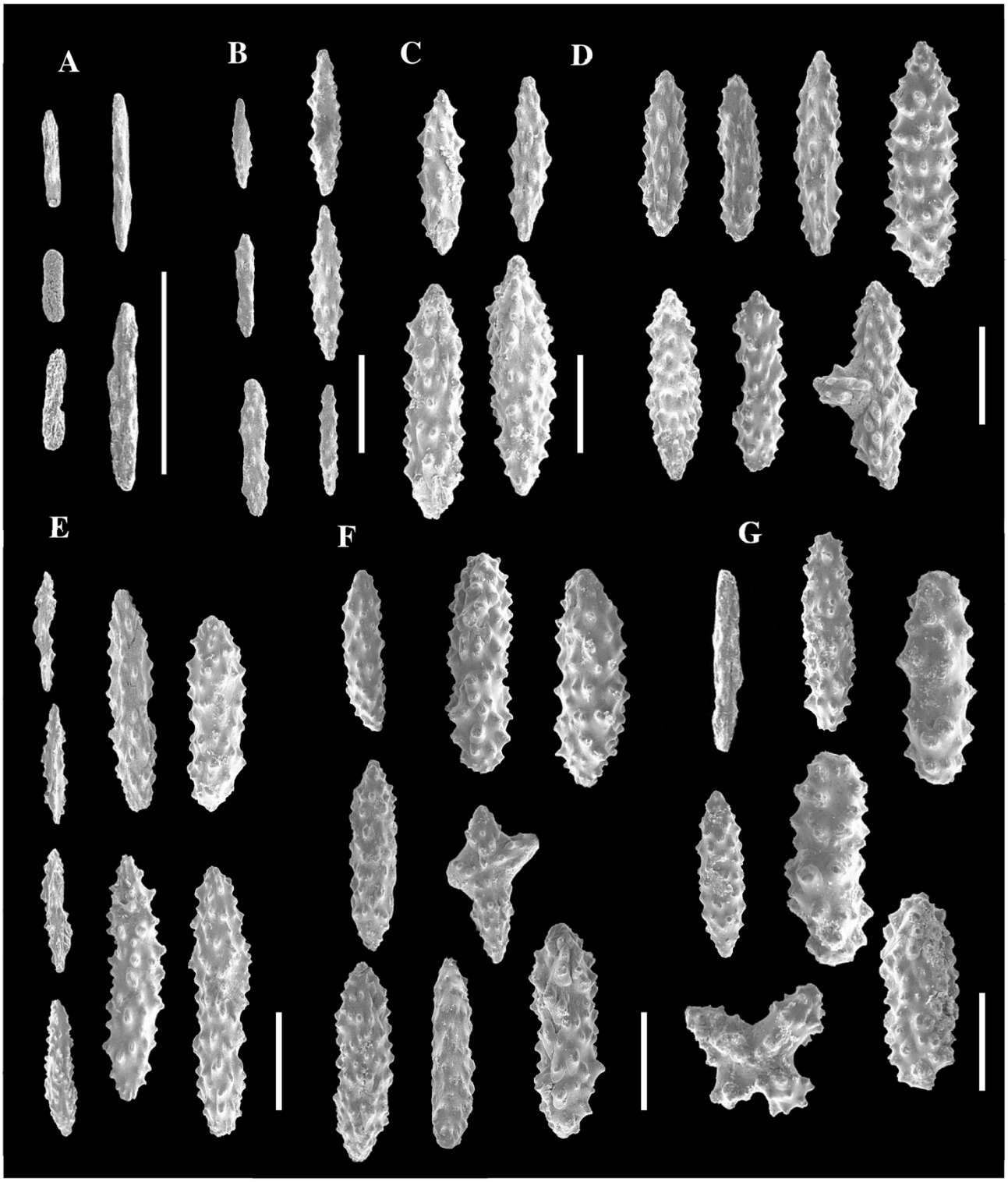

Fig. 2. Sclerites of *Klyxum molle* (Thomson & Dean, 1931), OCF-Cn20110929-08, (No. 62). A: tentacles.; B: anthocodiae; C: proximal portion of anthostele; D: surface layer of lobes; E: interior of lobes; F: surface layer of stalk; G: interior of stalk. Scale bars = 0.1 mm.
図 2. フトエダヤワトサカの骨片, OCF-Cn20110929-08, (No. 62). A: 触手; B: 花頭; C: 柄部基部; D: 裂葉皮部; E: 裂葉内部; F: 柄部皮部; G: 柄部内部. スケールバー = 0.1 mm.

Material examined. OCF-Cn20110927-15 (No. 15). Off Cape Bise, Motobu, Okinawa Island, 26°42′51.2″N, 127°52′26.8″, 6 m deep. September 27, 2011.

Description. *Colony*. Massive, 42 mm high with 54 × 72 mm maximum cross section (Fig. 3C, D).

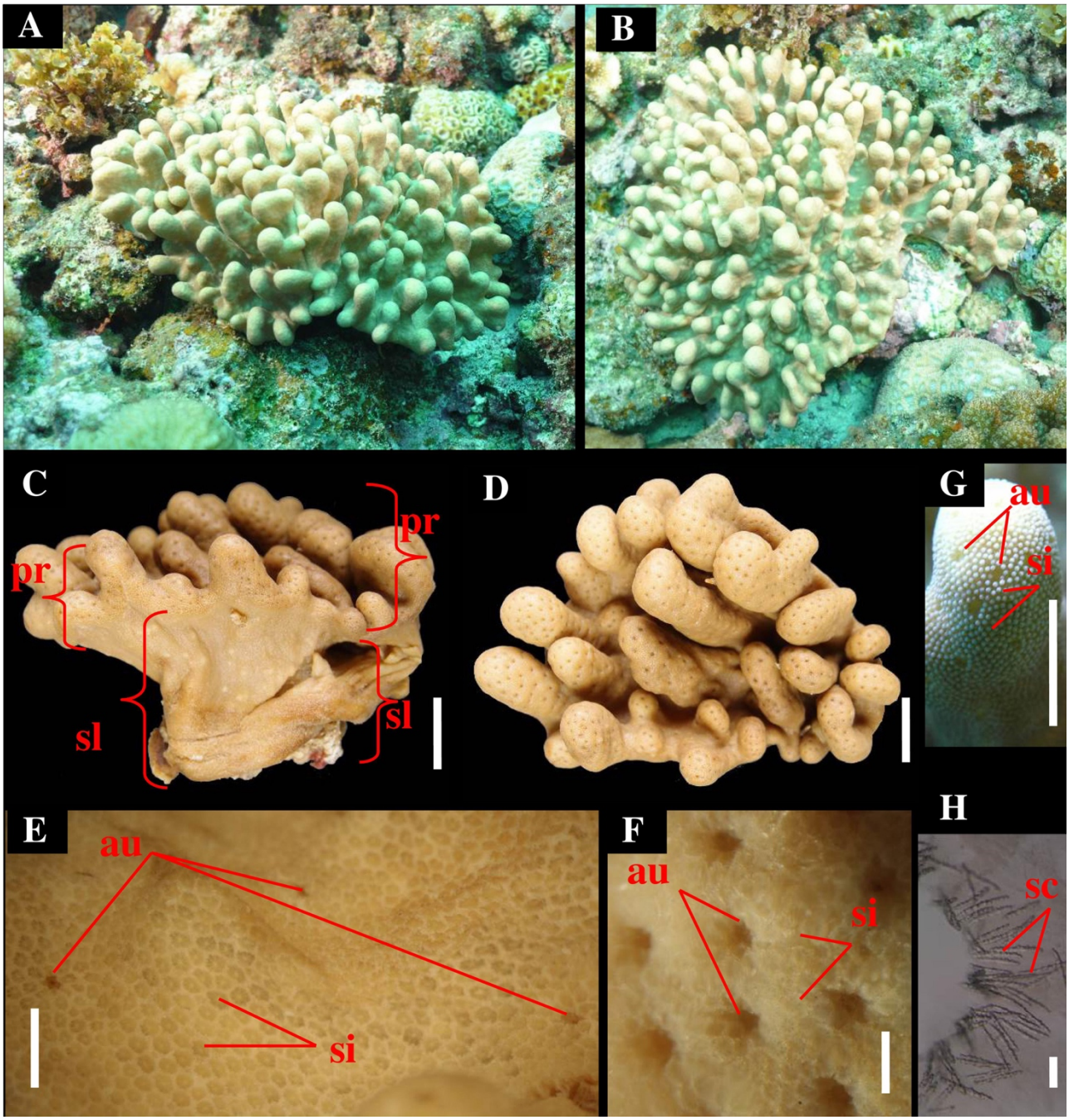

Fig. 3. *Lobophytum salvati* Tixier-Durivault, 1970, OCF-Cn20110927-15, (No. 15). A, B: colony *in situ*; C, D: colony in ethanol, showing waving periphery of polypary and many finger-like projections; E: enlargement of around center of polypary; F: enlargement of distal portion of lobe; G: enlargement of lobe *in situ*; H: arrangement of sclerites of anthocodia. au: autozooids; pr: polypary; sc: sclerites; si: siphonozooids; sl: stalk. Scales bars= 0.1 mm (H), 1 mm (E, F), 1 cm (C, D, G)

図 3. フトユビウネタケ *Lobophytum salvati* Tixier-Durivault, 1970, OCF-Cn20110927-15, (No. 15). A, B: 生態写真; C, D: エタノール標本写真, 冠部の波打つ周辺部と指状突起を示す; E: 冠部中心部の拡大; F: 裂葉頂端部の拡大; G: 生時の裂葉拡大; H: 花頭の骨片の配列. au: 通常ポリプ; pr: 冠部; sc: 骨片; si: 管状ポリプ; sl: 柄部. スケールバー = 0.1 mm (H), 1 mm (E, F), 1 cm (C, D, G).

Stalk 18–22 mm high, maximum proximal cross section 32 × 33 mm. Polypary covered with about 30 thick club-shaped lobes, 4–25 mm high, maximum proximal cross section 5–14 mm, maximum distal cross section, 5–9 mm. Periphery undulating, about 15 upright lobes at margin.

Polyps. Dimorphic. Retracted autozooids clearly hollow. Siphonozooids easily distinguishable by the

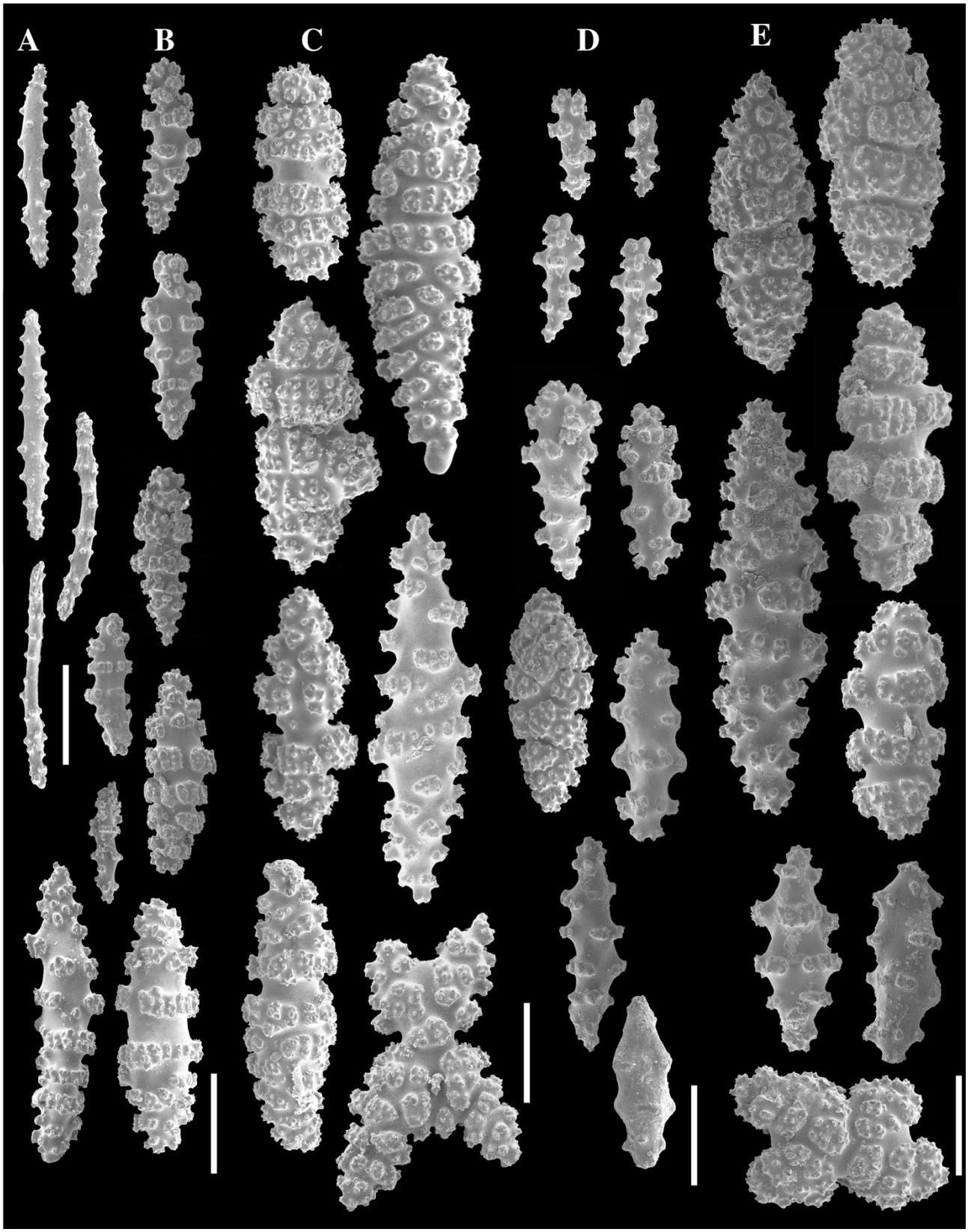

Fig. 4. Sclerites of *Lobophytum salvati* Tixier-Durivault, 1970, OCF-Cn20110927-15, (No. 15). A: point; B: surface layer of lobes; C: interior of lobes; D: surface layer of stalk; E: interior of stalk. Scale bars = 0.1 mm.
図 4. フトユビウネタケの骨片, 1970, OCF-Cn20110927-15, (No. 15). A: ポイント; B: 裂葉皮部; C: 裂葉内部; D: 柄部皮部; D: 柄部内部. スケールバー = 0.1 mm.

naked eye (Fig. 3G). Autozooids 1.0–1.5 mm apart at lobe distal portion, 2.5–3 mm apart at proximal portion, and 3.5–14 mm apart around polypary center. Lobe distal portion, 3–5 siphonozooids between two autozooids (Fig. 3F), proximal portion about six siphonozooids, polypary center around 8–26 siphonozooids (Fig. 3E). Anthocodiae with eight points of 5–6 small spindle pairs (Fig. 3H, 4A). No sclerites in tentacles and anthostele.

Sclerites. Lobe surface with clubs, 0.11–0.20 mm long, and spindles up to 0.33 mm long (Fig. 4B). Clubs with small warty head, occasionally with an indistinct central wart between head and handle, handle covered in 3–4 girdles of complex warts. Spindles with large complex warts usually arranged in 6–7 girdles. Lobe interior with cylinders and pointed spindles, 0.20–0.40 mm long, crosses rarely present (Fig. 4C). Cylinders and spindles usually with 4–8 girdles of large warts, sometimes irregularly arranged, frequently with median waist. Stalk surface layer with clubs 0.10–0.16 mm long, spindles up to 0.27 mm long, fusiform sclerites 0.17 mm long (Fig. 4D). Clubs with an indistinct central wart similar to those of lobe surface. Spindles thicker than those of lobe surface. Fusiform sclerites with cone-shaped processes. Stalk interior contain cylinders and spindles, 0.22–0.36 mm long, four distinct girdles of large warts on smaller cylinders (Fig. 4E). Additionally pointed fusiform sclerites, ca 0.2 mm long with four girdles of large warts, in stalk interior.

Color. Colony pale yellowish brown in life, yellowish white in ethanol.

Remarks. *Lobophytum salvati* is morphologically similar to *L. pauciflorum* (Ehrenberg, 1834) in their thick finger-like lobes. These two species, however, differ from each other in the number of cylinder girdles in stalk interior (four in *L. salvati* vs. usually two in *L. pauciflorum*).
Distribution. Okinawa Island, New Caledonia, Washington Island (south of Hawaiian Islands). Type locality: Ronhua Is., in Saint Vincent Bay, New Caledonia, depth unknown.

Family Nidaliidae Gray, 1869
Subfamily Siphonogorgiinae Kölliker, 1874

***Chironephthya hicksoni* Harrison, 1908**
[New Japanese name: Chibieda-kudayagi]
(Figs. 5–9)

Chironephthya hicksoni Harrison 1908: 188; 1909: 36, pl. 5, fig. 40. pl. 6, fig. 57.
Siphonogorgia hicksoni — Thomson & Dean 1931: 158 (reproduced from Harrison 1909)
(Not *Siphonogorgia hicksoni* Thomson & Mackinnon 1910: 189–190, pl. 11, fig. 3, pl. 14, fig. 4., see remarks and "Overview of the genera *Siphonogorgia* and *Chironephthya"*).

Material examined. OCF-Cn20121004-10 (No. 135). West coast of Sesoko Island, Motobu, near Okinawa Island, 26°38′39.9″N, 127°51′11.7″, 13.7 m deep. October 4, 2012. BM-1982.8.224.7 (holotype of *C. hicksoni* Harrison, 1908), Macclesfield Bank, Admiralty Islands, Papua New Guinea, unknown depth.

Description. *Colony*. Arborescent, 150 mm high, 35 × 85 mm in polypary diameter (Fig. 5B, C). Stalk missing. Lower stem maximum cross section 9 × 10 mm. Polypary comprising five upright main branches nearly all in one plane. Main branches projecting slender secondary branches in all directions (Fig. 5D), distal portion of main and secondary branches slightly flattened. Terminal branches short (2.5–11.5 mm), maximum diameter 2.1 × 2.1 mm to 2.6 × 3.0 mm.

Polyps. Monomorphic, crowded with groupings of 4–5 individuals at distal portion of terminal branches (Fig. 5G), scattered on secondary and lateral sides of terminal branches in spiral pattern (Fig. 5F). Several solitary polyps on stem. Anthocodiae <0.70 mm high, maximum cross section of <0.85 mm when contracted, almost completely retracted into calyces, diameter <1.2 mm. Tentacles with many thick rods, up to 0.40 mm long, with a few conical large warts (Fig. 6A), arranged longitudinally on rachis (Fig. 5J). Similar rods invade into pinnules. Anthocodiae consist of eight points, each comprising two to three sclerite pairs, and crown of six to eight transversely arranged sclerites, and one to two small sclerite pairs between each point (fig. 5K, L). Anthocodial formula is 1P + (1–2)p + (6–8)Cr + (1/2)M. Point sclerites, up to 0.60 mm long spindles covered in complex warts, with sharp upper and blunt lower ends (Fig. 6B). Crown sclerites, up to 0.70 mm long spindles with many complex warts (Fig. 6C). Below crown (introvert), 10–12 spindles, up to 0.28 mm long, arranged horizontally (Fig. 6D). Distal calyces on terminal branches sheath-like (Fig. 5H), outer side surrounded by 2–3 teeth comprising large (up to 3.0 mm long) spindles continuing from branch cortices and covered with many complex warts (Fig. 6E1). Many small spindles (up to 1.0 mm long) of inner side arranged vertically, with many complex warts (Fig. 6E2); between spindles, elongated rods (up to 0.5 mm long) with few simple warts (Fig. 6E3).

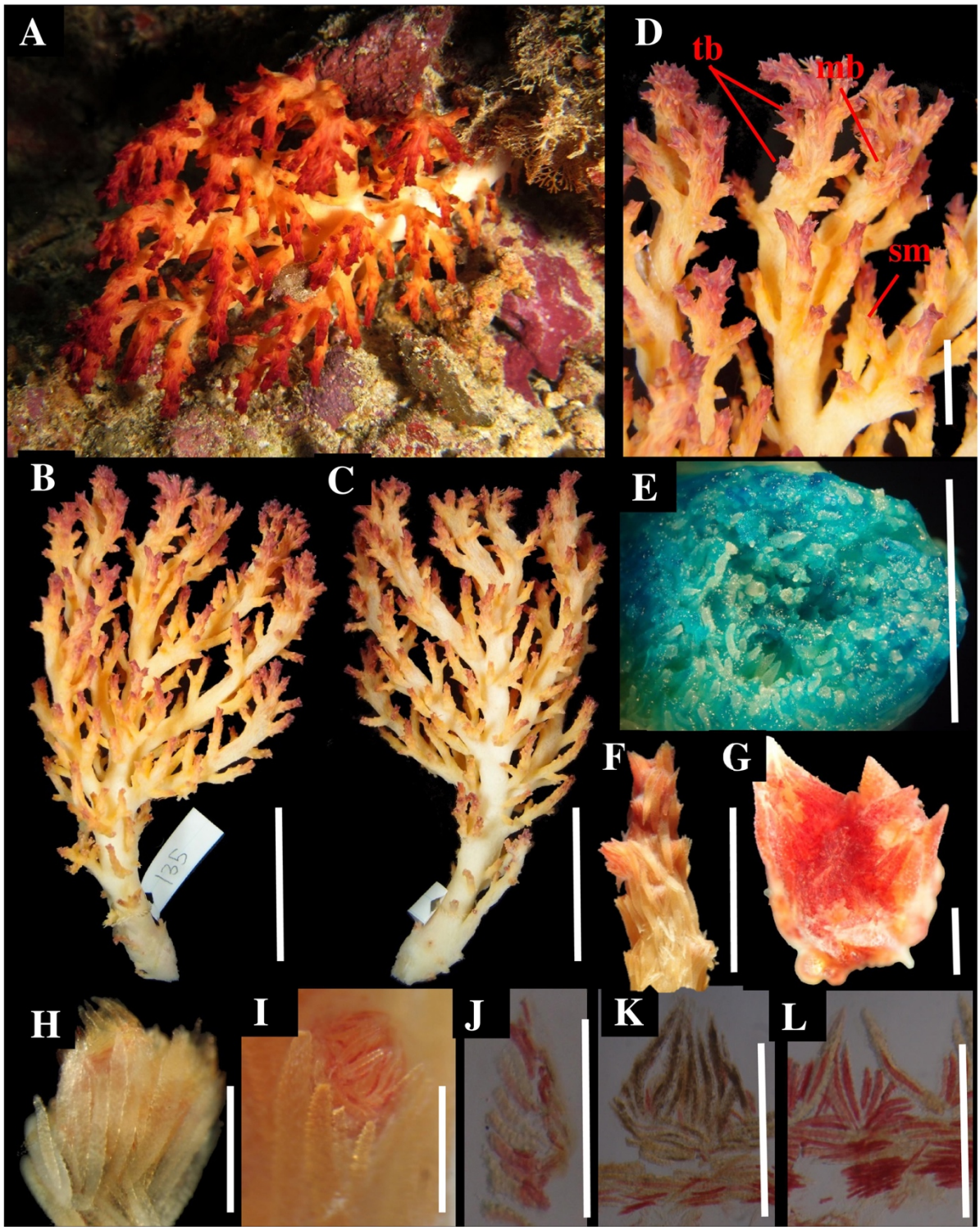

Fig. 5. *Chironephthya hicksoni* Harrison, 1908, OCF-Cn20121004-10, (No, 135). A: colony *in situ*. B, C: colony in ethanol; D: enlargement of B; E: cross section of stalk; F: enlargement of around distal portion of terminal branch; G: arrangement of polyps on distal portion of terminal branch; H: arrangement of sclerites of calyx on distal portion of terminal branch; I: arrangement of sclerites of calyx on stem; J: arrangement of sclerites of tentacle; K, L: arrangement of sclerites of anthocodia. mb: main branch; sm: stem; tb: terminal branch. Scale bars = 0.1 mm, 1 mm (G–L), 1 cm (D–F), 5 cm (B, C).

図 5. チビエダクダヤギ *Chironephthya hicksoni* Harrison, 1908, OCF-Cn20121004-10, (No, 135). A: 生態写真; B, C: エタノール標本写真; D: B の拡大; E：柄部横断面; F: 端末枝頂端の拡大; G: 端末枝頂端のポリプの配列; H: 端末枝頂端の莢の骨片の配列; I: 幹部の莢の骨片の配列; J: 触手の骨片の配列; K, L: 花頭の骨片の配列. Mb: 主枝; sm: 幹部; tb: 端末枝. スケールバー = 0.1 mm, 1 mm (G–L), 1 cm (D–F), 5 cm (B, C).

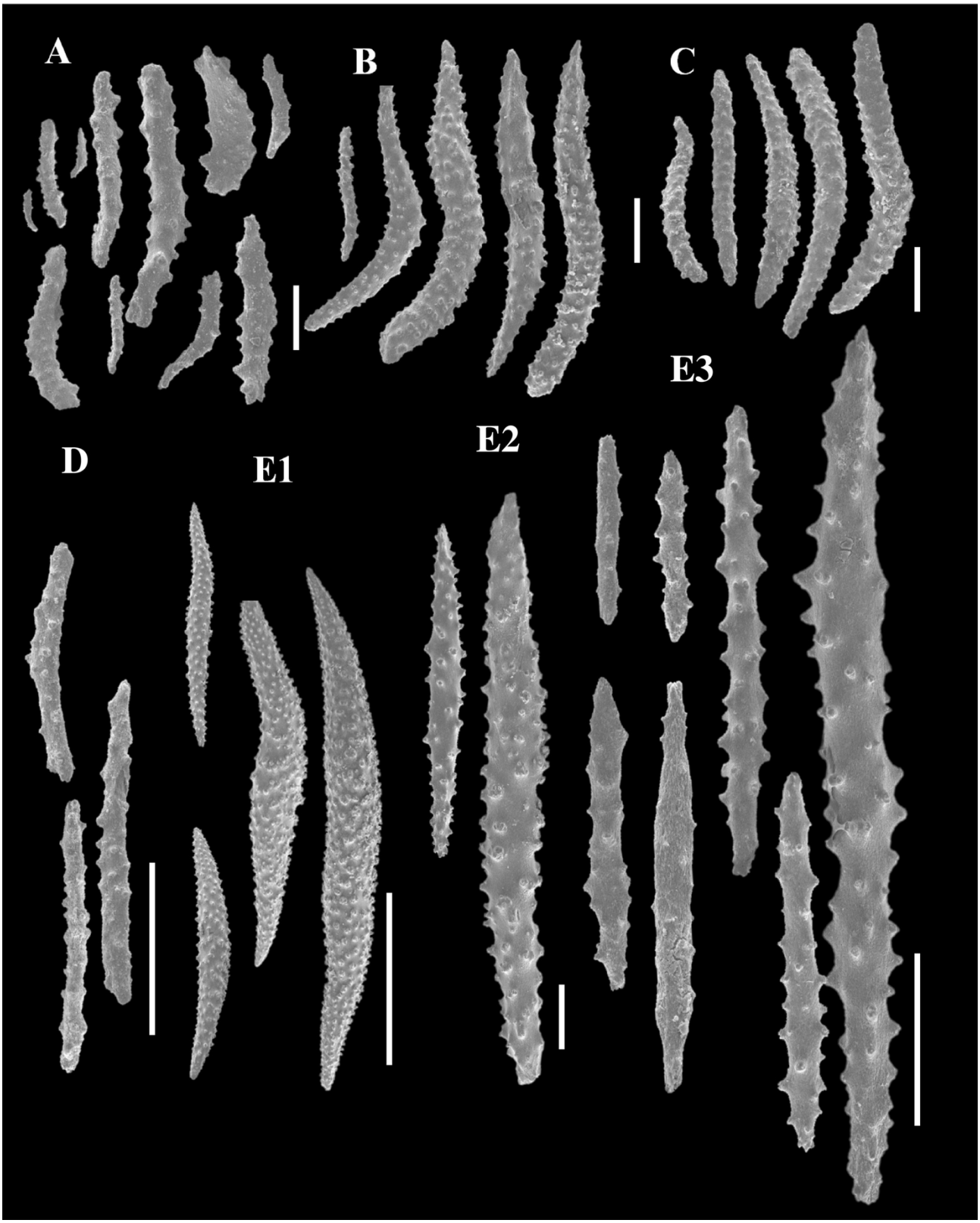

Fig. 6. Sclerites of *Chironephthya hicksoni* Harrison, 1908, OCF-Cn20121004-10, (No, 135). A: tentacle; B: point; C: crown; D: introvert; E: calyx of distal portion of terminal branches. Scale bars = 0.1 mm (A–D, E2–3), 1 mm (E1).
図 6. チビエダクダヤギの骨片, OCF-Cn20121004-10, (No, 135). A: 触手; B: ポイント; C: クラウン; D: 頸部; E: 端末枝頂端の莢. スケールバー = 0.1 mm (A–D, E2–3), 1 mm (E1).

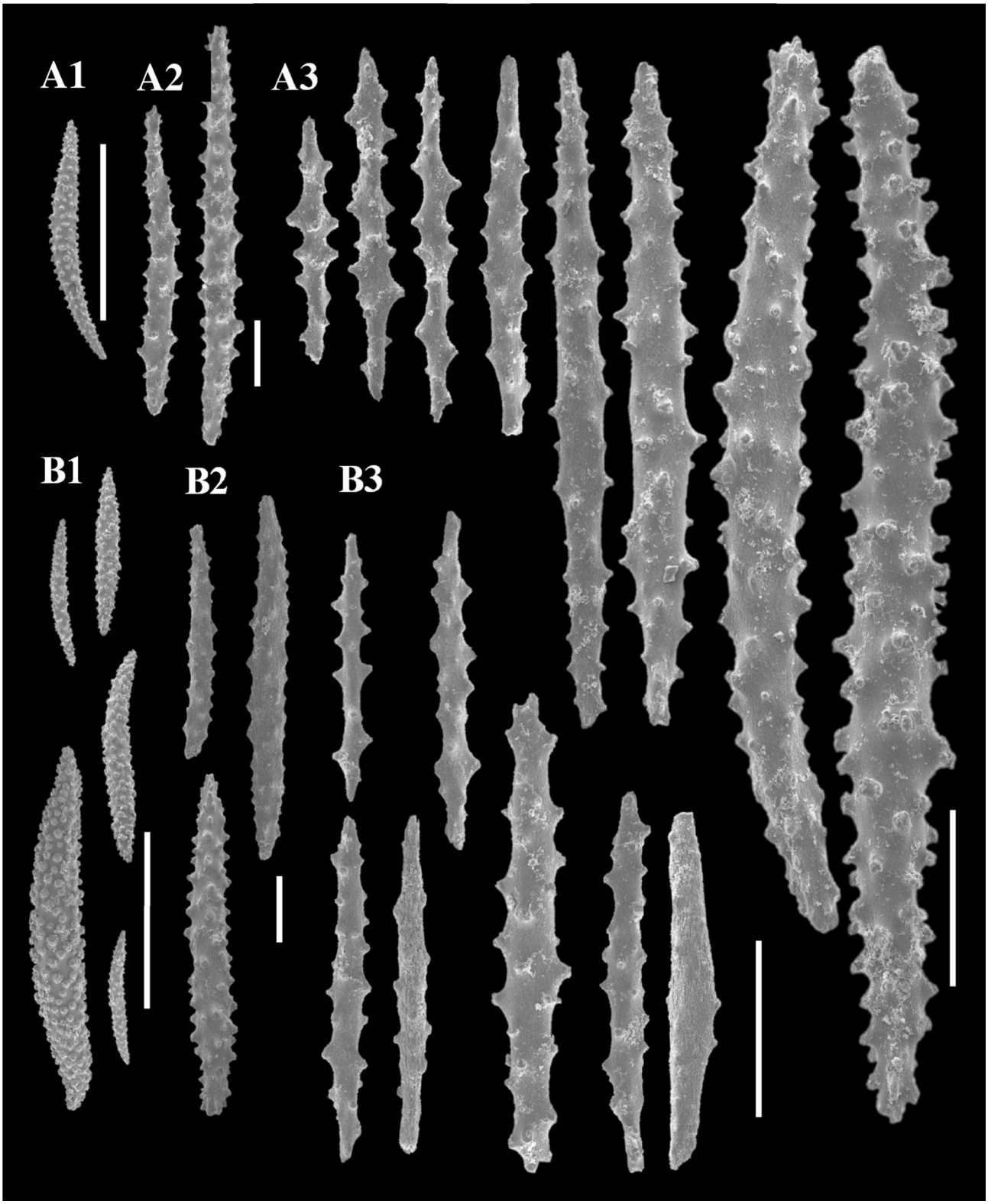

Fig. 7. Sclerites of *Chironephthya hicksoni* Harrison, 1908, OCF-Cn20121004-10, (No, 135). A: calyces on lateral sides of terminal branches; B: calyces on stem. Scale bars = 0.1 mm (A2, 3, B2, 3), 1 mm (A1, B1).
図 7. チビエダクダヤギの骨片, OCF-Cn20121004-10, (No, 135). A: 端末枝側面の莢; B: 幹部の莢. スケールバー = 0.1 mm (A2, 3, B2, 3), 1 mm (A1, B1).

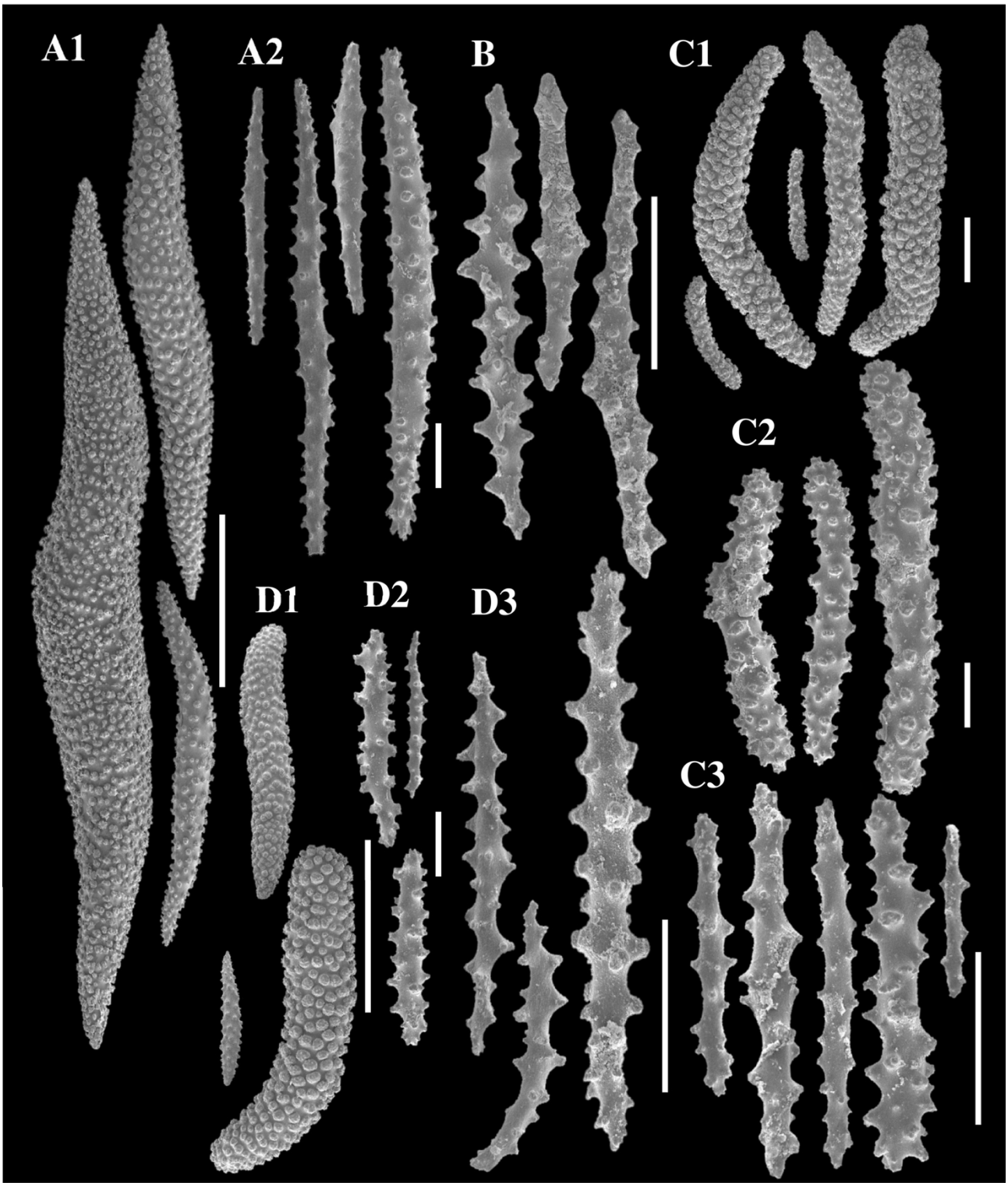

Fig. 8. Sclerites of *Chironephthya hicksoni* Harrison, 1908, OCF-Cn20121004-10, (No, 135). A: surface layer of branches; B: interior of branches; C: surface layer of middle portion of stem; D: interior of middle portion of stem. Scale bars = 0.1 mm (A2, B, C2, 3, D2, 3), 1 mm (A1, C1, D1).
図 8. チビエダクダヤギの骨片, OCF-Cn20121004-10, (No, 135). A: 枝部皮部; B: 枝部内部; C: 冠部中央の皮部; D: 冠部中央の内部. スケールバー = 0.1 mm (A2, B, C2, 3, D2, 3), 1 mm (A1, C1, D1).

Shelf-like, lateral calyces on branches and stem (Fig. 5I), outer side surrounded by 2–3 vertically arranged spindles (up to 1.5 mm long) with many complex warts (Fig. 7A1, 7B1). Between spindles, many slender spindles up to 0.7 mm long with a few complex warts (Fig. 7A2, right four of 7A3, 7B2), and needles up to 0.25 mm long with a few large warts (left four of Fig. 7A3). Inner side of calyces

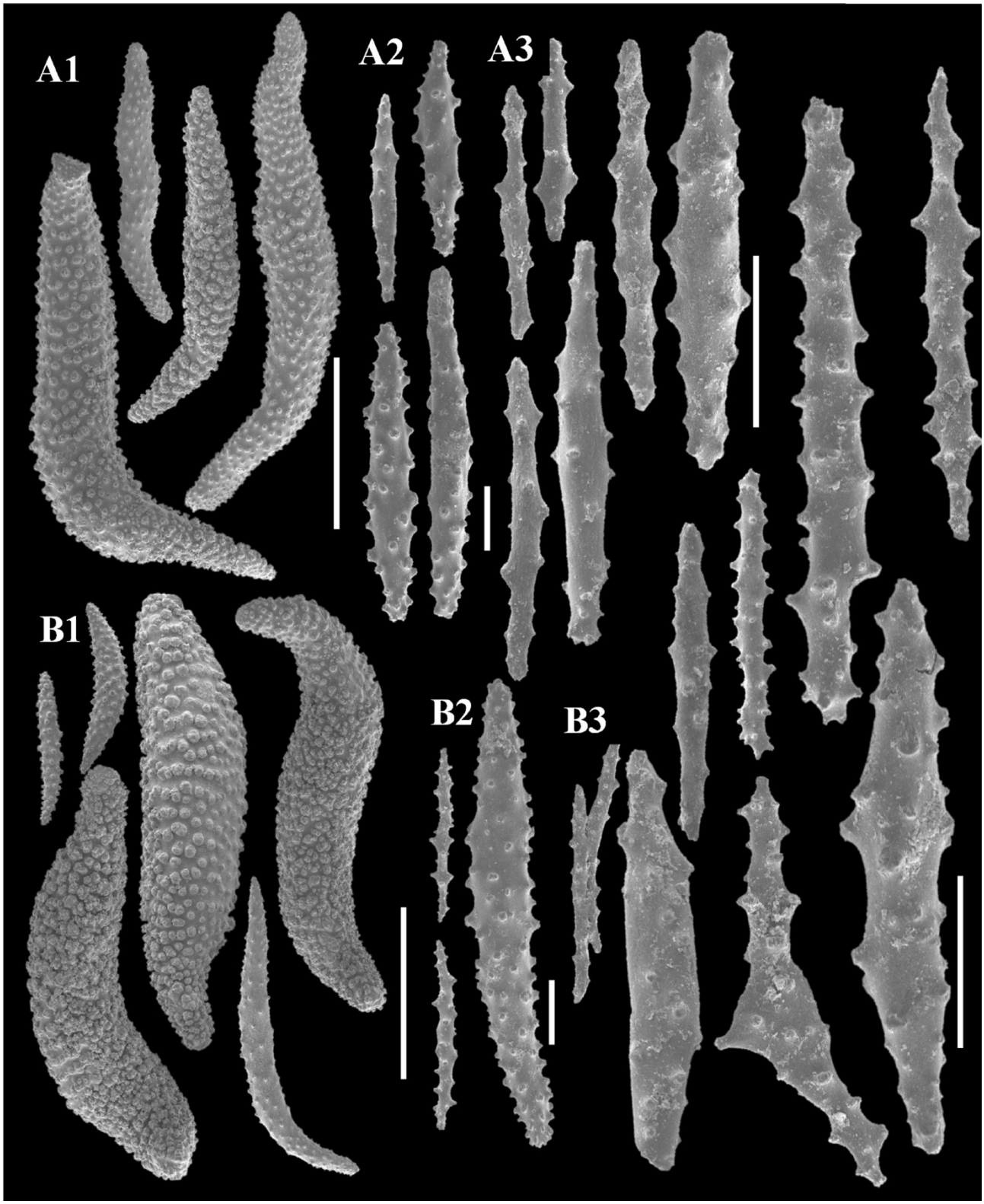

Fig. 9. Sclerites of *Chironephthya hicksoni* Harrison, 1908, OCF-Cn20121004-10, (No, 135). A: surface layer of lowest portion of stem; B: interior of lowest portion of stem. Scale bars = 0.1 mm (A2, 3, B2, 3), 1 mm (A1, B1).
図 9. チビエダクダヤギの骨片, OCF-Cn20121004-10, (No, 135). A: 幹部最下部の皮部; B: 幹部最下部の内部. スケールバー = 0.1 mm (A2, 3, B2, 3), 1 mm (A1, B1).

almost membranous with slender needles or elongated rods, up to 0.2 mm long with a few simple, vertically arranged warts (left four of Fig. 7B3). Between these sclerites, a few almost smooth

elongated rods, ca. 0.2 mm long, (one right end of Fig, 7B3).

Sclerites. Branch surface layers covered with large spindles, up to 5.5 mm long with many complex warts (Fig. 8A1). Slender spindles between them, up to 1.0 mm long, blunt both ends, with a few complex warts (Fig. 8A2). Branch interior contains needles (as in calyces), 0.30 mm long, with a few large simple warts (one each on the left and right of Fig. 8B), and rods up to 0.20 mm long, with a few simple large warts (center one of Fig. 8B). Surface layer of middle portion of stem covered with blunt-ended spindles up to 5.0 mm long, often bent at one end, with many complex warts (Fig. 8C1). Between spindles, shorter (up to 0.7 mm) blunt-ended spindles with complex large warts (fig. 8C2), and slender spindles up to 0.15 m long, with a few complex large warts (Fig. 8C3). Interior of middle portion of stem contains blunt-ended spindles up to 2.0 mm long with many compound warts (Fig. 8D1), blunt-ended slender spindles up to 0.35 mm long with a few compound warts (Fig. 8D2), and needles up to 0.30 mm long (Fig. 8D3). Surface layer of lower position of stem covered in spindles, often bent, up to 3.0 mm long with many complex warts (Fig. 9A1), and spindles up to 0.60 mm long with a few simple warts (Fig. 9A2). Between spindles, elongate rods up to 0.25 mm long, with a few simple warts (Fig. 9A3). Lower portion of stem interior contains spindles up to 3.0 mm long with many compound warts (Fig. 9B1), sharp-ended spindles 2.0 mm long with few simple warts (right end of Fig. 9B2), and blunt-ended slender spindles 0.80 mm long with a few simple warts (two on the left side of Fig. 9B2). Between spindles, elongated rods 0.30 mm long with a few simple small warts (left five and bottom right one of Fig. 7A3), and a few needles 0.30 mm long with few simple large warts (upper right one of Fig. 9B3). Terminal branch surface layers with vertically arranged spindles; branch stem and stalks with spindles arranged vertically, horizontally, and in layers. Branches fragile, but stem hard with numerous sclerites filling interior.

Color. Lower stem white, upper stem and branches gradually turn pale orange-yellow, terminal branches dark-red distally. Polyps white, point and crown sclerites yellow, polyp-stalk sclerites red.

Remarks. *Chironephthya hicksoni* was only briefly described by Harrison (1908, 1909) without any photograph or figure of the colony, based on a specimen collected from Macclesfield Bank, Admiralty Islands, Papua New Guinea. The specimen examined in this study closely resembles the holotype in the branching mode, anthocodial formula, stem surface layer sclerites (blunt spindles covered with warty projections), and large coenenchyma interior spindles with numerous typical small thorny forms. The only exceptions are colony/polyp color of terminal branch (dark-red vs. dull yellow in the holotype) and the size of the branch surface layer sclerites (up to 5.5 mm and much longer in the specimen examined vs. largest size of 3.7 mm in the original description). The differences are, however, relatively minor and considered as intraspecific variations.

The present study represents the second record of *C. hicksoni* since the original description. This species has long been forgotten in octocoral taxonomy. *Chironephthya hicksoni* is therefore still not listed in World Register of Marine Species (WoRMS; Ofwegen 2017a, b). The "Species Search Result for GBIF 2017 (Global Biodiversity Information Facility)" includes *C. hicksoni* (as *Siphonogorgia hicksoni* Harrison), but it is posted as a "doubtful species". Such situation is likely due to the species *Siphonogorgia hicksoni* Thomson & Mackinnon, 1910, that was described two years after the description of *Chironephthya hicksoni* Harrison, 1908. *Siphonogorgia hicksoni* was described based on a specimen collected from Providence Island, Seychelles. *Siphonogorgia hicksoni* is characterized by the following traits: polyps arranged only on the branches, not appearing on the stem, anthocodial formula 1P + (2–3)p + 10Cr + (1/2–1)M, and coenenchyme sclerites <1.3 mm long. Thus *S. hicksoni* is a totally different species from *Chironephthya hicksoni*. The genus *Chironephthya* Wright & Studer, 1889 (see ICZN Art. 12.2.5 for the genus name authorship), was often been considered as a junior synonym of *Siphonogorgia* Kölliker, 1874, by many authors (see "Overview of the genera *Siphonogorgia* Kölliker, 1874 and *Chironephthya* Wright & Studer, 1889) until Verseveldt & Bayer (1988) recognized them as two distinct genera. Both *Chironephthya hicksoni* Harrison, 1908, and *Siphonogorgia hicksoni* Thomson & Mackinnon, 1910, became congeneric and were secondary homonyms for long periods of time. However, no one proposed a replacement name for *Siphonogorgia hicksoni* Thomson & Mackinnon, 1910. Indeed Thomson & Dean (1931: 157–158) and Tixier-Durivault (1968: 18) considered *Siphonogorgia* and *Chironephthya* as synonyms but treated the two species by the same name, "*Siphonogorgia hicksoni*", with different authorships. Since no replacement name has been given, and the two genera are now regarded as distinct from each other, the two species names are valid (ICZN 1999 Art. 59.2).

Distribution. Okinawa Island, 13.7 m deep; Macclesfield Bank around Admiralty Island off Papua New Guinea, unknown depth. Type locality: Macclesfield Bank, depth unknown.

***Siphonogorgia* cf. *godeffroyi* Kölliker, 1874**
[New Japanese name: Enji-honkudayagi]
(Figs. 10–13)

? *Siphonogorgia godeffroyi* Kölliker 1874: 18–23, pl. 1, fig. 6; Whitelegge 1897: 223; Kükenthal 1906: 71; (reproduced from Kölliker 1874); Thomson & Dean 1931: 156 (reproduced from Kölliker 1874).

Material examined. OCF-–Cn20121004-17 (No. 142), West coast of Sesoko Island, Motobu, near Okinawa Island, 26°38′39.95″N, 127°51′11.7″, 23.9 m deep, October 4, 2012.

Comparative material. BM-1882-4-5-24 (holotype of *Siphonogorgia godeffroyi* Kölliker, 1874), Pelewinseln (Palau Islands), collected from unknown depth (photograph only); NMBE-Challenger (a fragment of *Siphonogorgia godeffroyi* described by Wright & Studer, 1889), Challenger St. 232, Hyalonema-ground (Sagami Bay), Japan, 345 fathoms.

Description. *Colony*. Simple arborescent, 200 mm high, polypary diameter 32 × 80 mm (Fig. 10D, E). Sterile stalk 54 mm long, maximum proximal cross section 13 × 20 mm, maximum distal 13 × 16 mm. Polypary comprising four main branches, one extending from 83 mm above stalk proximal portion, three diverging >117 mm above stalk proximal portion in one plane. Ten smaller branches 3–19 mm long also diverge >56 mm above stalk proximal portion. Secondary and short terminal branches extend chiefly from main and larger branches on colony front, except several terminal branches arising from colony back (Fig. 10B, C, F). Terminal branches club-shaped, ranging from quite short (3 mm) with maximum 2 × 3 mm size in cross-section, to quite long (10 mm) with maximum 3.5 × 4.0 mm size in cross-section. Stalk exhibits five canals.

Polyps. Monomorphic. Crowded (3–5) around distal end of terminal branches (Fig. 10I, J, K); single polyps and groups of 2–5 polyps distributed widely over branches and stem. Contracted polyps <0.80 mm in diameter, completely retractile into calyces <0.60 mm high, 1.1 mm in diameter. Tentacle rachis with many longitudinally arranged thin rods, up to 0.15 mm long (right five of Fig. 11A), on aboral side. Small slender rods, up to 0.10 mm long (two on the left end of Fig. 11A), invaded into pinnules. Anthocodiae consist of eight points, each comprising three to four sclerite pairs, and crown of eight to nine transversely arranged sclerites. Anthocodial formula 1P + (2–3) p + (8–9) Cr. Point sclerites, up to 0.60 mm long (fig. 11B), upper portions covered with many simple warts, lower portions covered with mix of compound warts. Crown sclerites, up to 0.60 mm long (Fig. 11C), upper portion with a few simple warts, lower portions with many complex warts. Horizontally arranged 5–6 slender spindles, up to 0.30 mm long, on under crown (introvert). Terminal-branch calyces sheath-like (Fig. 10G), with those on front side extruding two large teeth-like spindles (up to 2.8 mm) with many simple warts on upper portions (Fig. 11D1), mix of compound warts on lower portions. Spindles up to 1.0 mm long on lateral side of calyx, with many compound warts. Between spindles, slender blunt-ended spindles up to 0.50 mm long with a few simple warts (Fig. 11D2), and spindles or elongated rods up to 0.35 mm long with a few simple warts. Non-terminal-branch and stem calyces cone-like (Fig. 10H), composed of sclerites, as in calyces on lateral portions of terminal branches and stems.

Sclerites. Terminal-branch surface layer covered with large spindles up to 3.5 mm long, with many simple warts on one end, becoming gradually complex toward other end (right end of Fig. 11E). Between large spindles, slender, blunt-ended spindles or needles up to 0.35 mm long with a few simple warts, and spindles or rods up to 0.15 mm long with a few warts. Surface layer of other branches covered with point-ended spindles up to 2.5 mm long, with many compound warts, and thick blunt-ended spindles up to 2.0 mm long, with many compound warts (Fig. 11E). Between spindles, smaller blunt-ended spindles up to 0.50 mm long with a few compound warts, and spindles or rods up to 0.20 mm long with a few simple warts. Branch interiors contain slender, blunt-ended spindles or needles, up to 0.50 mm long with a few simple warts (right five of Fig. 11F), and spindles or rods up to 0.20 mm long with a few simple warts (left two of Fig. 11F). Stalk and stem surface layer covered with spindles up to 3.5 mm long often bent, with many compound warts (Fig. 12A1) and spindles or rods up to 0.70 mm long, with few compound warts (Fig. 12A2). Stem interiors contain a few spindles, up to 2.5 mm long with many compound and rounded warts (Fig. 12B1) and slender spindles, up to 1.0 mm long with a few compound warts (Fig. 12B2). Stalk interior contains many sclerites similar to those in stem interior. Surface-layer sclerites of terminal branches chiefly arranged vertically, branch, stem,

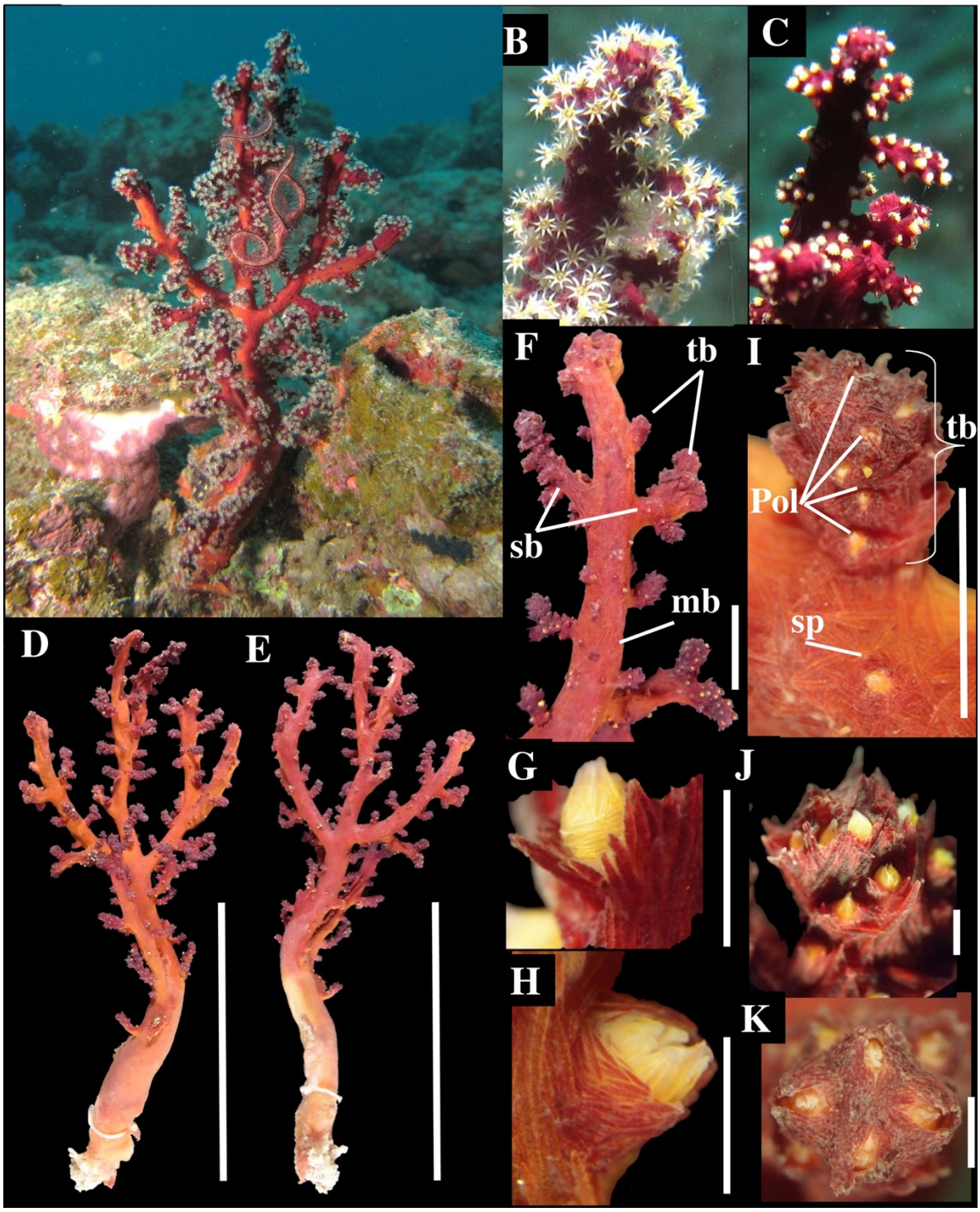

Fig. 10. *Siphonogorgia* cf. *godeffroyi* Kölliker, 1874, OCF-Cn20121004-17, (No. 142). A: colony *in situ*; B, C: enlargement of distal portion of a branch *in situ*; D, E: colony in ethanol; F: enlargement of distal portion of a branch; G: a polyp on terminal branch, showing arrangement of sclerites; H: a polyp on main branch, showing arrangement of sclerites; I: a terminal branch, showing arrangement of polyps; J: enlargement of around distal portion of a terminal branch; K: enlargement of distal portion of a terminal branch. mb: main branch; pol: polyp; sb: secondary branch; sp: solitary polyp; tb: terminal branch. Scale bars = 1 mm (G, H, J, K), 1 cm (F, I), 10 cm (D, E).

図 10. エンジホンクダヤギ *Siphonogorgia* cf. *godeffroyi* Kölliker, 1874, OCF-Cn20121004-17, (No. 142). A: 生態写真; B, C: 枝部頂端部の拡大; D, E: エタノール標本写真; F: 枝部著負担の拡大; G: 端末枝上のポリプ，骨片の配列を示す; H: 主枝上のポリプ，骨片の配列を示す; I: 端末枝，ポリプの配列を示す; J: 端末枝頂端付近の拡大; K: 端末枝頂端. mb: 主枝; pol: ポリプ; sb: 2 次枝; sp: 単独のポリプ; tb: 端末枝. スケールバー = 1 mm (G, H, J ,K), 1 cm (F, I), 10 cm (D, E).

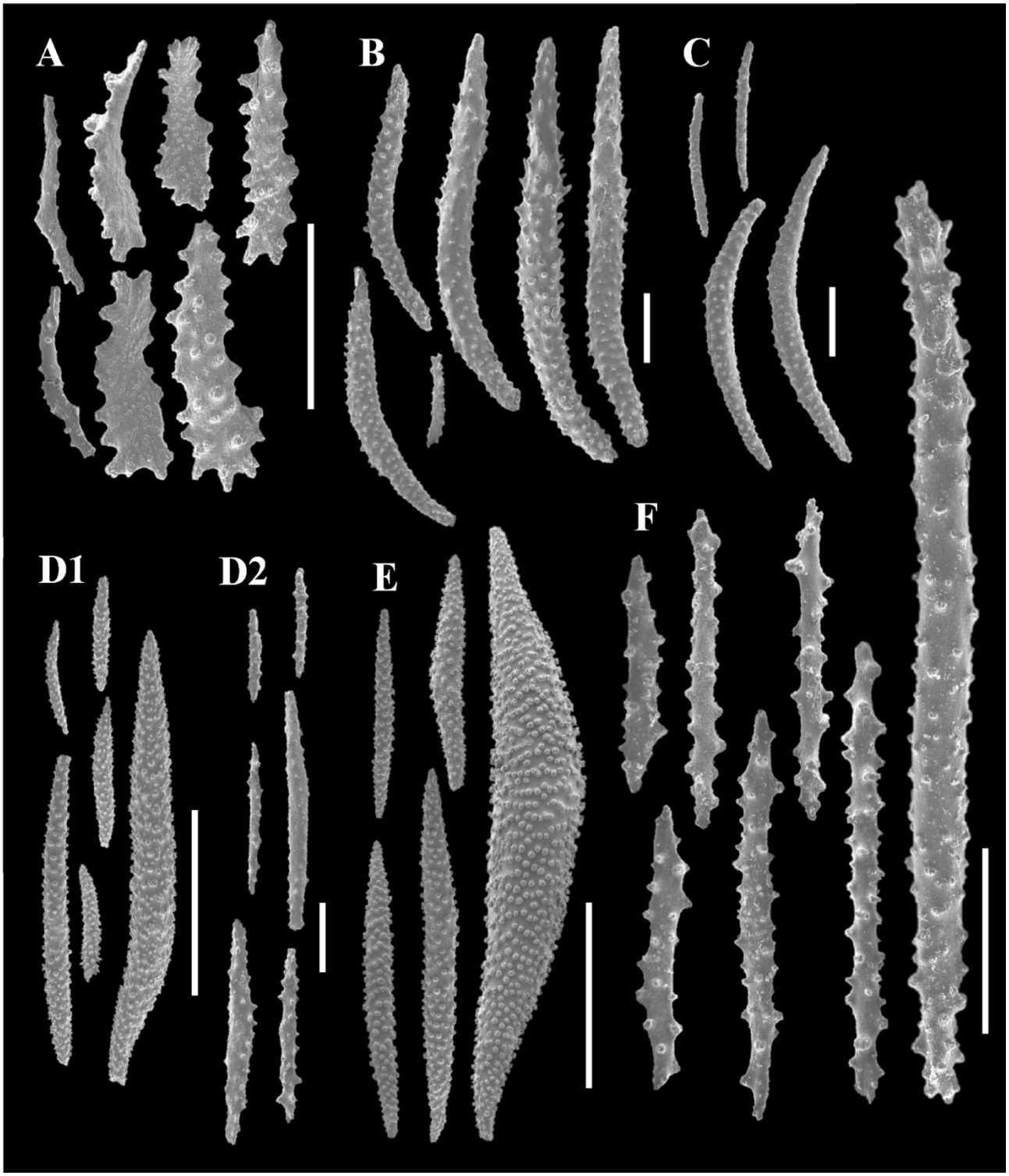

Fig. 11. Sclerites of *Siphonogorgia* cf. *godeffroyi* Kölliker, 1874, OCF-Cn20121004-17, (No. 142). A: tentacles; B: point; C: crown; D: calyces; E: surface layer of branches; F: interior of branches. Scale bars = 0.1 mm (A–C, D1, F), 1 mm (D2, E).
図 11. エンジホンクダヤギの骨片, OCF-Cn20121004-17, (No. 142). A: 触手; B: ポイント; C: クラウン; D: 莢; E: 枝部皮部; F: 枝部内部. スケールバー = 0.1 mm (A–C, D1, F), 1 mm (D2, E).

and stalk sclerites arranged vertically and horizontally, in layers. Branches fragile, but stem and stalk hard with numerous sclerites filling interior.

Color. Terminal branches deep-red. Other branches and stem orange-flame, stalk light-orange *in situ* and in ethanol. Polyps white, point and crown sclerites yellowish. Tentacles white.

Remarks. Kölliker (1874) described *S.*

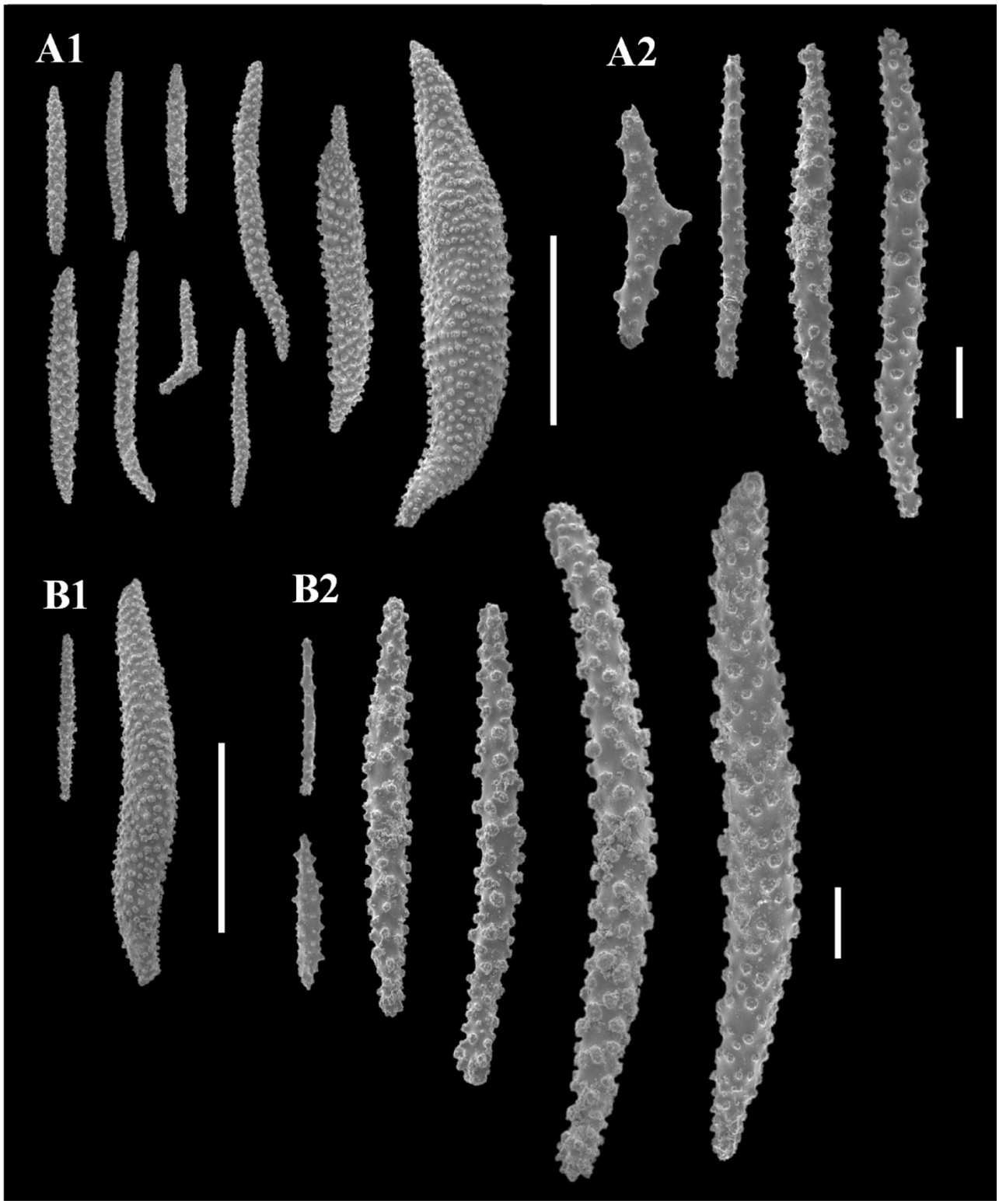

Fig. 12. Sclerites of *Siphonogorgia* cf. *godeffroyi* Kölliker, 1874, OCF-Cn20121004-17, (No. 142). A: surface layer of stem and stalk; B: interior of stem and stalk. Scale bars = 0.1 mm (A2, B2), 1 mm (A1, B1).
図 12. エンジホンクダヤギの骨片, OCF-Cn20121004-17, (No. 142). A: 幹部と柄部の皮部; B: 幹部と柄部の内部. スケールバー = 0.1 mm (A2, B2), 1 mm (A1, B1).

godeffroyi, based on a single specimen from Palau Islands (Fig. 13), collected from unknown depth. He described the branching mode, sclerites of coenenchyme, and colony/polyp color considerably in detail. The specimen collected in this study (Fig. 10) closely resembles to the original description, and

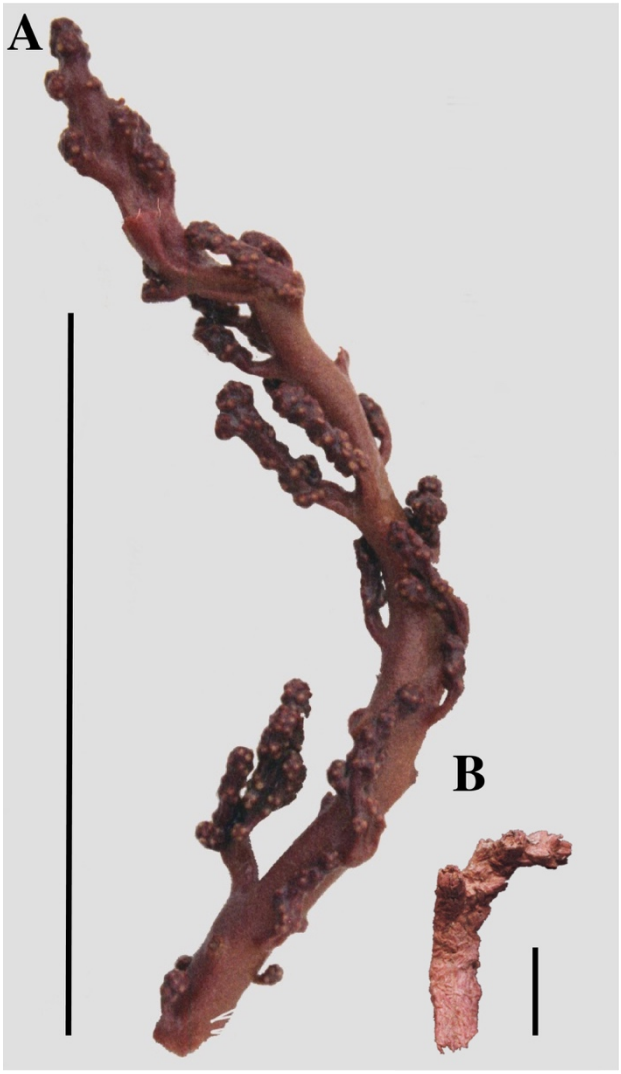

Fig. 13. *Siphonogorgia godeffroyi* Kölliker, 1874. A: holotype, BM-1882-4-5-24; B: a fragment of Wright & Studer's specimen from Hyalonema ground, NMBE-Challenger, st. 232. Scale bars = 1 cm (B), 10 cm (A).
図 13. エンジホンクダヤギ *Siphonogorgia godeffroyi*. A: ホロタイプ, BM-1882-4-5-24; B. Hyalonema ground から採集された Wright & Studer'の標本の細片, NMBE-Challenger, st. 232. スケールバー = 1 cm (B), 10 cm (A).

the external form agrees well with the photograph of the holotype (Fig. 13). However, since neither Kölliker (1874) nor others including the current work have described the characteristics of the anthocodial formula of the type specimen, we refrain from identifying the Okinawan specimen as *S. godeffroyi*.

The Okinawan specimen also resembles *S. pendula* Studer, 1889 (type locality Seychelles) in the branching mode and colony/polyp color but differs in the anthocodial formula (1P + (2–3)p + (8–9)Cr vs. 1p + (8–10)Cr in *S. pendula)* and longer sclerites of colony-interior (> 2.5 mm long vs. > 0.952 mm long in *S. pendula*) (Studer 1889). These differences preclude the identification of the Okinawan specimen to *S. pendula*. Wright & Studer (1889) provided a very rough description of a specimen of "*S. godeffroyi*" collected from 630 m depth at Hyalonema-ground (in Sagami Bay, Japan), fragments of which are stored in Naturhistorisches Museum der Burgergemeinde Bern, Switzerland. However, Wright & Studer's (1889) specimen from Sagami Bay differs from the original description of *S. godeffroyi* in the shape of the terminal branches (club-shaped vs. slender shaped in Wright & Studer's 1889 specimen). This difference indicates that Wright & Studer's (1889) specimen appears to be a different species.

Distribution. Okinawa Island, 23.9 m deep; *S. godeffroyi* found from Palau Islands and Funafuti in Tuvalu, 73–128 m deep. ? Hyalonema-ground, 630 m deep. Type locality: Palau Islands, depth unknown.

Overview of the genera *Siphonogorgia* Kölliker, 1874, and *Chironephthya* Wright & Studer, 1889.

Material examined. *Chironephthya dipsacea* Wright & Studer, 1889, BM-1890-4-11-23 (holotype), Challenger St. 232, Hyalonema-ground, Japan, 345fms., 12 May 1875; *Chironephthya crassa* Wright & Studer, 1889, BM-90-4-11-26 (holotype), Challenger St. 232, Hyalonema-ground, Japan, 345fms., 12 May 1875; *Chironephthya scoparia* Wright & Studer, 1889, BM-90-4-11-24 (holotype), Challenger St. 232, Hyalonema-ground, Japan, 345fms., 12 May 1875; *Chironephthya caribaea* (Deichmann, 1936), USNM-1025683 (non-type), North Atlantic Ocean, Gulf of Mexico, United States, Texas, Flower Garden Banks National Marine Sanctuary, West Flower Gardens Bank, 27.51.45N 93.49.01W, depth 77 m, Wicksten, Mary K., Date: 26 May 2004, Gear: ROV-Sea Rover, Exped., Flower Garden Survey; *Neospongodes atlantica* Kükenthal, 1903, ZMH-C2350 (paratype), Bahia, Paessler leg, i. d. Kükenthal 1902.

Overview. Genus *Siphonogorgia* was established by Kölliker (1874) for the Palauan species *S. godeffroyi*. Regarding genus *Chironephthya*, the external form of the colony is very similar to that in *Siphonogorgia*, and this genus was established by Wright & Studer (1889) based on materials collected from Japan (Hyalonema ground, Sagami Bay) by the Challenger Expedition in 1875. They described three *Chironephthya* species in the Challenger Expedition Monograph, i.e. *C. dipsacea*, *C. crassa* and *C. scoparia* (Fig. 14), without designating a type species, which has not been done yet. In the same

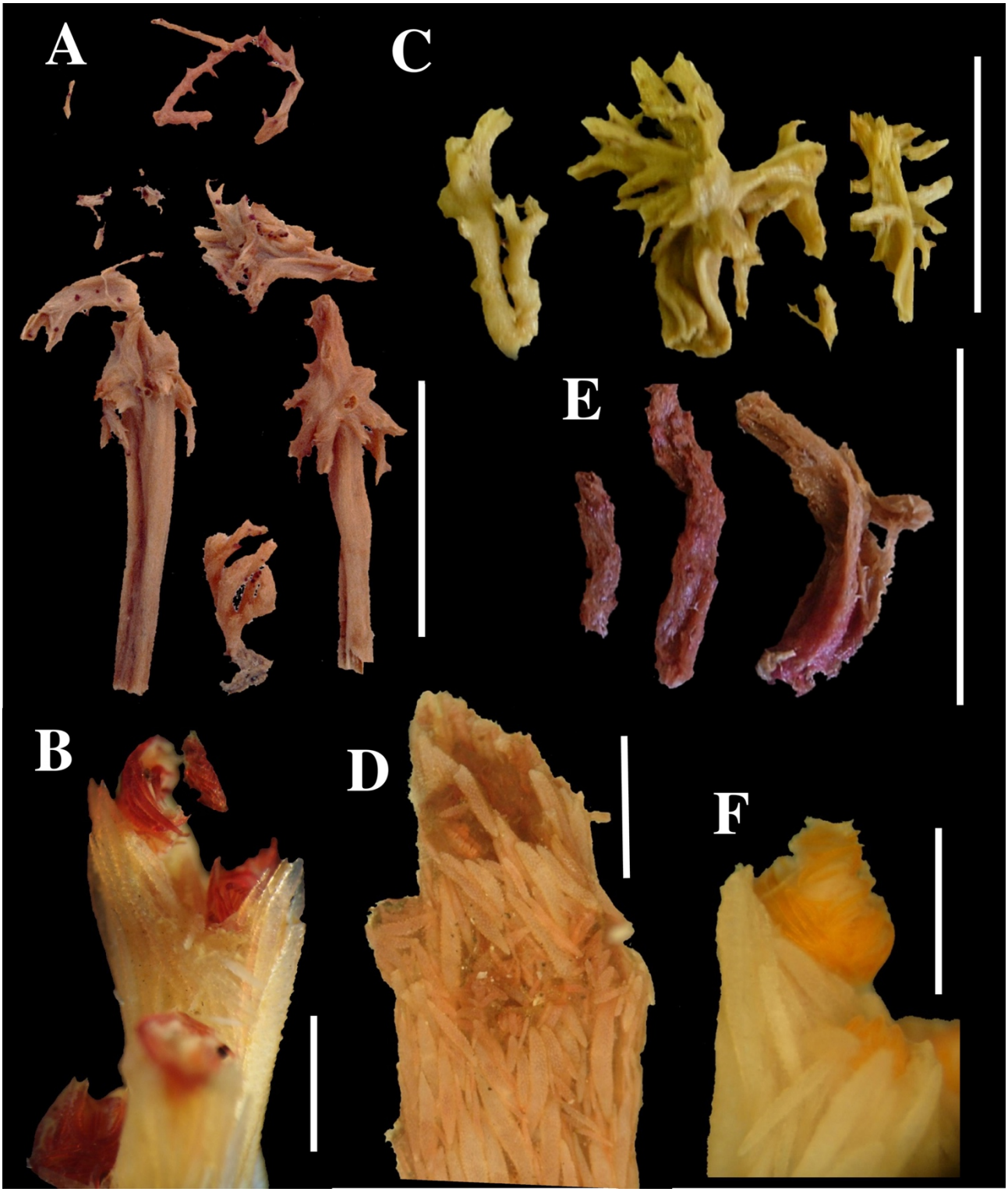

Fig. 14. *Chironephthya* species described by Wright & Studer (1898). A, B: *C. dipsacea* Wright & Studer, 1898 (holotype, BM-1890-4-11-23); C, D: *C. scoparia* Wright & Studer, 1898 (holotype, BM-90-4-11-24); E, F: *C. crassa* Wright & Studer, 1898 (holotype, BM-90-4-11-26). Scale bars = 1 mm (B, D, F), 5 cm (A, C, E).
図 14. Wright & Studer (1898)により記載されたクダヤギ属の 3 種. A, B: アカバナクダヤギ (ホロタイプ, BM-1890-4-11-23); C, D: *C. scoparia* (ホロタイプ, BM-90-4-11-24) (種の和名なし); E, F: *C. crassa* (ホロタイプ, BM-90-4-11-26) (種の和名なし). スケールバー = 1 mm (B, D, F), 5 cm (A, C, E).

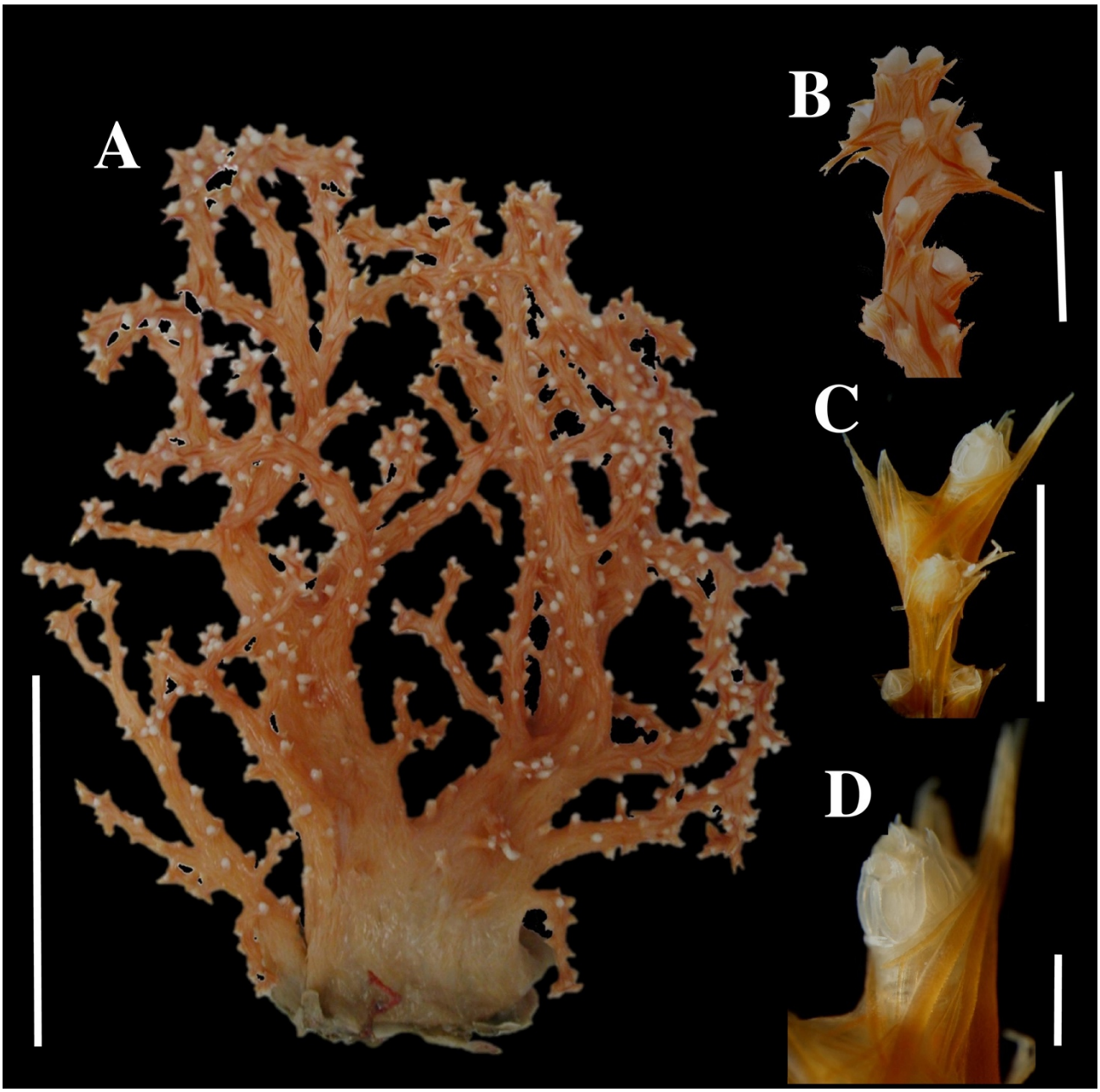

Fig. 15. *Chironephthya caribaea* (Deichmann, 1936) (USNM-1025683). Scale bars = 1 mm (D), 5 mm (B, C), 5 cm (A).
図 15. *Chironephthya caribaea* (Deichmann, 1936) (種の和名なし) (USNM-1025683). スケールバー = 1 mm (D), 5 mm (B, C), 5 cm (A).

paper, they also described the major taxonomic character to distinguish *Chironephthya* from *Siphonogorgia* as: "This genus comes nearest to *Siphonogorgia* Kölliker, but is essentially distinguished by the fact that the polyps occur along the entire course of the branches, and are less retractile. The habit of the colony is more suggestive of *Nephthya*" (Wright & Studer 1889: 231). However, since many known *Siphonogorgi*a species at the time contained the diagnostic characters of *Chironephthya*, various authors have discussed whether *Chironephthya* is a valid genus or not, e.g., Hickson (1903), Thomson (1905), Harrison (1909), Charmers (1929). During this process, Thomson & Mackinnon (1910) showed the possibility that *Chironephthya* is a subgenus of *Siphonogorgia*, while Kükenthal (1906) considered that *Chironephthy*a is a junior synonym of *Siphonogorgia*. After Kükenthal (1906), except for Harrison (1909) and Tixier-Durivault (1940), there were no additional species described for *Chironephthya* until Cairns & Bayer (2009). Utinomi (1958) did not recognize the validity of *Chironephthya* in the review of the family Nidaliidae, and Bayer (1981) and Tixier-Durivault (1987) accepted his opinion. However, Verseveldt & Bayer

(1988) resurrected genus *Chironephthya* in the key to the genera of the family Nidaliidae without any explanation. The distinctive traits of both genera that they indicated in their key were as follows. *Siphonogorgia*: Polyps clustered at the ends of terminal branchlets, absent from surface of trunk and main branches. *Chironephthya*: Polyps scattered on trunk and main branches as well as at ends of terminal branchlets. Later, Fabricius & Alderslade (2001) redefined the major distinctive traits of both genera as follows. *Siphonogorgia*: Polyps may occur on most of the branches, or they may be restricted to just the terminal branchlets, which can be lobe-like. Calyces low. *Chironephthya*: Polyps are generally found only on the terminal and near terminal branchlets, though in some species they can be found on the main branches, and occasionally on the upper stem. Calyces prominent, shelf-like.

Both genera had only been recorded from the Pacific until Bayer (1961: 56) transferred two species, *Neospongodes agassizii* Deichmann, 1936, and *N. caribaea* Deichmann, 1936 (Fig. 15) from the West Indies (off Cuba and off Martinique, respectively), to *Siphonogorgia*. He had made this change in the remarks of the genus *Neospongodes* without explanation. *Neospongodes* is a genus of the family Nephtheidae established by Kükenthal (1903) based on two species, *N. atlantica* (Fig. 16) and *N bahiensis* (this species was considered as a junior synonym of *N. atlantica* by Verseveldt 1983) from Bahia, Brazil. He gave a diagnosis on this genus as follows: Nephtheid of tree-like structure; zooids isolated or in bundles, with supporting bundles; canal walls forming an irregular axis in the center of the stem and larger branches (English translation by Deichmann 1936: 66). Because *Neospongodes* does not have calyces, *N. agassizii* and *N. caribaea*, both of which have obvious calyces, are not *Neospongodes*. However, it is uncertain why Bayer (1961) considered these two species as nidaliid *Siphonogorgia*. Subsequently Cairns & Bayer (2009) transferred these two species to genus *Chironephthya* in a checklist of the subclass Octocorallia from the Gulf of Mexico. This change is thought to be based on the identification traits of both genera by Verseveldt & Bayer (1988), but they also did not state specific reasons for this decision. Recently, Pérez et al. (2011) reviewed previous discussion on the taxonomic status of genera *Siphonogorgia* and *Chironephthya*, and identified Brazilian specimens as *Chironephthya*, *C.* sp. Moreover, López-González et al. (2014) described a new species of *C. mediterranea* from the Mediterranean Sea. In their paper, they re-described types of both *C. agassizii* and *C. caribaea* and compared the morphological characters of these two Atlantic species and their new Mediterranean species. In addition, they analyzed molecular data (mtMutS; mtMutS+COI; mtMutS+Igr1+COI) including these three species and several species of Indo-Pacific *Chironephthya* and *Siphonogorgia*. According to their results, the Mediterranean and Atlantic species have a close relationship and forming a sister group, and this Atlanto-Mediterrarean clade is a sister group of the Red Sea species Chironephthya sp. 2 with lower support. The remaining Red Sea and Indo-West Pacific sequences were placed in different clades. (López-González et al., 2014: 677). Regarding the relationship between *Siphonogorgia* and *Chironephthya*, they stated that "No shared sequence was found between these specimens assigned to these two genera"; in other words, they could not match obtained molecular information with morphological taxonomy.

The fundamental problem of the systematics of the genera *Siphonogorgia* and *Chironephthya* is that no type species has yet been fixed for *Chironephthya*, which makes it impossible to verify the validity of the genus and, if it is valid, to rearrange constituent species into the two genera. Other recent problem is whether the Atlantic and Mediterranean *Chironephthya* are the same as those in the Indo-Pacific. In Atlantic and Mediterranean *Chironephthya* spindles forming the calyces and covering the outer layer of the terminal branches are somewhat sparse, internal walls between longitudinal canals are thin, and the amount of contained sclerites is less than that of Indo-Pacific species. For these reasons, *Chironephthya* from the Atlantic and the Mediterranean seem to be unlikely to belong to the same genus as *Chironephthya* specimens from the Pacific. The necessity of a review of both genera has been pointed out by both Pérez et al. (2011) and López-González et al. (2014). Furthermore, the taxonomic status of both genera should be reviewed considering these historical problems.

Currently in WoRMS, *Siphonogorgia* and *Chironephthya* include 54 and 3 valid species, respectively (Ofwegen 2017a, b). The three C*hironephthya* species listed therein, however, are the above-mentioned three Atlantic and Mediterranean species only, and no possible type species (*C. dipsacea*, *C. crassa* and *C. scoparia*) are listed. Additionally, in the GBIF list (July 2017), the positioning of species names in both genera is confused as mentioned above (remarks of *Chironephthya hicksoni*). Careful revisions of these

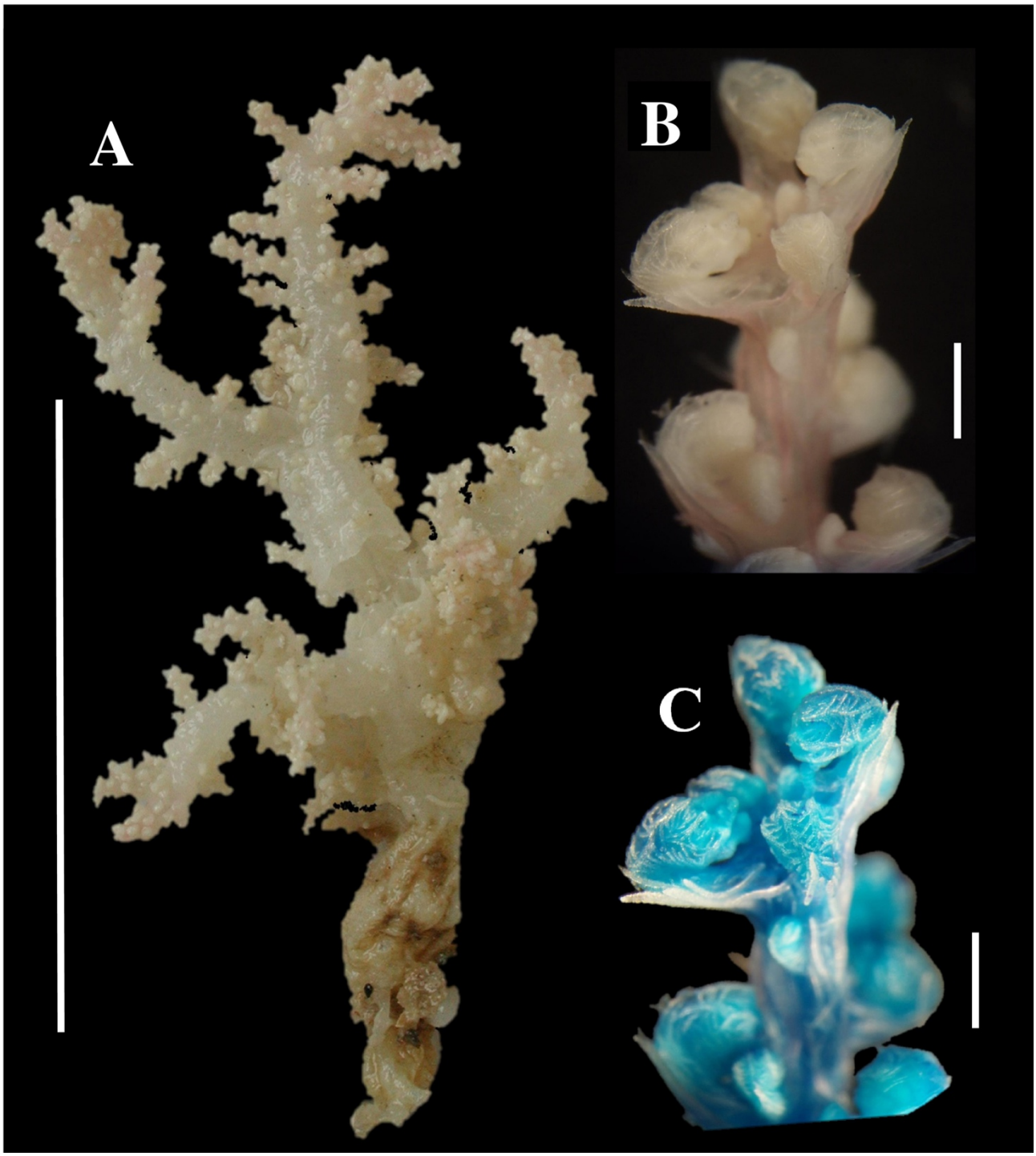

Fig. 16. *Neospongodes atlantica* Kükenthal, 1903, (Paratype, ZMH-C2350). A: colony; B: distal end of a terminal branch; C: same as B, stained with methylene blue. Scale bars = 1 mm (B, C), 5 cm (A).
図 16. *Neospongodes atlantica* Kükenthal, 1903, (和名なし) (Paratype, ZMH-C2350). A: 群体; B: 端末枝頂端; C: メチレンブルーで染色した B. スケールバー = 1 mm (B, C), 5 cm (A).

databases are required for systematic studies.

Acknowledgements

We thank H. Igei of Okinawa Churashima Foundation and C. Nishihara, former research assistant of Okinawa Churashima Foundation Research Center, for providing assistance. We also thank S.D. Cairns of National Museum of Natural History, Smithsonian Institution (USNM), H. Ruhberg of Zoologisches Institut & Zoologisches Museum Universität Hamburg (ZMH), S. Halsey of

the Natural History Museum, London (BM), and C. Kropf of the Naturhistorisches Museum der Burgergemeinde Bern (NMBE), for loaning important and valuable specimens from their museums, K. Miyazaki and the other staff members of the Seto Marine Biological Laboratory, Kyoto University, are thanked for providing SEM facilities. T. Naruse of the Tropical Biosphere Research Center of University of the Ryukyus, J.D. Reimer of the Biology Program, Faculty of Science, University of the Ryukyus, and anonymous reviewers are appreciated for their constructive comments and suggestions, which helped improve the manuscript. Finally, we thank the staff of the Okinawa Churashima Foundation and the Biological Institute on Kuroshio for research management. This study was partly supported by a Grant-in-Aid for International Scientific Research from the Japanese Ministry of Education, Science and Culture (No. 12575008, principal investigator S.F. Mawatari) to Y. I., and the Japan Science Society (JSS, No. 11-381M & 18-276G) to Y. I.

References

Alderslade, P., 2000. Four new genera of soft corals (Coelenterata: Octocorallia), with notes on the classification of some established taxa. Zoologische Mededelingen, Leiden, 74(16): 237–249.

Bayer, F.M., 1961. The shallow-water Octocorallia of the West Indian region. Studies on the fauna of Curaçao and other Caribbean Islands. 12: i–viii, 1–373.

Bayer, F.M., 1981. Key to the genera of Octocorallia exclusive of Pennatulacea (Coelenterata: Anthozoa), with diagnoses of new taxa. Proceedings of the Biological Society of Washington, 94(3): 902–947.

Bayer, F.M., M. Grasshoff, & J. Verseveldt, 1983. Illustrated trilingual glossary of morphological and anatomical terms applied to Octocorallia. E. J. Brill / Dr. W. Backhuys, Leiden.

Benayahu, Y., 1995. Species composition of soft corals (Octocorallia, Alcyonacea) on the coral reefs of Sesoko Island, Ryukyu Archipelago, Japan. Galaxea JCRS, 12: 103–124.

Benayahu, Y., 2002. Soft corals (Octocorallia: Alcyonacea) of the southern Ryukyu Archipelago: The families Tubiporidae, Alcyoniidae, and Briareidae. Galaxea JCRS, 4: 11–32.

Benayahu, Y., 2010. A new genus of a soft coral of the family Xeniidae (Cnidaria: Octocorallia) from Japan. Galaxea JCRS, 12: 53–64.

Benayahu, Y. & C.S. McFadden, 2011. A new genus of soft coral of the family Alcyoniidae (Cnidaria, Octocorallia) with re-description of a new combination and description of a new species. ZooKeys, 84: 1–11.

Benayahu, Y., D. Weil, & M. Kleinman, 1990. Radiation of broadcasting and brooding patterns in coral reef alcyonaceans. Advances in Invertebrate Reproduction, 5: 323–328.

Cairns, S.D. & F.M. Bayer, 2009. Chapter 13. Octocorallia (Cnidaria) of the Gulf of Mexico. In: D.L. Felder & D.K. Camp (eds.), Gulf of Mexico–Origins, Waters, and Biota. Volume 1. Biodiversity. Pp.321–331, Texas A&M University Press, Texas.

Charmers, D., 1929. The alcyonarian genus *Siphonogorgia*, with descriptions of new species. Proceedings of the Royal Physical Society of Edinburgh, 21(4): 159–169.

Deichmann, E., 1936. The Alcyonaria of the Western part of the Atlantic Ocean. Report on the scientific results of dredging operations from 1877 to 1880, in charge of Alexander Agassiz, made by the United States Coast survey steamer "Blake," lieut. Commander C. D. Sigsbee, U.S.N., and Commander J. R. Bartlett, U.S.N., Commanding, including also the results of the dredging operations from 1867 to 1879, in charge of L. F. de Pourtales and L. Agassiz, made by the United States Coast Survey Steamers "Corwin," "Bibb," and "Hassler," Actingmaster R. Platt, Llieut. Commander P. R. Johnson, U.S.N., Commanding, 49. Memoirs of the Museum of Comparative Zoology at Harvard College, 53: 1–317, pls. 1–37.

Ehrenberg, C.G., 1828. In: F. Hemprich & C. Ehrenberg (eds.), Symbolae physicae, seu icones et descriptiones corporum naturalium novorum aut minus cognitorum quae ex itineribus per Libyam, Aegyptium, Nubiam, Dongalam, Syriam, Arabiam et Habessiniam, pars zoologica II, animalia evertebrata exclusis insectis. Officina Academica Berolini.

Ehrenberg, C.G., 1834. Beiträge zur physiologischen Kenntniss der Corallenthiere im allgemeinen, und besonders des rothen Meeres, nebst einem Versuche zur physiologischen Systematik derselben. Abhandlungen der Koniglichen Akademie der Wissenschaften in Berlin, 1832(1), 225–380.

Fabricius, K. & P. Alderslade, 2001. Soft corals and sea fans: A comprehensive guide to the tropical shallow-water genera of the Central West Pacific,

the Indian Ocean and the Red Sea. Australian Institute of Marine Science. Townsville. Australia. 264 pp.

Gray, J. E., 1869. Notes on the fleshy alcyonoid corals (*Alcyonium*, Linn., or *Zoophytaria carnosa*). Annals and Magazine of Natural History, including Zoology, Botany and Geology, (4) 3: 117–131.

Haeckel, E., 1866. Generelle Morphologie der Organismen, Allgemeine Grundzüge der Organischen Formen-Wissenschaft, mechanisch begründet durch die von Charles Darwin reformirte Descendez-Theorie, 2. Allgemeine Entwicklungsgeschicte der Organismen. Kritische Grundzüge der mechanischen Wissenschaft von den entwickelten Formen der Organismen, begründet durch die Descendenz-Theorie: I–CLX + 1–462. Verlag von Georg Reimer, Berlin.

Harrison, R.M., 1908. Some new Alcyonaria from the Indian and Pacific Oceans – Preliminary notice. Journal of the Linnean Society of London, Zoology, 30: 185–190.

Harrison, R.M., 1909. On some new Alcyonaria from the Indian and Pacific Oceans, with a discussion of the genera *Spongodes, Siphonogorgia, Chironephthya*, and *Solenocaulon*. Transactions of the Linnean Society of London, 11: 17–44, pls. 3–7.

Hickson, S.J., 1903. The Alcyonaria of the Maldives. Part I. The genera *Xenia, Telesto, Spongodes, Nephthya, Paraspongodes, Chironephthya, Siphonogorgia, Solenocaulon,* and *Melitodes*. In: J.S. Gardiner(ed.). The fauna and geography of the Maldive and Laccadive Archipelagoes, 2(1): 473–502, pls. 26–27.

Iha, C. & T. Yoshino, 1997. Octocorals (Coelenterata: Octocorallia) in the collection of Department of Marine Sciences, the University of the Ryukyus (Part 1). Bulletin of the College of Science, University of the Ryukyus, 64: 87–112.

Imahara, Y., 1991. Report on the Octocorallia from the Ryukyu Islands of Japan. Bulletin of Institute of Oceanic Research and Development, Tokai University, 11/12: 59–94.

Imahara, Y., 1996. Previously recorded octocorals from Japan and adjacent seas. Precious Corals & Octocoral Research, (4/5): 17–44.

Imahara, Y., 2014. Methods and techniques of octocoral taxonomy. In: Y. Imahara, F. Iwase & H. Namikawa (eds.), The Octocorals of Sagami Bay. Pp. 28–55, Tokai University Press, Kanagawa.

Kölliker, R.A. von, 1874. Die Pennatulide *Umbellula* und zwei neue Typen der Alcyonarien. Festschrift zur Feier des fünfundzawinzigjährigen Bestehens der Physicalisch-medizinsichen Gesellschaft in Würzburg. 1–23.

Kolonko, K., 1926. Beiträge zu einer Revision der Alcyonarien. Die Gattung *Sinularia*. Mitteilungen aus dem Zoologischen Museum in Berlin, 12 (2): 291–334, pls. 1–4.

Kükenthal, W., 1903. Uber eine neue Nephthyidengattung aus dem südatlantischen Ocean. Zoologischer Anzeiger, 26, 272–275.

Kükenthal, W., 1906. Japanische Alcyonaceen. In: F. Doflein (ed.), Beiträge zur Naturgeschichte Ostasiens. Mathematisch-Physikalischen Klasse der Königlich Bayerischen Akademie der Wissenschaften, Supplement-Band, 1(1): 9–86, figs. 1–69, pls. 1–5.

Lamouroux, J.V.F., 1812. Extrait d'un mémoire sur la classification des Polypiers coralligènes non entièrement pierreux. Nouveaux Bulletin des Sciences, par la Société Philomathique de Paris 3: 181–188.

López-González, P. J., Grinyó, J. & Gili, J. M., 2014. *Chironephthya mediterranea* n. sp. (Octocorallia, Alcyonacea, Nidaliidae), the first species of the genus discovered in the Mediterranean Sea. Marine Biodiversity, 45: 667–688. Doi: 10.1007/s12526-014-0269-5. (Printed version: Marine Biodiversity, 2015, 45: 667–688).

Miyazaki, Y. & J.D. Reimer, 2014. Morphological and genetic diversity of *Briareum* (Anthozoa: Octocorallia) from the Ryukyu Archipelago, Japan. Zoological Science, 31: 692–702.

Ofwegen, L.P. van 2017a. *Siphonogorgia* Kölliker, 1874. Accessed through: World Register of Marine Species at http://www.marinespecies.org/aphia.php?p=taxdetails&id=206094 on 2017-07-15.

Ofwegen, L.P. van 2017b. *Chironephthya* Studer, 1887. Accessed through: World Register of Marine Species at http://www.marinespecies.org/aphia.php?p=taxdetails&id=415194 on 2017-07-15.

Ofwegen, L.P. van & Y. Benayahu, 2006. A new genus of paralcyoniid soft corals (Octocorallia, Alcyonacea, Paralcyoniidae) from the Indo-West Pacific. Journal of the Japanese Coral Reef Society, 8: 25–37.

Pérez, C.D., Neves, B.M. & Oliveira, D.H.R., 2011. New records of octocorals (Cnidaria: Anthozoa) from the Brazilian coast. Aquatic Biology, 13: 203–214.

Studer, T., 1887. Versuch eines Systemes der Alcyonaria. Archiv für Naturgeschichte, 53(1):

1–74, pl. 1.

Studer, T., 1889. Supplementary report on the Alcyonaria collected by H.M.S. Challenger during the Years 1873–76. Report on the Scientific Results of the Exploring Voyage of H.M.S. *Challenger* 1873–76, Zoology, 32 (part 81): 1–31, pls. 1–6.

Thomson, J.A., 1905. Appendix to the report on the Alcyonaria collected by Professor Herdman, at Ceylon, in 1902. In: Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Mannar. Part 4, supplementary report, 28: 167–186, 1 pl.

Thomson, J.A. & L.M.I. Dean, 1931. The Alcyonacea of the Siboga Expedition with an addendum to the Gorgonacea. *Siboga*-Expeditie Monogrphie, 13d. E. J. Bril, Leiden.

Thomson, J.A. & D.L. Mackinnon, 1910. Alcyonarians collected on the Percy Sladen Trust Expedition by Mr. J. Stanley Gardiner, Part 2, the Stolonifera, Alcyonacea, Pseudaxonia, and Stelechotokea. Transactions of the Linnean Society of London, 13: 165–211.

Tixier-Durivault, A., 1940. Note sur *Chironephthya retractilis* Harrison et l'axe des spicules des Alcyonaires. Bulletin du Muséum national d'Histoire naturelle Paris, (2)11(7): 442–448.

Tixier-Durivault, A., 1966. Octocoralliaires. Faune de Madagascar, Publiée sous les auspices du Gouvernement de la République Malgache. Du Centre National de la Recherche Scientifique et de l'Office de la Recherche Scientifique et Technique Outre-Mer, Paris, 21: 1–456, figs. 1–399.

Tiier-Durivault, A., 1968. Les Octocoralliaires du Sud-est Asiatique Octocorallia (Octocoralliaof South East Asia. Singapore National Academy of Science, Special publication no. 1, Prodromus for a check list of the non-planktonic marine fauna of south East Asia, Singapore.

Tixier-Durivault, A., 1970a. Les octocoralliaires de Nouvelle-Calédonie. L' Expéd. française récifs coralliens Nouvelle Calédonie. Expedition francaise sur les recifs coralliens de la Nouvelle-Calédonie organisee sound l'egide de la fondataion Singer-Polignac 1960–1963, 4: 171–350.

Tixier-Durivault, A., 1970b. Les octocoralliaires de Nha-Trang (Viet-Nam). Cahiers du Pacifique, 14: 115–236.

Tixier-Durivault, A., 1987. Sous-classe des Octocoralliaires. In: Grasse P. (ed.), Traité de Zoologie, Volume III, Fascicule 3. Cnidaires Anthozoaires, pp. 3–185. Masson, Paris.

Utinomi, H., 1958. A revision of the genera *Nidalia* and *Bellonella* with an emendation of nomenclature and taxonomic definitions for the family Nidaliidae (Octocorallia, Alcyonacea). Bulletin of the British Museum (Natural History), Zoology, 5(5): 101–121.

Utinomi, H., 1976a. A review of the Japanese species of *Alcyonium*, with descriptions of two new species and an almost forgotten rare species (Octocorallia, Alconacea). Publications of the Seto Marine Biological Laboratory, 23(3/5): 191–204, pls. 1, 2.

Utinomi, H., 1976b. Shallow-water octocorals of the Ryukyu Archipelago (part I). Sesoko Marine Science Laboratory, Technical Report, 4: 1–5.

Utinomi, H., 1977a. Shallow-water octocorals of the Ryukyu Archipelago (part II). Sesoko Marine Science Laboratory, Technical Report, 5: 1–11.

Utinomi, H., 1977b. Shallow-water octocorals of the Ryukyu Archipelago (Part III). Sesoko Marine Science Laboratory, Technical Report, 5: 13–34.

Verrill, A.E., 1865. Synopsis of the polyps and corals of the North Pacific Exploring Expedition, under Commondre Ringgold and Captain John Rodgers, U. S. N., from 1853 to 1856. Collected by Dr. Wm. Stimpson, naturalist to the Expedition, with descriptions of some additional species from the west coast of Northern America. Part II. Alcyonaria. Proceedings of the Essex Institute, 4: 181–196.

Verseveldt, J., 1970. A new species of *Sinularia* (Octocorallia: Alcyonacea) from Madagascar. Israel Journal of Zoology, 19 (3): 165–168, figs. 1–3.

Verseveldt, J., 1971. Octocorallia from North-western Madagascar (part 2). Zoologische Verhandelingen / uitgegeven door het Rijksmuseum van Natuurlijke Historie te Leiden, 117: 1–73.

Verseveldt, J., 1977. Octocorallia from various localities in the Pacific Ocean. Zoologische Verhandelingen / uitgegeven door het Rijksmuseum van Natuurlijke Historie te Leiden, 150: 3–42.

Verseveldt, J., 1983. A revision of the genus *Lobophytum* von Marenzeller (Octocorallia, Alcyonacea). Zoologische Verhandelingen / uitgegeven door het Rijksmuseum van Natuurlijke Historie te Leiden, 200: 1–103.

Verseveldt, J. & F.M. Bayer, 1988. Revision of the genera *Bellonella*, *Eleutherobia*, *Nidalia* and *Nidaliopsis* (Octocorallia: Alcyoniidae and Nidaliidae), with descriptions of two new genera.

Zoologische Verhandelingen / uitgegeven door het Rijksmuseum van Natuurlijke Historie te Leiden, 245: 3–131.
Williams, G.C., 1997. A new genus and species of nephtheid soft coral (Octocorallia: Alcyonacea) from the western Pacific Ocean, and a discussion of convergence with several deep-sea benthic organisms. Proceedings of the California Academy of Sciences, 49: 423–437.
Whitelegge, T., 1897. The Alcyonaria of Funafuti. Part I. Memoirs of the Australian Museum, 3: 211–225.
Wright, E.P. & T. Studer, 1889. Report on the Alcyonaria collected by H.M.S. "*Challenger*" during the years 1873–1876. Report on the Scientific Results of the Exploring Voyage of H.M.S. *Challenger* 1873–76, Zoology, 31: i–lxxvii + 1–134.

日本初記録の４種のソフトコーラルの記載，及び琉球列島産浅海性ソフトコーラル類の一覧，およびホンクダヤギ属とクダヤギ属の分類について

今原幸光[1]・山本広美[2]・高岡博子[3]・野中正法[2]
[1](公財) 黒潮生物研究所和歌山研究室 (e-mail: imaharay@k.email.ne.jp)
[2](一財) 沖縄美ら島財団総合研究センター
[3]沖縄美ら海水族館

要旨. 琉球列島からはこれまでに 121 種のソフトコーラル（未公表の 4 種と石軸亜目のウスカワヤギ属 2 種を含む）が発見されていた. 2011–2012 年に（一財）沖縄美ら島財団と（公財）黒潮生物研究所が，本部半島北部沿岸のソフトコーラル相の調査を行った結果，ウミヅタ科 3 属，ウミトサカ科 6 属，チヂミトサカ科 3 属，タイマツトサカ科 2 属，ウミアザミ科 2 属及び石軸亜目のウスカワヤギ科 1 属の合計 6 科 17 属の標本を得ることができた. それらの中には，日本からの初記録の 4 種の含まれていることが明らかになった. 本報告では，日本初記録の 4 種 (フトエダヤワトサカ，フトユビウネタケ，チビエダクダヤギ，エンジホンクダヤギ）を記載すると共に，今回の調査で再確認された 12 種，及びこれまでに発見されていながら未公表であった 4 種（ヤブコエダ，フトジクコエダ，フトクダヤギ，チガイウミアザミ）を含む琉球列島産ソフトコーラル 133 種のリストを掲載した. さらに，本報告に含まれていたホンクダヤギ属とクダヤギ属の分類学的地位についての問題点を指摘した.

投稿日: 2016 年 12 月 22 日
受理日: 2017 年 9 月 3 日
発行日: 2017 年 11 月 27 日

Appendix 1. List of shallow water soft coral species found from the Ryukyu Archipelago.
Notation of the listed species information: Species name, author(s) and published year, recorder from the Ryukyu Archipelago (Omitted if the authorship and the recorder(s) same. If the species was published under a different scientific name, the different name is indicated in parentheses), Japanese name. Following symbols are used: *: species that was newly found from Japan in this survey; **: species that was collected in this survey and is already known from Japan; ?: species that was found by this survey and is probably undescribed.
附録 1. 琉球列島から発見された浅海性ソフトコーラル一覧表.
種情報の表記法: 種の学名, 著者名と発表年, 琉球列島からの記録者 (種の学名の発表と同一者の場合は省略し, 異なる学名で発表された場合はその学名を () で示した), 和名. 次の記号の意味: *: 今回の調査で発見された日本初記録種; **: 日本からすでに発見されており, 今回の調査でも確認された種; ?: 今回の調査で発見された未記載の可能性のある種.

Phylum Cnidaria Verrill, 1865 [刺胞動物門]
Class Anthozoa Ehrenberg, 1834 [花虫綱]
Subclass Octocorallia Haeckel, 1866 [八放サンゴ亜綱]
Order Alcyonacea Lamouroux, 1812 [ウミトサカ目]

Suborder Stolonifera Thomson & Simpson, 1909 [ウミヅタ亜目]
Family Clavulariidae Hickson, 1894 [ウミヅタ科]
Subfamily Clavulariinae Hickson, 1894 [ウミヅタ亜科]
** 1 *Clavularia inflata* Schenk, 1896, Utinomi 1953, 1976b, Imahara 1991, present survey [ツツウミヅタ]
2 *C. racemosa* Utinomi, 1950, Marine Park Center 1990 [ハナヅタ]
3 *C. viridis* (Quoy & Gaimard, 1833), Imahara 1991 [ナガウミヅタ]
? 4 Clavulariidae gen. sp., present survey [ウミヅタ科の未記載属·種]
Subfamily Sarcodictyiinae Bayer, 1981 [アミゴケ亜科]
5 *Sarcodictyon gotoi* (Okubo, 1929), Utinomi 1976b [アミゴケ]
Subfamily Telestinae Milne-Edwards & Haime, 1857 [コエダ亜科]
6 *Carijoa* sp., Imahara unpublished [ヤブコエダ: 新称]
Family Coelogorgiidae Bourne, 1900 [フトジクコエダ科: 新称]
7 *Coelogorgia* sp., Imahara unpublished [フトジクコエダ: 新称]
Family Tubiporidae Ehrenberg, 1828 [クダサンゴ科]
8 *Tubipora* musica Linnaeus, 1758, Utinomi 1976b [クダサンゴ]

Suborder Alcyoniina Lamouroux, 1812 [ウミトサカ亜目]
Family Alcyoniidae Lamouroux, 1812 [ウミトサカ科]
** 9 *Aldersladum jengi* Benayahu & McFadden, 2011, present survey [ナガエダオバナトサカ: 新称]
** 10 *Cladiella australis* (Macfadyen, 1936), Benayahu 1995, present survey [センジュノウトサカ: 新称]
11 *C. brachyclados* Ehrenberg, 1834, Benayahu 1995 [マルエダノウトサカ: 新称]
12 *C. digitulata* (Klunzinger, 1877), Utinomi 1977b, Benayahu 1995 [ユビノウトサカ]
13 *C. krempfi* (Hickson, 1919), Utinomi 1977b [クレンフノウトサカ]
14 *C. pachyclados* (Klunzinger, 1877), Utinomi 1977b, Imahara 1991, Benayahu 1995 [フトエダノウトサカ]
15 *C. sphaerophora* (Ehrenberg, 1834), Utinomi 1977b [タマノウトサカ]
* 16 *Klyxum molle* (Thomson & Dean, 1931), present survey [フトエダヤワトサカ: 新称]
17 *K. okinawanum* (Utinomi, 1976), Utinomi 1976a, 1977b [オキナワヤワトサカ: 改称]
18 *K. simplex* (Thomson & Dean, 1931), Benayahu 2002 [ヌルヤワトサカ: 新称]
19 *K. utinomii* (Verseveldt, 1971), Benayahu 2002 [ウチノミヤワトサカ: 新称]
20 *Lobophytum batarum* Moser, 1919, Utinomii 1977b [タカウネタケ]
21 *L. catalai* Tixier-Durivault, 1957, Marine Park Center 1990 [オヤユビウネタケ]
22 *L. compactum* Tixier-Durivault, 1956, Benayahu 1995 [種の和名なし]
23 *L. crassospiculatum* (Moser, 1919), Utinomi 1977b [ナガウネタケ]
** 24 *L. crassum* von Marenzeller, 1886, Utinomi 1977b, Imahara 1991, present survey [フトウネタケ]
25 *L.* cf. *crassum* von Marenzeller, 1886, Utinomi 1977b (*L. hedleyi*) [ヘドレーウネタケ]
26 *L. crebriplicatum* von Marenzeller, 1886, Utinomi 1953 [種の和名なし]
27 *L. cristagalli* von Marenzeller, 1886, Utinomi 1977b, Imahara 1991 [トサカウネタケ]

Appendix 1 (continued). 附録 1 (続き).

28 *L. durum* Tixier-Durivault, 1956, Benayahu 2002 [種の和名なし]
29 *L. pauciflorum* (Ehrenberg, 1834), Utinomi 1977b [イボウネタケ]
30 *L. rigidum* Benayahu, 1995 [種の和名なし]
* 31 *L. salvati* Tixier-Durivault, 1970, present survey [ウトユビウネタケ: 新称]
32 *L. sarcophytoides* Moser, 1919, Utinomi 1977b [オオシャコウネタケ]
** 33 *L. schoedei* Moser, 1919, present survey [バラウネタケ]
34 *L. venustum* Tixier-Durivault, 1957, Benayahu 1995 [種の和名なし]
35 *Parsphaerasclera grayi* (Thomson & Dean, 1931), Verseveldt & Bayer 1988 (*Eleutherobia grayi*) [種の和名なし]
36 *Protodendron repens* (Thomson & Henderson, 1906), Benayahu 2002 [タバネトサカ: 新称]
37 *Rhytisma fulvum* (Forskål, 1775), Benayahu 2002 [ウスカワトサカ: 新称]
38 *Sarcophyton acutangulum* (von Marenzeller, 1886), Utinomi 1977b [ウミキノコ]
39 *S. cinereum* Tixier-Durivault, 1946, Imahara 1991, Benayahu 1995 [サカズキウミキノコ]
40 *S. crassocaule* Moser, 1919, Benayahu 2002 [種の和名なし]
41 *S.* cf. *crassocaule* Moser, 1919, Utinomi 1977b (*Lobophytum carnatum*) [コブシウミキノコ: 新称]
42 *S. ehrenbergi* von Morenzeller, 1886, Utinomi 1977b, Benayahu 1995, 2002 [コブウミキノコ]
43 *S. elegans* Moser, 1919, Imahara 1991 [ヒラウミキノコ]
** 44 *S. glaucum* (Quoy & Gaimard, 1833), Utinomi 1977b, Imahara 1991, Benayahu 1995, 2002, present survey [オオウミキノコ]
45 *S. infundibuliforme* Tixier-Durivault, 1958, Benayahu 2002 [種の和名なし]
46 *S. roseum* Pratt, 1903, Benayahu 2002 [種の和名なし]
47 *S. tenuispiculatum* Thomson & Dean, 1931, Benayahu 2002 [種の和名なし]
48 *S. tortuosum* Tixier-Durivault, 1946, Benayahu 1995 [種の和名なし]
** 49 *S. trocheliophorum* von Marenzeller, 1886, Utinomi 1977b, Imahara 1991, Benayahu 1995, 2002, present survey [ヒダベリウミキノコ]
50 *Sinularia abrupta* Tixier-Durivault, 1970, Benayahu 1995 [種の和名なし]
51 *S. brassica* May, 1898, Benayahu 2002 [種の和名なし]
52 *S.* cf. *brassica* May, 1898, Utinomi 1977b (*S. triaena*) [ミツバカタトサカ]
53 *S. capillosa* Tixier-Durivault, 1970, Imahara 1991 [ナガレカタトサカ]
54 *S. ceramensis* Verseveldt, 1977, Benayahu 2002 [種の和名なし]
55 *S. erecta* Tixier-Durivault, 1945, Benayahu 2002 [種の和名なし]
** 56 *S. flexibilis* (Quoy & Gaimard, 1833), Utinomi 1977b, Imahara 1991, Benayahu 1995, 2002, present survey [ヤナギカタトサカ]
57 *S. gardineri* (Pratt, 1903), Utinomi 1977b [シバカタトサカ]
58 *S. gibberosa* Tixier-Durivault, 1970, Benayahu 1995, 2002 [種の和名なし]
59 *S. gravis* Ticier-Durivault, 1970, Benayahu 1995, 2002 [種の和名なし]
60 *S. gyrosa* (Klunzinger, 1877), Benayahu 1995 [種の和名なし]
61 *S. heterospiculata* Verseveldt, 1970, Benayahu 2002 [種の和名なし]
62 *S. higai* Benayahu, 2002 [種の和名なし]
63 *S. hirta* (Pratt, 1903), Utinomi 1977b [イガカタトサカ]
64 *S. humesi* Verseveldt, 1968, Benayahu 2002 [種の和名なし]
65 *S. leptoclados* (Ehrenberg, 1834), Utinomi 1977b, Imahara 1991, Benayahu 1995, 2002 [コエダカタトサカ]
66 *S. lochmodes* Kolonko, 1926, Utinomi 1977b, Imahara 1991, Benayahu 2002 [シゲミカタトサカ]
67 *S. macropodia* (Hickson & Hiles, 1900), Utinomi 1977b [フトカブカタトサカ]
68 *S. mayi* Lüttschwager, 1915, Utinomi 1977b, Imahara 1991 [ハケカタトサカ]
69 *S. maxima* Verseveldt, 1971, Imahara 1991 [ツノカタトサカ]
70 *S. mollis* Kolonko, 1926, Imahara 1991, Benayahu 2002 [ヤワタコアシカタトサカ]
71 *S. nanolobata* Verseveldt, 1977, Benayahu 1995 [種の和名なし]
72 *S. notanda* Tixier-Durivault, 1966, Benayahu 1995 [種の和名なし]
73 *S. numerosa* Tixier-Durivault, 1970, Imahara 1991, Benayahu 2002 [コブカタトサカ]
74 *S. ornata* Tixier-Durivault, 1970, Imahara 1991 [トガリカタトサカ]
75 *S. ovispiculata* Tixier-Durivault, 1970, Benayahu 1995, 2002 [種の和名なし]

Appendix 1 (continued). 附録 1 (続き).

76 *S. parva* Tixier-Durivault, 1970, Benayahu 2002 [種の和名なし]
77 *S. pavida* Tixier-Durivault, 1970, Imahara 1991 [ワタゲカタトサカ]
** 78 *S. polydactyla* (Ehrenberg, 1834), Utinomi 1977b, Benayahu 1995, 2002, present survey [タコアシカタトサカ]
79 *S. querciformis* (Pratt, 1903), Utinomi 1977b, Benayahu 1995, 2002 [ヒメカタトサカ]
80 *S. robusta* Macfadyen, 1936, Utinomi 1977b [ドルイカタトサカ]
81 *S. tanakai* Benayahu, 2002 [種の和名なし]
82 *S. variabilis* Tixier-Durivault, 1945, Benayahu 1995, 2002 [種の和名なし]
83 *S. vrijmoethi* Verseveldt, 1971, Imahara 1991, Benayahu 1995, 2002 [フトエダカタトサカ]
84 *S. yamazatoi* Benayahu, 1995 [種の和名なし]

Family Nephtheidae Gray, 1862 [チヂミトサカ科]
85 *Capnella imbricata* (Quoy & Gaimard, 1833), Imahara 1991 [カワラフサトカサ]
86 *Dendronephthya castanea* Utinomi 1952, Imahara 1991 [クリトゲトサカ]
87 *D. gigantea* (Verrill, 1864), Imahara 1991 [オオトゲトサカ]
** 88 *D. habereri* Kükenthal, 1905, Imahara 1991, present survey [ビロードトゲトサカ]
89 *D. koellikeri* Kükenthal 1905, Imahara 1991, present survey [ケリカートゲトサカ]
** 90 *D. mollis* (Holm, 1894), the present survey [ヤワトゲトサカ: 新称]
91 *D. mucronata* (Pütter, 1900), Imahara 1991 [トゲトゲトサカ]
92 *D. suensoni* (Holm, 1894), Imahara 1991 [スエンソントゲトサカ]
93 *D. thomsoni* Harrison, 1908, Imahara 1991 [アカネトゲトサカ]
? 94 *D.* sp. aff. *habereri* Kükenthal, 1905, present survey [ヒメビロードトゲトサカ: 新称]
95 *Lemnalia cervicornis* (May, 1898), Imahara 1991 [ロッカクウミゼリ]
96 *Litophyton albida* (Holm, 1894), Imahara 1991 (*Nephthe albida*) [サクラチヂミトサカ]
97 *L. erecta* Kükenthal, 1903, Imahara 1991 (*Nephthea erecta*) [タチチヂミトサカ]
98 *L. striata* Kükenthal, 1903, Imahara 1991 (*Nephthea striata*) [スジチヂミトサカ]
99 *Pacifiphyton bollandi* Williams, 1997 [エナガトサカ: 新称]
100 *Paralemnalia thyrsoides* (Ehrengerg, 1834), Imahara 1991 [ボウウミワラビ]
101 *Scleronephthya gracillima* (Kükenthal, 1906), Imahara 1991 (*Alcyonium gracillimum*) [ベニウミトサカ]
?102 *Scleronephthya* sp. 1 aff. *gracillima* (Kükenthal, 1906), present survey [コンボウベニトサカ: 新称]
?103 *Scleronephthya* sp. 2 aff. *gracillima* (Kükenthal, 1906), present survey [コギクベニトサカ: 新称]
?104 Nephtheidae gen. sp., present survey [ヒメベニトサカ: 新称]

Family Nidaliidae Gray, 1869 [タイマツトサカ科]
Subfamily Nidaliinae Gray, 1869 [タイマツトサカ亜科]
105 *Nephthyigorgia* sp., Imahara unpublished [フトクダヤギ: 新称]
106 *Nidalia borongaensis* Verseveldt & Bayer, 1988, Imahara 1991 [タイマツトサカ]

Subfamily Siphonogorgiidae Kölliker, 1875 [クダヤギ亜科]
107 *Cironephthya dipsacea* Wright & Studer, 1889, Imahara 1991 (*Siphonogorgia dipsacea*) [アカバナクダヤギ]
108 *C. dofleini* (Kükenthal, 1906), Imahara 1991 (*Siphonogorgia dofleini*) [ニクイロクダヤギ]
109 *C. variabilis* Hickson, 1903, Imahara 1991 (*Siphonogorgia variabilis*) [ホソエダクダヤギ]
*110 *C. hicksoni* Harrison, 1908, present survey [チビエダクダヤギ: 新称]
?111 *C.* sp. aff. *lobata* (Verseveldt, 1982), present survey [ナガエダクダヤギ: 新称]
?112 *Siphonogorgia* sp. aff. *pustulosa* Studer, 1889, present survey [モツレホンクダヤギ: 新称]
*113 *S.* cf. *godeffroyi* Kölliker, 1974, present survey [エンジホンクダヤギ: 新称]

Family Paralcyoniidae Gray, 1869 [カクレトサカ科]
114 *Ceeceenus quadrus* Ofwegen & Benayahu, 2006 [シロカワリトサカ: 新称]

Family Xeniidae Ehrenberg, 1828 [ウミアザミ科]
115 *Anthelia* cf. *ternatana* (Schenk, 1896), Utinomi 1977a [テルナタイタアザミ]
?116 *Asterospicularia* sp., present survey [コンペイトウアザミ: 新称]
117 *Cespitularia erecta* Macfadyen, 1936, Imahara 1991 [タチエダアザミ]
118 *Efflatounaria tottoni* Gohar, 1939, Benayahu 1995 [コヅレウミアザミ: 新称]
119 *Funginus heimi* Tixier-Durvault, 1970, Imahara 1991 [カンムリウミアザミ]
120 *Heteroxenia elisabethae* Kölliker, 1874, Imahara unpublished [チガイウミアザミ]

Appendix 1 (continued). 附録 1 (続き).

121 *Sympodium caeruleum* Ehrenberg, 1834, Utinomi 1977a [チヂミウミアザミ]
122 *Xenia crassa* Schenk, 1896, Utinomi 1977a [オオウミアザミ]
123 *X. elongata* Dana, 1846, Imahara 1991 [ミナミウミアザミ]
124 *X. mayi* Roxas, 1933, Imahara 1991 [コフキウミアザミ]
125 *X. membranacea* Schenk, 1896, Utinomi 1977a [キイロウミアザミ]
126 *X. plicata* Schenk, 1896, Utinomi 1977a [ヒダウミアザミ]
127 *X.* sp. aff. *plicata* Schenk, 1896, Utinomi 1977a (*X. blumi*), Imahara 1991 (*X. blumi*) [種の和名なし]
128 *X. stillifera* Verseveldt, 1977, Benayahu 1995 [種の和名なし]
129 *X. umbellata* Lamarck, 1816, Utinomim 1977a [コダチウミアザミ]
130 *Yamazatum iubatum* Benayahu, 2010 [ヤマザトウミアザミ: 新称]
? 131 Xeniidae gen. sp., present survey [ウミアザミ科の未記載属·種]

Suborder Scleraxonia Studer, 1887 [石軸亜目]
Family Briareidae Gray, 1859 [ウスカワヤギ科]
132 *Briareum stechei* (Kükenthal, 1908), Benayahu 2002 (*B. excavatum*) [種の和名なし]
**133 *B. violaceum* (Quoy & Gaimard, 1833), Utinomi 1976b (*Pachyclavularia violacea*), Imahara 1991 (*P. violacea*), present survey [ムラサキハナヅタ]