

Four New Records of *Dendronephthya* Species (Octocorallia: Alcyonacea: Nephtheidae) from Korea

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ABSTRACT

Soft corals were collected from the subtidal zone in the coastal regions of Jeju Island between 1975 and 2010. By the taxonomic work on them, three species in the subgenus *Dendronephthya* (*Dendronephthya*) and one species in the subgenus *Dendronephthya* (*Roxasia*) of family Nephtheidae were newly added to Korean fauna: *Dendronephthya* (*Dendronephthya*) *aurea* Utinomi, 1952, *Dendronephthya* (*D.*) *koellikeri* Kükenthal, 1905, *Dendronephthya* (*D.*) *mucronata* (Pütter, 1900), and *Dendronephthya* (*Roxasia*) *decussatospinosa* Utinomi, 1952. These species are mainly distributed on the rocky substratum at the southern coast from 10 and 32 m. As a result of this study thirteen species in the genus *Dendronephthya* have been reported from Korean waters until now.

Keywords: Octocorallia, Alcyonacea, Nephtheidae, *Dendronephthya* (*Dendronephthya*), *Dendronephthya* (*Roxasia*)

INTRODUCTION

The genus *Dendronephthya*, including half of the Nephtheidae (approximately 250 species) (Daly et al., 2007), was separated from the genus *Spongodes* by Lesson (1831). However, in 1846, Dana renamed the *Spongodes* as *Spoggodia*, for no discernible reason, and Gray next divided the *Spoggodia* into the two subgenera, *Spoggodes* and *Spoggodia* in 1862. Holm (1895) and Wright and Studer (1889) used the generic name *Spongodes*, and divided that genus into four subgenera (*Nephthea*, *Panope*, *Spoggodia*, and *Spongodes*) and three groups (Spicate, Glomerate, and Divaricate), respectively. In 1896, Kükenthal distinguished *Spongodes* from *Nephthea*, and divided the former group into two subgenera *Spongodes* and *Spoggodia*; May (1899) and Pütter (1900) followed this classification. Finally, in 1905, Kükenthal replaced the subgenera *Spongodes* and *Spoggodia* with the genera *Dendronephthya* and *Stereonephthya* respectively. Also, Kükenthal divided the genus *Dendronephthya* into three main divisions, Glomerate, Divaricate, and Umbellate, based on the colonial growth form. Later, Henderson (1909), Nutting (1912), Sheriffs (1922), Thomson and Dean (1931), Roxas (1933), and Utinomi (1952, 1954) followed the classification of Kükenthal.

However, Harrison (1909) did not agree with the change of the original term (*Spongodes*) to the new *Dendronephthya*, and so employed *Spongodes*. In 1959, Tixier-Durivault and Prevorsek split the genus *Dendronephthya* into three new genera, *Spongodes*, *Roxasia*, and *Morchellana*, thus replacing the Glomerate, Divaricate, and Umbellate descriptors, respectively, of Kükenthal. However, Utinomi (1962) created the three subgenera *Dendronephthya*, *Roxasia*, and *Morchellana*, corresponding to species in the Glomerate, Divaricate, and Umbellate divisions. Verseveldt (1966, 1968, 1970, 1973, 1974a, 1974b, 1977) and Imahara (1977, 1991, 1996a, 1996b, 2003a, 2003b) used the subgenera of Utinomi in some reports, in preference to the classification of Tixier-Durivault and Prevorsek. Song (1976) followed the taxonomy of Kükenthal but did not divide the genus *Dendronephthya* into subgenera or genera.

Among the 250 recorded species of *Dendronephthya*, nine have been reported to date in Korean waters (Song 1976, Rho and Song 1977). These species were especially abundant at depths of 5–40 m off the southern coast of Jeju-do. In a series of taxonomic studies of *Dendronephthya* off the coast of Jeju-do, four species have newly been added to the octocorallian fauna.

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MATERIALS AND METHODS

All specimens examined in this study were collected from subtidal zones of Jeju-do between depth of 10 and 32 m by SCUBA or fishing nets between 1975 and 2010 (Fig. 1). Collected specimens were anesthetized with menthol for 6–8 h, and were then fixed in 4–5% (v/v) formalin with seawater. After that, fixed specimens were washed with tap water, and preserved in 70% alcohol (v/v).

For identification, each specimen was examined for morphological characteristics such as growth form, size of each part of colony, polyp, and sclerite, anthocodial armature and grade, and coloration under stereomicroscopes (Semi SV-6 and SV-11; Carl Zeiss, Jena, Germany and S8APO; Leica, Wetzlar, Germany) and a light microscope (Eclipse 80i; Nikon Co., Tokyo, Japan). The color of each part was recorded with a color code based on the color chart (新配色カード 199b, Japan Color Research Services Company, Japan). To examine the sclerites, a bit of tissue from the each part was dissolved in a diluted solution of the clorox for five minutes. In addition, the white sclerites of the polyp head were stained with a mixture of methylene blue and ethanol for the visualization of anthocodial arrangement.

Images of the living dendronephthya colonies under water were taken by a digital camera (5060-WZ; Olympus, Tokyo, Japan) with an underwater housing (Patima-7070; Patima Uw_Eng Co. Ltd., Seoul, Korea). Further images of the collected specimens were taken by a digital camera (G7; Canon Inc., Tokyo, Japan) prior to fixation. Images of polyps and

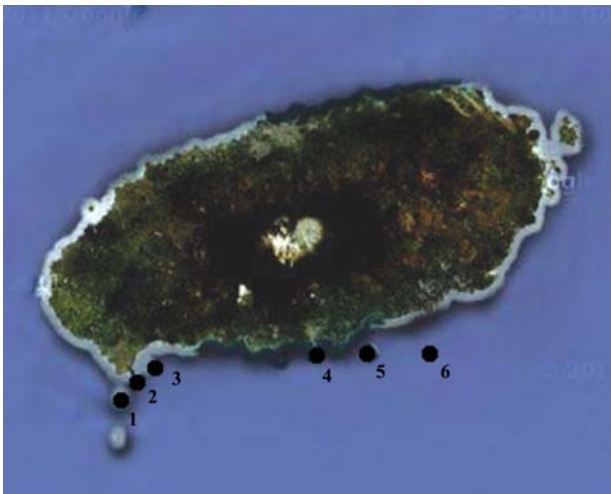


Fig. 1. Sampling sites in Jeju Island. 1, Gapado; 2, Songaksan; 3, Hyungjaeseom Island; 4, Munseom Island and Seogwipo Port; 5, Seopseom Island; 6, Seopseom Island-Jigwido.

supporting bundles (SBs) were taken by a stereomicroscope (S8APO; Leica) with camera (DFC 290; Leica). The size of the polyps and SBs, and angle of SB to polyp head were then measured using an image analyzer (LAS version 3.6; Leica). Images of sclerites were taken by a light microscope (Eclipse 80i; Nikon Co.) mounted with a camera (DS-5Mc; Nikon Co.), and the size of sclerites were then calculated with an image analyzer (NIS-Elements BR 3.0; Nikon Co.). In addition, the image editing program (HeliconFocus 5.1 Pro; Helicon Soft Ltd., Kharkov, Ukraine) were used to create one completely focused image of the sclerite from several partially focused images by combining the focused areas.

For the identification and classification, Utinomi's subgenera classification based on the division of colonial growth form by Kükenthal (1905), and the anthocodial grade and formula by Sheriffs (1922), were followed. Terminology is based on the literature, illustrated trilingual glossary of morphological and anatomical terms applied to Octocorallia (Bayer et al., 1983).

SYSTEMATIC ACCOUNTS

Phylum Cnidaria Hatschek, 1888
Class Anthozoa Ehrenberg, 1834
Subclass Octocorallia Haeckel, 1866
Order Alcyonacea Lamouroux, 1816
Family Nephtheidae Gray, 1862

Diagnosis. Upright and branched colonies with a usually distinct sterile stalk which bears a dendritic branching mass of polypiferous ramifications. Polyps not retractile.

Genus *Dendronephthya* Kükenthal, 1905

Diagnosis. Polyps always form a small bundle or occasionally large bundle. Polyp with SB.

¹*Subgenus *Dendronephthya* Utinomi, 1962

Diagnosis. Colonial growth form glomerate by branching slightly, grouping the bundles of polyp in smaller or larger rounded bunches, and so making the irregular surface of polyparium.

²**Dendronephthya* (*Dendronephthya*) *aurea* Utinomi, 1952 (Table 1, Figs. 2, 6A, B)

Dendronephthya aurea Utinomi, 1952: 170, text-fig. 4, Pl. 9, fig. 7.

Korean name: ¹*수지맨드라미아속 (신칭), ²*황금수지맨드라미 (신칭)

Table 1. Diagnostic characters on sclerites of *Dendronephthya (Dendronephthya) aurea*

Part	Color	Type	Size (length × width, mm)
Polyp			
Tentacle	off N-1, off N-2	Rod	0.05 × 0.01–0.11 × 0.03
Point	b6, It8 ⁺ , v4	Hockeystick spindle	0.52 × 0.05–0.96 × 0.12
	b6, It8 ⁺ , v4	Spindle	0.22 × 0.03–0.59 × 0.06
Intermediate	It8 ⁺	Spindle	0.17 × 0.03–0.20 × 0.04
Supporting bundle	b6	Spindle	1.63 × 0.17–3.41 × 0.26
Stalk	v4, v7	Spindle	0.22 × 0.02–1.38 × 0.11
Branch			
Cortex	W	Spindle	0.33 × 0.04–2.90 × 0.24
		Spindle	0.15 × 0.05–1.06 × 0.81
Canal wall	W	Spindle: flat	0.16 × 0.03–0.28 × 0.04
		Antler	0.09 × 0.03–0.15 × 0.05
Stalk			
Cortex	W	Spindle	0.10 × 0.03–1.16 × 0.27
		Spindle: bifurcated, branched	0.17 × 0.09–0.77 × 0.40
		Spindle: unilaterally spinose	0.26 × 0.11–0.62 × 0.18
		Butterfly	0.24 × 0.09–0.77 × 0.34
		Club	0.24 × 0.12–0.47 × 0.26
		Radiate	0.05 × 0.04–0.16 × 0.18
Canal wall	W	Spindle	0.18 × 0.06–1.55 × 0.26
		Spindle: flat	0.19 × 0.04–0.28 × 0.05
		Antler	0.11 × 0.03–0.19 × 0.08

off N-1, beige white; off N-2, yellowish white; b6, bright yellowish orange; It8⁺, light yellow; v4, vivid reddish orange; v7, vivid reddish yellow; W, white.

Spongodes aurea: Tixier-Durivault and Prevorsek, 1959: 68, text-figs. 33–35.

Dendronephthya (Dendronephthya) aurea: Utinomi, 1962: 106; Imahara, 2006: 97.

Material examined. Korea: 1 colony, Jeju-do: Seogwipo-si, Munseom, 22 Jan 1998, Song JI, Lee YJ (EWZS3955); 1 colony, Seogwipo-si, Seopseom, 33° 13'45.85''N, 126° 35' 46.47''E, 13 Jan 2009, Hwang SJ (EWZS3801), 18–26 m deep by SCUBA diving and underwater camera.

Description. Glomerate. Compact, rigid colony with short and wide stalk. Height of colony over 30 cm in alive. But, contracted specimens of colony 72 and 95 mm high, 54 and 74 mm wide, of which sterile stalk 33 and 20 mm long, 19 and 40 mm in wide, respectively. Main branches up to four, compactly grouped with rounded terminal branches. Foliaceous lower branches short or widen, and covered upper part of stalk or not. Rounded of polyp bundles closely covered main stem and branches. Each bundle composed of 16–24 polyps. Polyps compactly arranged in almost parallel.

Polyps about 2.8–3.9 mm long with 1.1–1.5 mm of stalk. Flat polyp head stands at obtuse angle with stalk, 0.49–0.67 mm high and 0.73–0.97 mm wide. Anthocodial armature composed eight pairs of points. Usually one of uppermost pair like hockeystick, larger and broad toward tip, not projected or sometimes far from polyp head about average of 0.19

mm, sometimes up to 0.40 mm with obliquely upwards thorns on free end. Intermediate sclerites between each pair of points absent or up to one pair. Crowns and supplementary sclerites absent. Tentacle sclerites loosely in rows, sometimes unseen. SBs normally composed of three or four spinose spindles, and usually one strongly projected from head over 0.67–1.56 mm, additional one extended short distance. Long and thick spindles loosely on stalks.

Anthocodial grade and formula:

$$\text{III} = \text{IP} + (2-4) \text{p} + 0\text{Cr} + \text{very strong SB} + (0 \text{ or } 1/2-1)\text{M}$$

On cortex of branch, spinose spindles densely disposed, mainly straight or curved, varying in size. Various types of sclerites on cortex of stalk, warty or spinose spindles majority, straight or bent, sometimes bifurcated or branched. Others unilaterally spinose spindles, four-rayed sclerites like 'butterfly', club, radiate, irregular bodies. On canal wall of branch and stalk, spindles and antler. Straight or curved spindles sometimes bifurcated or branched, and smaller spindles flat. Detailed color, type, and size of sclerites of each part measured in Table 1.

In living, stalks white or reddish white, white main stems and branches white. Sclerites of polyp and SBs golden yellow, but sometimes polyps partially yellowish red. Free tips of SB and uppermost points somewhat white. Rods of tentacles colorless or light yellow, sometimes red. In alcohol,

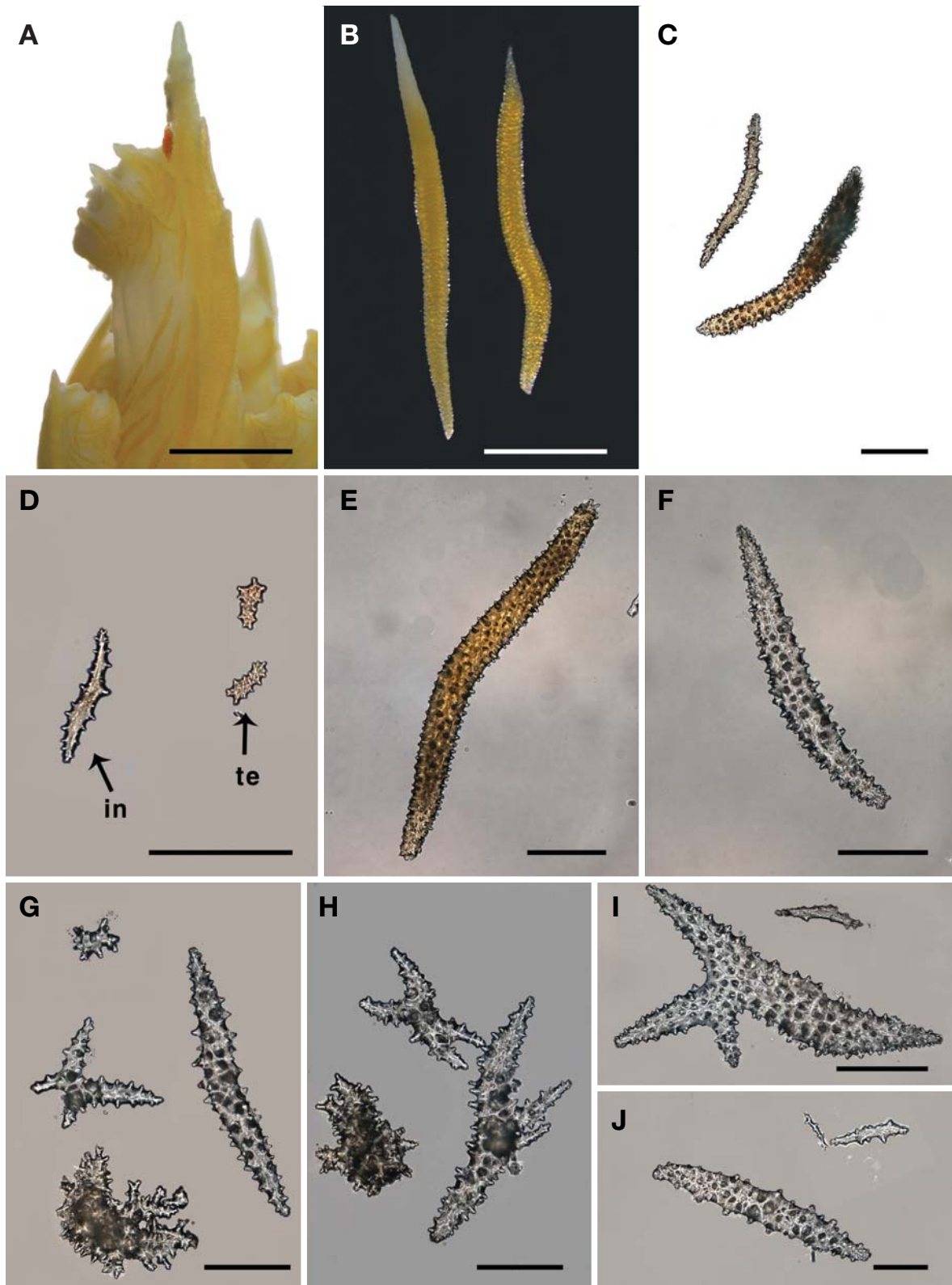


Fig. 2. Sclerites of *Dendronephthya* (*Dendronephthya*) *aurea*. A, Polyp armature; B, Supporting bundle; C, Point; D, Tentacle (te) and intermediate (in); E, Polyp stalk; F, Branch cortex; G, H, Stalk cortex; I, Canal wall of branch; J, Canal wall of stalk. Scale bars: A, B=1 mm, C–J=0.2 mm.

stalks, main stems, branches wear paler, and especially upward stalk.

Habitat. This species inhabits on the gentle slope of rocks between depth of 18 and 26 m, and shows ectosymbiosis with the polychaetes.

Remarks. This species was characterized by the glomerate colonial form similar with *D. gigantea* and the anthocodial gade III. External appearance of this species and coloration were similar to the *D. koellikeri* and *D. mucronata*, but this species was distinguished from the two species by anthocodial formula and not projecting uppermost points. Our specimens differ from the previous records in having the more polyps making the bundle, and little larger uppermost points. For the rest, there is a considerable agreement with *D. aurea*, especially as regards as uppermost point with broad free tip.

Distribution. Pacific Ocean: Korea (Jejudo Island), Japan (Sagami Bay, Kii coast), Vietnam.

^{1*}*Dendronephthya (Dendronephthya) koellikeri*
Kükenthal, 1905 (Table 2, Figs. 3, 6C, D)

Dendronephthya koellikeri Kükenthal, 1905: 573, text-fig. J, Pl. 27, fig. 15.

Spongodes koellikeri: Tixier-Durivault and Prevorsek, 1959: 142, text-figs. 82–85.

Dendronephthya (Dendronephthya) koellikeri: Verseveldt, 1966: 34, text-figs. 20, 21, Pl. 7, fig. 1; Imahara, 1991: 76, text-fig. 15, Pl. 2, fig. f.

Material examined. Korea: 1 colony, Jeju-do: Seogwipo-si, Seopseom, 28 Nov 2005, Hwang SJ (EWZS1234); 1 colony, Seogwipo-si, Daejeog-eup, Songaksan, 33° 12' 15.51''N, 126° 17' 34.66''E, 1 Sep 2008, Hwang SJ, Cho IY (EWZS2631); 1 frag., Seogwipo-si, Andeok-myeon, Hyungjaeseom, 33° 12' 34.71''N, 126° 19' 07.04''E, 2 Sep 2008, Hwang SJ, Cho IY (EWZS2629); 1 frag., Seogwipo-si, Andeok-myeon, Hyungjaeseom, 33° 12' 34.71''N, 126° 19' 07.04''E, 2 Sep 2008, Hwang SJ, Cho IY (EWZS2630), 10–23 m deep by SCUBA diving and underwater camera.

Description. Glomerate. Massive and compact colony with short and wide stalk. Height of colony up to 50 cm in alive. But, small specimens of colony 63 and 84 mm high, 84 and 43 mm wide, of which sterile stalk 14 and 20 mm long, 25 and 14 mm in width, respectively. Sterile stalk occupies up to quarter of whole length of colony in expanded state. Branches rise from whole surface of stem, but laterally flattened in small colony. Main branches more over four in larger colony, less than three on smaller colony. Foliaceous lower branches widen, covered upper part of stalk. Rounded masses of polyp bundles grouped compactly on terminal twig on main stem and branches. Each bundle composed of 15–28 polyps.

Polyps about 2.8–3.7 mm long with 1.0–1.6 mm of stalk. Flat polyp head stands at obtuse angle with stalk, 0.57–0.78 mm high and 0.76–0.96 mm wide. Anthocodial armature composed eight pairs of points. Usually one of uppermost

Table 2. Diagnostic characters on sclerites of *Dendronephthya (Dendronephthya) koellikeri*

Part	Color	Type	Size (length × width, mm)
Polyp			
Tentacle	off N-1, PI1	Rod	0.04 × 0.01–0.14 × 0.04
Point	b6, PI2	Hockeystick spindle	0.66 × 0.07–1.12 × 0.14
	b6, PI2, PI6	Spindle	0.34 × 0.02–0.78 × 0.10
Intermediate	b6, PI1	Spindle	0.22 × 0.03–0.29 × 0.04
Supporting bundle	b6, PI8	Spindle	1.61 × 0.17–3.15 × 0.28
Stalk	b6, PI7	Spindle	0.21 × 0.01–1.14 × 0.10
Branch			
Cortex	PI7, W	Spindle	0.12 × 0.01–2.23 × 0.19
Canal wall	W	Spindle	0.43 × 0.07–0.59 × 0.10
		Antler	0.08 × 0.01–0.21 × 0.04
Stalk			
Cortex	W	Spindle	0.21 × 0.05–2.04 × 0.23
		Spindle: bifurcated, branched	0.65 × 0.23–1.14 × 0.41
		Spindle: unilaterally spinose	0.36 × 0.16–0.81 × 0.27
		Spindle: flat	0.15 × 0.03–0.28 × 0.05
		Club	0.23 × 0.13–0.75 × 0.25
		Radiate	0.08 × 0.03–0.22 × 0.17
Canal wall	W	Spindle	0.30 × 0.06–1.51 × 0.25
		Antler	0.13 × 0.03–0.18 × 0.05

off N-1, beige white; PI1, purplish pink; b6, bright yellowish orange; PI2, purplish pink; PI6, pink; PI8, deep pink; PI7, pink; W, white.

Korean name: ^{1*}콜리커수지맨드라미 (신칭)

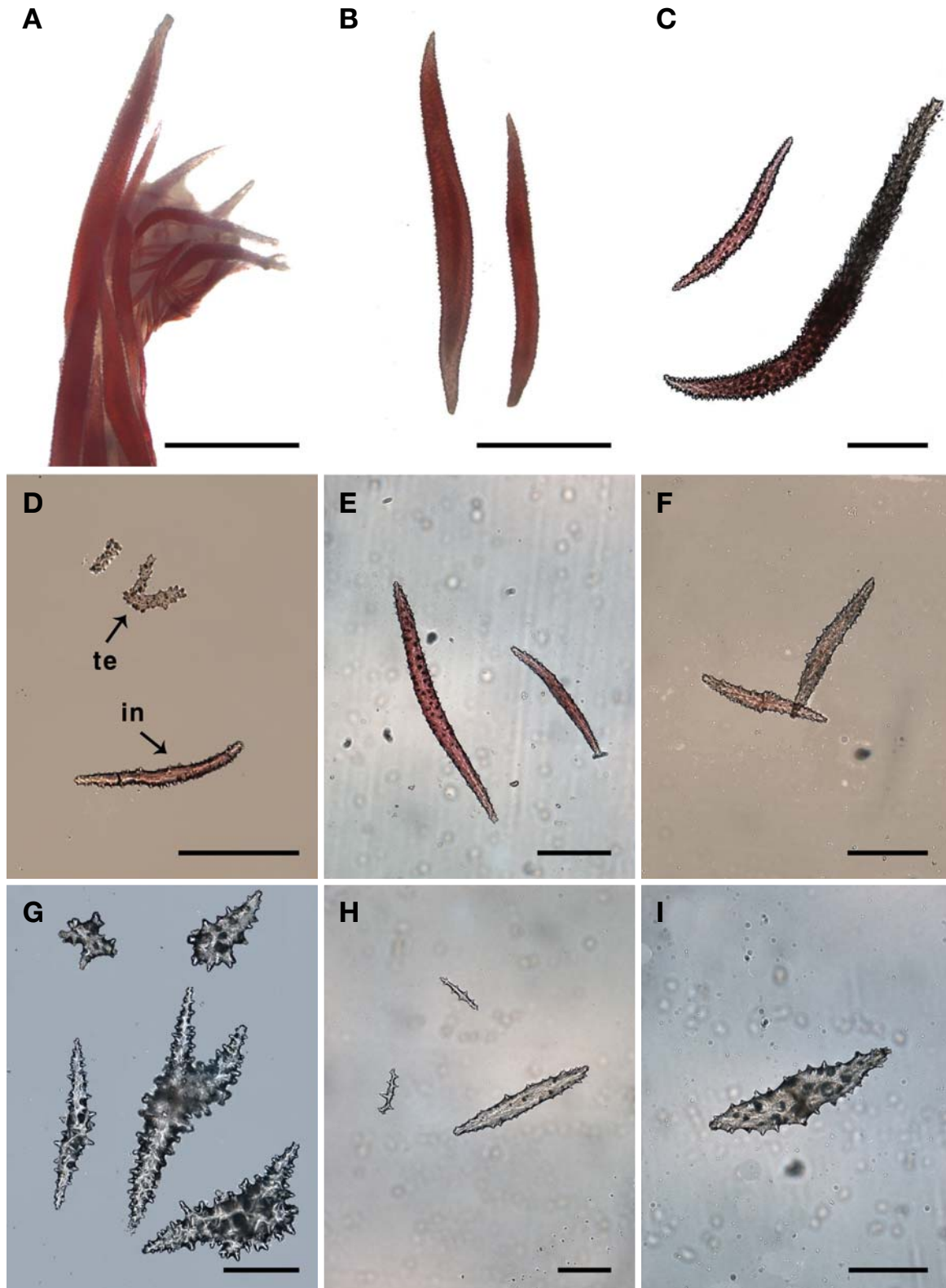


Fig. 3. Sclerites of *Dendronephthya* (*Dendronephthya*) *koellikeri*. A, Polyp armature; B, Supporting bundle; C, Point; D, Tentacle (te) and intermediate (in); E, Polyp stalk; F, Branch cortex; G, Stalk cortex; H, Canal wall of branch; I, Canal wall of stalk. Scale bars: A, B=1 mm, C-I=0.2 mm.

pair like hockeystick, larger and longer, prominently projected from polyp head about 0.31–0.76 mm with obliquely upwards thorns on free end. Intermediate sclerites between each pair of points absent or up to one pair. Crowns and supplementary sclerites absent. Tentacle sclerites in row, sometimes unseen. SBs normally composed of three or four spinose spindles, one or two spindle projected from head over 0.89–1.62 mm. Long and thick spindles loosely on stalks, sometimes densely.

Anthocodial grade and formula:

$$IV=1P+(1-3)p+0Cr+\text{very strong SB}+(0 \text{ or } \frac{1}{2}-1)M$$

On cortex of branch, spinose spindles densely disposed, mainly straight or slightly curved, varying in size. Larger spindles red. Various types of sclerites on cortex of stalk, warty or spinose spindles majority, straight or slightly curved, sometimes bifurcated or branched. Others unilaterally spinose spindles, flat small spindles, club, radiate. On branch and stalk canal walls, spindles and antler. Straight spindles short and thick in middle, sometimes bifurcated. Curved spindles large. Detailed color, type, and size of sclerites of each part measured in Table 2.

In living, stalks, main stems, white or light red, and paler upward, while branches white. Sclerites of polyp pinkish red or golden yellow, and free tips of SB and uppermost points

white. In alcohol, stalks, main stems, branches wear paler, and especially upward stalk.

Habitat. This species inhabits on the gentle slope of rocks between depth of 10 and 23 m, and colonies showing the color variation with red and yellow live together.

Remarks. This species was characterized by glomerate colonial form and flat polyp head with markedly projected and large points. And also, two color types of red and yellow were described by Kükenthal (1905) from the type locality. Some of these specimens differ from the previous records in having the one or two intermediate sclerites, and little shorter spindle in branch cortex. For the rest, there is a considerable agreement with *D. koellikeri*, especially as regards as large spindle and bifurcated or branched spindle in stalk cortex.

Distribution. Pacific Ocean: Korea (Jejudo Island), Japan (Okinawa), Palau, Indonesia (Borneo, Sumatra, Kei Island).

^{1*}*Dendronephthya (Dendronephthya) mucronata*

(Pütter, 1900) (Table 3, Figs. 4, 7A, B)

Spongodes mucronata Pütter, 1900: 454, Pl. 29, fig. 5; Tixier-Durivault and Prevorsek, 1959: 81, text-figs. 42–44.

Dendronephthya mucronata: Kükenthal, 1905: 555, Pl. 26, fig. 7.

Dendronephthya (Dendronephthya) mucronata: Verseveldt, 1966: 28, text-fig. 17, Pl. 6, fig. 1; 1973: 72, text-fig. 3;

Table 3. Diagnostic characters on sclerites of *Dendronephthya (Dendronephthya) mucronata*

Part	Color	Type	Size (length × width, mm)
Polyp			
Tentacle	off N-1, v5	Rod	0.06 × 0.02–0.14 × 0.05
Point	b6, v5	Hockeystick spindle	0.61 × 0.06–1.10 × 0.10
		Spindle	0.24 × 0.02–0.48 × 0.04
Intermediate	v7	Spindle	0.16 × 0.02–0.20 × 0.03
Supporting bundle	b6	Spindle	1.21 × 0.08–2.51 × 0.20
Stalk	v5, v6	Spindle	0.10 × 0.02–1.18 × 0.11
Branch			
Cortex	v7, W	Spindle	0.28 × 0.04–2.47 × 0.18
		Spindle: flat	0.19 × 0.04–0.39 × 0.06
Canal wall	W	Spindle	0.54 × 0.05–1.48 × 0.16
		Antler	0.08 × 0.02–0.17 × 0.05
Stalk			
Cortex	W	Spindle	0.23 × 0.09–1.07 × 0.22
		Spindle: bifurcated, branched	0.20 × 0.13–0.55 × 0.38
		Spindle: unilaterally spinose	0.33 × 0.12–0.70 × 0.23
		Spindle: 'C'	0.29 × 0.13–0.70 × 0.23
		Club	0.22 × 0.11–0.49 × 0.24
		Radiate	0.08 × 0.04–0.23 × 0.18
		Spindle	0.35 × 0.10–1.56 × 0.44
Canal wall	W	Spindle: flat	0.20 × 0.03–0.26 × 0.07
		Antler	0.11 × 0.03–0.25 × 0.08

off N-1, beige white; v5, vivid orange; b6, bright yellowish orange; v6, vivid yellowish orange; v7, vivid reddish yellow; W, white.

Korean name: ^{1*}뽕족수지맨드라미 (신칭)



Fig. 4. Sclerites of *Dendronephthya* (*Dendronephthya*) *mucronata*. A, Polyp armature; B, Supporting bundle; C, Point; D, Tentacle (te) and intermediate (in); E, Polyp stalk; F, Branch cortex; G, H, Stalk cortex; I, Canal wall of branch; J, Canal wall of stalk. Scale bars: A, B=1 mm, C-J=0.2 mm.

1974b: 96; 1977: 174; Imahara, 1991: 78, text-fig. 16, Pl. 2, fig. g.

Material examined. Korea: 1 colony, Jeju-do: Seogwipo-si, Daejeong-eup, Songaksan, 21 Oct 1998, Song JI, Lee YJ (EWZS3958); 1 colony, Seogwipo-si, Daejeong-eup, Gapado, 4 Jan 2006, Choi EJ, Hwang SJ (EWZS1254), 12–20 m deep by SCUBA diving and underwater camera.

Description. Glomerate. Compact, rigid colony with short and wide stalk. Height of colony over 50 cm in alive. But, small specimen of colony 78 mm high, 55 mm wide, of which sterile stalk 30 mm long, 24 mm wide. Main branches four, and short, lobe-like terminal branches grouped on main branches, stem. Foliaceous lower branches short or widen, and covered upper part of stalk or not. Rounded lobes of polyp bundles closely covered main stem and branches. Each bundle composed of 15–25 polyps.

Polyps about 2.7–3.2 mm long with 0.8–1.1 mm of stalk. Flat polyp head stands at obtuse angle with stalk, 0.52–0.74 mm high and 0.77–0.99 mm wide. Anthocodial armature composed eight pairs of points. Usually one of uppermost pair like hockystick, larger and longer, distinctly projected from polyp head about 0.23–0.46 mm, sometimes up to 0.60 mm with obliquely upwards thorns on free end. Intermediate sclerites between each pair of points absent, sometimes one. Crowns and supplementary sclerites absent. Tentacle sclerites loosely in rows, sometimes unseen. SBs normally composed of three or four spinose spindles and two or three smaller spindles, two or three spindle projected from head over 0.74–1.22 mm. Long and thick spindles on stalks, sometimes densely.

Anthocodial grade and formula:

$$IV=1P+(1-3)p+0Cr+very\ strong\ SB+ \\ (0\ or\ sometimes\ \frac{1}{2})M$$

On cortex of branch, spinose or warty spindles densely disposed, mainly straight or slightly curved, varying in size. Larger spindles sometimes yellow. Smaller spindle rather flat. Various types of sclerites on cortex of stalk, warty or spinose spindles majority, straight or bent, sometimes bifurcated or branched. Others unilaterally spinose spindles, unique bow-shaped spindles like 'C', club, radiate. On canal wall of branch, straight or curved spindles, antler. On canal wall of stalk, spindles and antler. Spindles sometimes bifurcated or branched, and smaller spindles flat. Detailed color, type, and size of sclerites of each part measured in Table 3.

In living, stalk, main stem, white or light red, and paler upward, while branch light red in larger colony and white in smaller colony. Sclerites of polyp golden yellow, and free

tip of SB and uppermost point somewhat white. Sometimes, sclerites of tentacle, points, ventral side of polyp stalk red. In alcohol, stalk, main stem, branch get paler, and especially upward stalk.

Habitat. This species inhabits on the gentle slope of rocks between depth of 12 and 20 m.

Remarks. This species was characterized by glomerate colonial form and lobe-like polyp grouping. This species has also simple anthocodial formula like *D. koellikeri* showing the same colonial growth form and habitat in Jejudo Island. But, this species was distinguished from the *D. koellikeri* by the rather narrow angle of polyp head, the short stalk, the short foliaceous branches, and the smaller spindles in cortex of stalk. Our specimens differ from the previous records in having the more polyps making the bundle, and little shorter spindle in branch cortex. For the rest, there is a considerable agreement with *D. mucronata*, especially as regards as the unique bow-shaped like 'C' spindle and the flat small spindle in the canal wall of stalk.

Distribution. Pacific Ocean: Korea (Jejudo Island), Japan (Nagasaki, Okinawa), East China Sea, Vietnam, Indonesia (Palu, Mamuju), Fiji, Australia (Bowen, Port Denison).

¹*Subgenus *Roxasia* Utinomi, 1962

Diagnosis. Colonial growth form divaricate by branching abundantly, diverging polyp bundles from one another, scattering polyps on slender twigs, and not forming bunches of polyp bundles or umbels.

²**Dendronephthya (Roxasia) decussatospinosa*
Utinomi, 1952 (Table 4, Figs. 5, 7C, D)

Dendronephthya decussatospinosa Utinomi, 1952: 187, text-fig. 16, Pl. 11, fig. 25.

Roxasia decussatospinosa: Tixier-Durivault and Prevorsek, 1960: 270, figs. 239–241.

Dendronephthya (Roxasia) decussatospinosa: Imahara, 2006: 97.

Material examined. Korea: 10 fragments, Jeju-do: Seogwipo-si, Seogwipo Port, 12 Apr 1975, Rho BJ, Song JI (EWZS 3874); 1 frag., Seogwipo-si, Seogwipo Port, 33° 13'52.09''N, 126° 33'58.68''E, 23 Jun 2005, in the Sea Korea (EWZS1233); 1 colony, Seogwipo-si, Munseom, 33° 13'32.45''N, 126° 34' 06.84''E, 27 Nov 2005, Hwang SJ, Choi EJ (EWZS1232); 1 frag., Seogwipo-si, Seopseom – Jigwido, 33° 14'02.68''N, 126° 37'00.85''E, 15 May 2007, Cho IY (EWZS228); 1 frag., Seogwipo-si, Seopseom, 33° 14'23.28''N, 126° 37'50.14''E, 9 Sep 2007, Hwang SJ, Cho IY (EWZS1433); 1 frag., Seog-

Table 4. Diagnostic characters on sclerites of *Dendronephthya (Roxasia) decussatospinosa*

Part	Color	Type	Size (length × width, mm)
Polyp			
Tentacle	W	Rod	0.05 × 0.01–0.13 × 0.03
Point	W	Hockeystick spindle	0.98–1.01 × 0.06
	W	Spindle	0.30 × 0.03–0.38 × 0.04
Crown	W	Bent spindle, spindle	0.16 × 0.02–0.22 × 0.02, 0.24 × 0.02–0.28 × 0.04
Supplementary	W	Spindle	0.28 × 0.02
Intermediate	W	Spindle	0.07–0.14 × 0.02
Supporting bundle	W	Spindle	1.90 × 0.13–3.45 × 0.22
Stalk	W	Spindle	0.14 × 0.02–0.53 × 0.04
Branch			
Cortex	p4 ⁺	Spindle	0.11 × 0.03–0.78 × 0.11
		Bifurcated spindle	0.22 × 0.15
		Cross	0.07 × 0.08–0.17 × 0.13
Canal wall	W	Antler	0.07 × 0.03–0.13 × 0.08

W, white; p4⁺, pale yellowish pink.

wipo-si, Munseom, 33° 13'38.83''N, 126° 33'47.60''E, 20 Jun 2010, Hwang SJ et al. (EWZS4037), 24–32 m deep by SCUBA diving, fishing nets and underwater camera.

Description. Divaricate. Arborescent colony with long stalk in one plane and flattened. Height of colony up to 100 cm in alive. But, small specimen of colony 145 mm high, 125 mm wide, and 47 mm thick, of which the sterile stalk 80 mm long, 26 mm in wide, and 21 mm thick. Stalk occupies over half of whole length of colony in contracted state, and one third of colony in expanded state. Polyparium branched up to 3th ramifications. Primary branches symmetrical from erect main stem, long, and six in number. Branches of middle longer than upper and lower ones, and base of two lowest branched from stalk distinctly foliaceous. Primary branches 40–106° from main stem, with decrease to upward, and secondary ones 80–115° from former ones. Groups of polyp bundles at twig on main stem of polyparium and branches, and umbel shape in large colony. Bundles composed of two groups of 5–10 polyps branched dichotomously.

In expanded state, polyps about 2.5–5.0 mm long with 1.1–2.6 mm of stalk, attaining 2.0–3.3 mm in length except for projecting portion of SB. Polyp head stands at obtuse or right angle with stalk, 0.36–0.67 mm high and 0.50–1.00 mm wide. Anthocodial armature composed eight pairs of points. Usually one of pair larger and longer, hockeystick like large uppermost point projected from polyp head about 0.21–0.46 mm. Sometimes, crowns and supplementary sclerites en chevron or horizontal. Tentacle sclerites in two rows rod. SBs normally composed of three sclerites with numerous fine spines, sometimes one. One sclerite with smooth free tip of SB projecting from polyp head about over 0.53 mm, up to 1.94 mm. Ventral side of necks devoid of sclerites, and

numerous sclerites on lateral side.

Anthocodial grade and formula:

$$VI=(1-2)P+(2-3)Cr+(2-4)Sup+very\ strong\ SB \\ +(\frac{1}{2}-2)M$$

Spindle on cortexes of branch densely disposed, and mainly straight or little curved, rarely bifurcated or cross. Canal walls have a few of antler. Color, type, and size of sclerites of each part measured as follow.

In living, main stems, branches, and twig pinkish purple, while polyps and stalk of polyps pale pink. Sterile stalks light pink or purple, and paler upward. And also, color tone more or less variable according to colonial size, showing darker color in small colonies. In alcohol, all colors wear paler, and especially upward stalk, polyps and stalks of polyp somewhat white.

Habitat. This species inhabits on the gentle slope of rocks between depth of 24 and 32 m. This dendronephthyan shows ectosymbiosis with *Coeloplana anthostella* belonging to Ctenophora and polychaete worms with similar color of host branch (pale pink) on the polyparium, and *Hydrichthella epigorgia* attaching on the sterile stalk.

Remarks. When this species was recorded by Utinomi (1952), he just examined one relatively small colony less than 20 cm in height. Our specimens were differed from the Utinomi's type specimen by having a few antlers in the canal wall, and showing pink to pinkish purple of stems and branches in color. And also, polyps and sclerites from our specimens were rather larger than those of type specimen.

Distribution. Pacific Ocean: Korea (Jejudo Island), Japan (Seto).

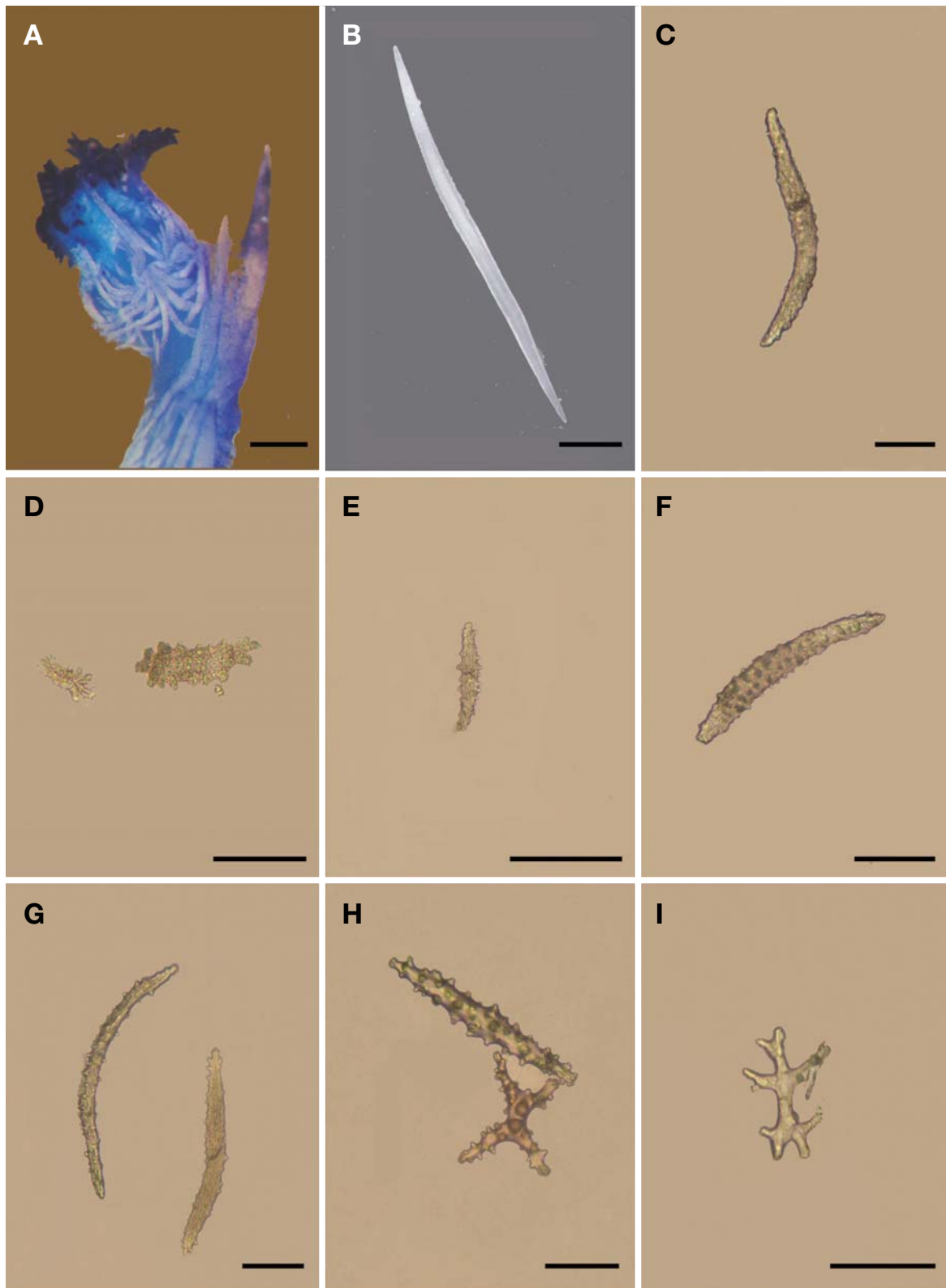


Fig. 5. Sclerites of *Dendronephthya (Roxasia) decussatospinosa*. A, Polyp armature; B, Supporting bundle; C, Point; D, Tentacle; E, Intermediate; F, Crown; G, Polyp stalk; H, Branch cortex; I, Canal wall of branch. Scale bars: A, B=0.5 mm, C-I=0.1 mm.

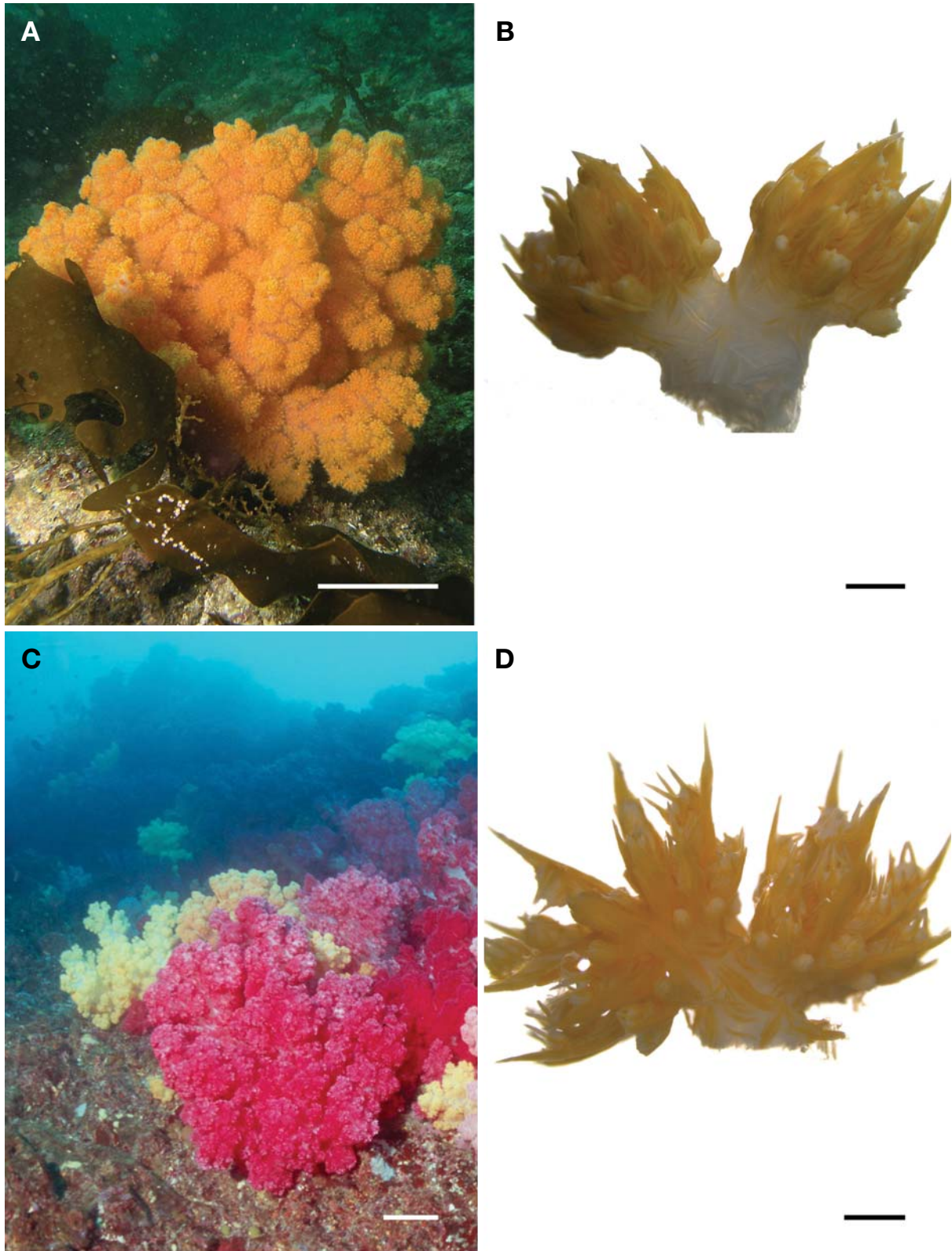


Fig. 6. Colonies and polyp bundles of *Dendronephthya* (*Dendronephthya*) *aurea* (A, B) and *D. (D.) koellikeri* (C, D). A, Colony in expanded state; B, Polyp bundles; C, Pink and yellow colored colonies in expanded state; D, Polyp bundles. Scale bars: A, C=10 cm, B, D=1 mm.

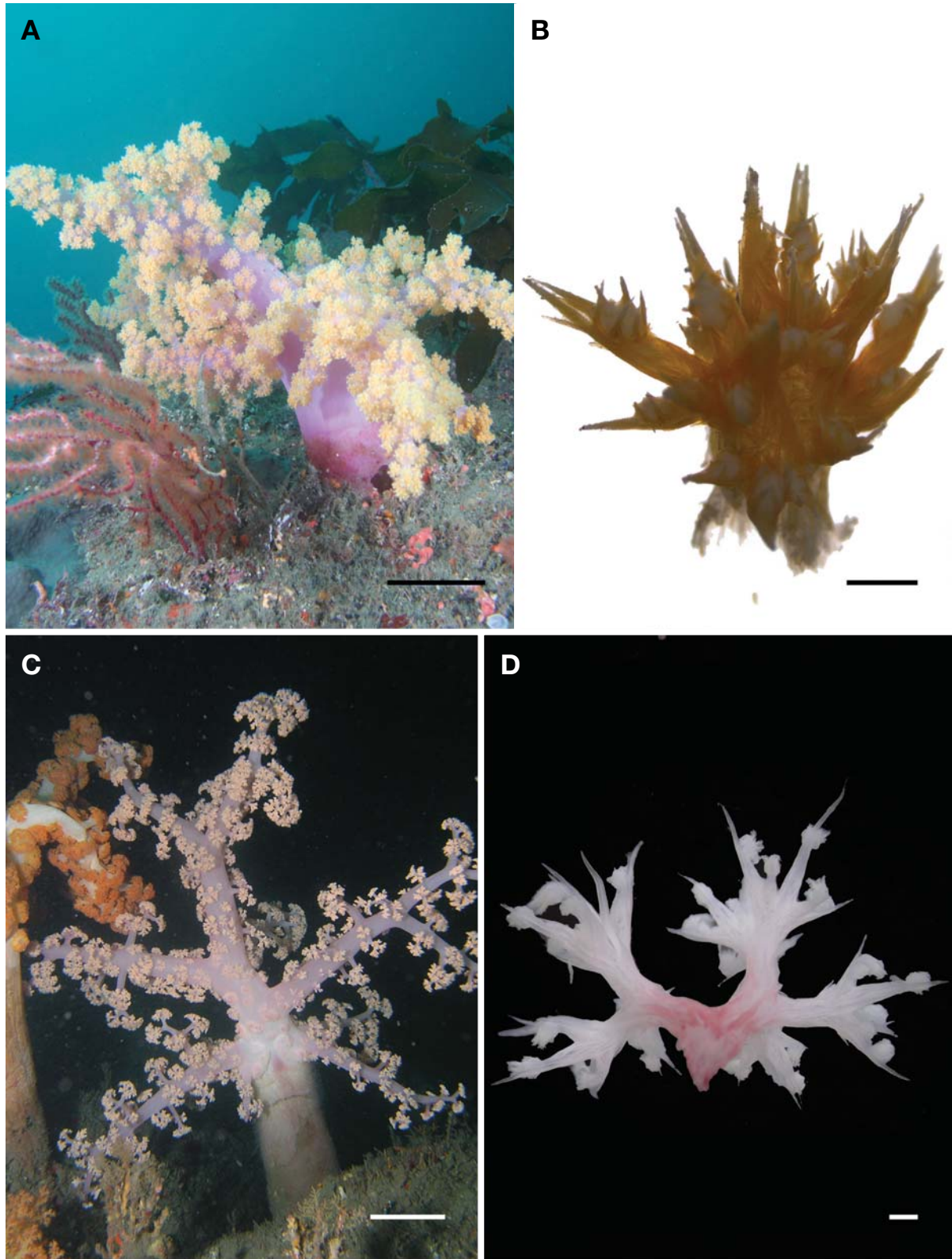


Fig. 7. Colonies and polyp bundles of *Dendronephthya* (*Dendronephthya*) *mucronata* (A, B) and *Dendronephthya* (*Roxasia*) *decussatospinosa* (C, D). A, Colony in expanded state; B, Polyp bundle; C, Colony in expanded state; D, Polyp bundles. Scale bars: A, C=10 cm, B, D=1 mm.

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REFERENCES

- Bayer FM, Grasshoff M, Verseveldt J, 1983. Illustrated trilingual glossary of morphological and anatomical terms applied to Octocorallia. E.J. Brill, Leiden, pp. 1-75.
- Daly M, Brugler MR, Cartwright P, Collins AG, Dawson MN, Fautin DG, France SC, McFadden CS, Opresko DM, Rodriguez E, Romano SL, Stake JL, 2007. The phylum Cnidaria: a review of phylogenetic patterns and diversity 300 years after Linnaeus. *Zootaxa*, 1668:127-182.
- Dana JD, 1846. Structure and classification of zoophytes. Lea and Blanchard, Philadelphia, PA, pp. 116-117.
- Gray JE, 1862. 3. Description of some new species of *Spogodes* and of a new allied genus (*Morchellana*) in the collection of the British Museum. Proceeding of the Zoological Society of London, 30:27-31.
- Harrison RM, 1909. II. 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 London 2nd Series: Zoology, 11:17-44.
- Henderson WD, 1909. An account of the alcyonarians collected by the Royal Indian Marine Survey Ship *Investigator* in the Indian Ocean, with a report on the species of *Dendronephthya* by W.D. Henderson. II. The alcyonarians of the littoral area. The Indian Museum, Calcutta, pp. 1-319.
- Holm O, 1895. Beiträge zur Kenntniss der Alcyonidengattung *Spongodes* Lesson. *Zoologische Jahrbücher (Systematik)*, 8:8-57 (in German).
- Imahara Y, 1977. Nephtheid octocorals from Suruga Bay, the Pacific coast of central Japan. *Annotationes Zoologicae Japonenses*, 50:164-173.
- Imahara Y, 1991. Report on the Octocorallia from the Ryukyu Islands of Japan. *Bulletin of Institute Oceanic Research and Development, Tokai University*, 11/12:59-94.
- Imahara Y, 1996a. Catalogue of the invertebrate materials in the Wakayama Prefectural Museum of Natural History, 1 (1982-1992). *Bulletin of the Wakayama Prefectural Museum of Natural History*, 14:41-86 (in Japanese with English abstract).
- Imahara Y, 1996b. Previously recorded octocorals from Japan and adjacent seas. *Precious Corals & Octocoral Research*, 4:5:17-44.
- Imahara Y, 2003a. Octocorals of the Döderlein collection. *Rep Activ 2000-2002. Grants-in-Aid for Scientific Research (B)* (No. 12575008). Japan Society for the Promotion of Science, Tokyo, pp. 259-266.
- Imahara Y, 2003b. Preliminary list of Japanese octocorals deposited in the various museum in Europe, excluding Döderlein's collection. *Rep Activ 2000-2002. Grants-in-Aid for Scientific Research (B)* (No. 12575008). Japan Society for the Promotion of Science, Tokyo, pp. 267-289.
- Imahara Y, 2006. Preliminary report on the alcyonacean and pennatulacean octocorals collected by the natural history research of the Sagami Sea. *Memoirs of National Science Museum, Tokyo*, (40):91-101.
- Kükenthal W, 1905. Versuch einer revision der Alcyonarien. II. Die familie der Nephthyiden. 2. Teil. Die gattungen *Dendronephthya n.g.* und *Stereonephthya n.g.* *Zoologische Jahrbücher (Systematik)*, 21:503-726 (in German).
- Lesson RP, 1831. Illustrations de zoologie ou recueil de figures d'animaux peintes d'après nature. Arthus Bertrand, Paris, 23:1-354.
- May W, 1899. Beiträge zur systematik und chorologie der Alcyonaceen. *Jenaische Zeitschrift für Naturwissenschaft*, 33:1-180.
- Nutting CC, 1912. Descriptions of the Alcyonaria collected by the U.S. Fisheries steamer "Albatross", mainly in Japanese waters, during 1906. *Proceedings of the United States National Museum*, 43:1-104.
- Pütter A, 1900. Alcyonaceen des Breslauer Museums. *Zoologische Jahrbücher (Systematik)*, 13:443-462 (in German).
- Rho BJ, Song JI, 1977. A study on the classification of the Korean Anthozoa 3. Alcyonacea and Pennatulacea. *Journal of the Korean Research Institute for Better Living*, 19:81-100.
- Roxas HA, 1933. Philippine Alcyonaria. II. The families Alcyoniidae and Nephthyidae. *The Philippine Journal of Science*, 50:345-470.
- Sherriffs WR, 1922. 4. Evolution within the genus *Dendronephthya (Spongodes)* (Alcyonaria), with descriptions of a number of species. *Proceedings of the Zoological Society of London*, 92:33-77.
- Song JI, 1976. A study on the classification of the Korean Anthozoa. 2. Alcyonacea. *Korean Journal of Zoology*, 19:51-62.
- Thomson JA, Dean LMI, 1931. The Alcyonacea of the Siboga Expedition with an addendum to the Gorgonacea. *Siboga Expedition Monographs, Leiden*, 13d:1-227.
- Tixier-Durivault A, Prevorsek M, 1959. Révision de la famille des Nephtheidae. 1. Le genre *Spongodes* Lesson 1831. *Mémoires du Muséum National d'Histoire Naturelle (Nouvelle Série), Série A, Zoologie*, 20:1-151 (in French).
- Tixier-Durivault A, Prevorsek M, 1960. Le genre *Roxasia* (Alcyonaria, Nephtheidae). *Spolia Zoologica Musei Hauniensis*, 18:1-292 (in French).
- Utinomi H, 1952. *Dendronephthya* of Japan. I. *Dendronephthya* collected chiefly along the coast of Kii Peninsula. *Publications of the Seto Marine Biological Laboratory*, 2:161-212.
- Utinomi H, 1954. *Dendronephthya* of Japan. II. New species and new records of *Dendronephthya* and the allied *Stereo-*

- nephthya* from Kii region. Publications of the Seto Marine Biological Laboratory, 3:319-338.
- Utinomi H, 1962. Preliminary list of octocorals of Sagami Bay deposited in the Biological Laboratory of the Imperial Household. Publications of the Seto Marine Biological Laboratory, 10:105-108.
- Verseveldt J, 1966. Biological results of the Snellius Expedition XXII. Octocorallia from the Malay Archipelago (Part II). Zoologische Verhandlungen, 80:1-107.
- Verseveldt J, 1968. Preliminary note on some new Octocorallia from Madagascar. Proceedings Koninklijke Nederlandse Akademie van Wetenschappen Amsterdam (Series C), 71: 52-59.
- Verseveldt J, 1970. Report on some Octocorallia (Alcyonacea) from the northern Red Sea. Israel Journal of Zoology, 19: 209-229.
- Verseveldt J, 1973. Octocorallia from north-western Madagascar (Parts IIIA, IIIB). Proceedings Koninklijke Nederlandse Akademie van Wetenschappen Amsterdam (Series C), 76: 69-100.
- Verseveldt J, 1974a. Alcyonacea (Octocorallia) from the Red Sea, with a discussion of a new *Sinularia* species from Ceylon. Israel Journal of Zoology, 23:1-37.
- Verseveldt J, 1974b. Octocorallia from New Caledonia. Zoologische Mededelingen Leiden, 48:95-122.
- Verseveldt J, 1977. Australian Octocorallia (Coelenterata). Australian Journal of Marine and Freshwater Research, 28: 171-240.
- Wright EP, Studer T, 1889. Report on the Alcyonaria collected by H.M.S. Challenger during the years 1873-1876. Report on the Scientific Results of the Voyage of H.M.S. Challenger During the Years 1873-1876, London, 31:1-314.

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