The Marine Fauna of New Zealand:

New Zealand Primnoidae (Anthozoa: Alcyonacea) Part 1. Genera *Narella*, *Narelloides*, *Metanarella*, *Calyptrophora*, and *Helicoprimnoa*

Stephen D. Cairns

NIWA Biodiversity Memoir 126

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COVER PHOTO

Narella hypsocalyx n. sp. (Primnoidae) (upper centre), commonly referred to as the 'rasta coral' because of its 'dreadlock' branches. Colonies of dead and living scleractinian coral *Solenosmilia variabilis* are in the foreground. Photographed using NIWA's Deep Towed Imaging System (DTIS) at R.V. *Tangaroa* station 0905/58, Graveyard Seamount complex, north-central Chatham Rise, 1014–1040 m.

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NATIONAL INSTITUTE OF
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ABSTRACT

Eighteen species in five of the 17 primnoid genera known to occur off New Zealand are described and illustrated, three of the genera described as new: ***Narelloides***, ***Metanarella***, and ***Helicoprimnoa***. Thirteen of the 18 species are also newly described, five in the genus *Narella*, five in the genus *Calyptrophora*, and three in the newly described genera. Comparative character tables are provided for the New Zealand species of *Narella* and *Calyptrophora* and for the primnoid genera having multiple pairs of medial abaxial scales; a dichotomous key is also provided for the species of New Zealand *Narella*. A brief review is given of the 10 primnoid species previously reported from New Zealand. One of the species reported herein, *Calyptrophora clinata*, was heretofore known only from the Northwest Atlantic. New morphological terminology is suggested for describing the arrangement of coenenchymal scales and for the ratio of body-wall scale lengths.

Keywords: Primnoidae, *Narella*, *Calyptrophora*, *Narelloides* n. gen., *Metanarella* n. gen., *Helicoprimnoa* n. gen., taxonomic revision, new genera, new species, New Zealand.

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INTRODUCTION

The family Primnoidae is among the most diverse within the Octocorallia, consisting of about 250 species in 43 genera (Cairns & Bayer 2009). Primnoids exist worldwide at depths of 8–6400 m (Zapata-Guardiola & López-González 2012), although they tend to favour bathyal depths of 200–1000 m. Because of their large size (up to 2 m) and local abundance (especially on seamounts, Rogers *et al.* 2007), some genera form habitat for fish (Stone 2006; Etnoyer & Warwick 2007) and other invertebrates (Kreiger & Wing 2002; Cairns *et al.* 2009: 63), and thus are of economic significance.

Although primnoids are common throughout the world, only ten species have been reported from the New Zealand region (Cairns *et al.* 2009), including the Kermadec Islands and Trench. The first New Zealand primnoid, *Callogorgia ventilabrum*, was reported by Studer (1878) from off Three Kings Island at 165 m, collected on the *Gazelle* Expedition. Shortly thereafter Wright & Studer (1889) reported three new species from one *Challenger* station (station 171) north of Raoul Island, Kermadec Ridge, at 1097 m: *Calyptrophora wyvillei*, *Stachyodes regularis* (= *Narella studeri*), and *Thouarella moseleyi*. Somewhat later, Thomson & Rennet (1931) reported *Dicholaphis (= Mirostenella) delicatula* from off Macquarie Island (2742 m). Madsen (1956) described the deepest known alcyonacean *Primnoella (= Convexella) krampi* from the Kermadec Trench at 5850 m. Much later, Bayer (1996) reported two species of *Callozostron* from this region: *C. mirabile* Wright, 1885 from off Antipodes Island (952–1336 m) and *C. acanthodes* Bayer, 1996 from the Bay of Plenty region (1354–1995 m). Shortly thereafter, Bayer (1998) described *Fannyella (= Metafannyella) eos* from the Auckland Islands Shelf (333–371 m). The species checklist found in Cairns *et al.* (2009), the octocoral portion written by Juan Sánchez, lists a tenth species as *Primnoella australasiae* (Gray, 1850). This checklist also implies the existence of another 30 primnoid species in New Zealand waters, including four *Calyptrophora* and eight *Narella*. The present study confirms the eight *Narella* species and an additional three *Calyptrophora*, suggesting that the list of 40 presumptive primnoid species listed by Cairns *et al.* (2009) may have been an underestimate. Eighteen species in five genera, including the species-rich genera *Calyptrophora* and *Narella*, are also reviewed, but there are another 17 primnoid genera known from New Zealand waters, including the species-rich *Thouarella* and *Callogorgia*, which it is hoped will form the basis for future numbers of this series. As part of a colour identification guide, Tracey *et al.* (2011) allude to some of the commoner primnoids from New Zealand.

MATERIAL AND METHODS

This study was based on specimens from 84 stations collected by and deposited at NIWA, which have resulted from a variety of programmes and cruises sponsored by NZOI/NIWA (see Appendix 1) over a 40-year period, including: RV *Taranui* (Three Kings (1965), North West Slope Benthos (1968), Noumea (1966)); the MV *Tangaroa* (TAN) *Challenger* Centenary cruise (1974), Norfolk Basin geology (1983), Kermadec Coral (1982), Tasman Basin (1982); the RV *Tangaroa* Seamounts of the Chatham Rise (1996, 2001, 2009), Kermadec Ridge Volcanics (2002), Bay of Plenty and Hikurangi Plateau Seamounts (2004), Graveyard Seamounts (2006), KARMA (2010), and Ministries of Fisheries Scientific Observers Bycatch Programme (TRIP, 1998–2009); the Nova expedition (1964); and the RV *Kaharoa* (KAH) Aotea Seamount voyage (2002). Two extralimital records from the *Albatross* (deposited at the NMNH) are also included.

The distributions of the species described are shown in Figures 1–7.

Morphological terminology follows the glossary of Bayer *et al.* (1983); however, several terms are introduced herein to facilitate the description of various species. For instance, in most primnoid species the coenenchymal scales are thin (0.1–0.2 mm) and elongate, usually thinnest at their edges, allowing them to overlap slightly or be overlapped by adjacent scales, thus conferring a certain degree of flexibility to the branch. However, in some species of *Narella*, coenenchymal scales are quite thick (up to 0.8 mm) and often polygonal in shape, too thick to overlap adjacent scales, instead usually tightly fitted together in an inflexible mosaic pattern. Their lateral edges are so wide that they are tuberculate like their inner faces. These thick scales afford a more effective anchoring for the polyps but provide little to no branch flexibility, the colonies being

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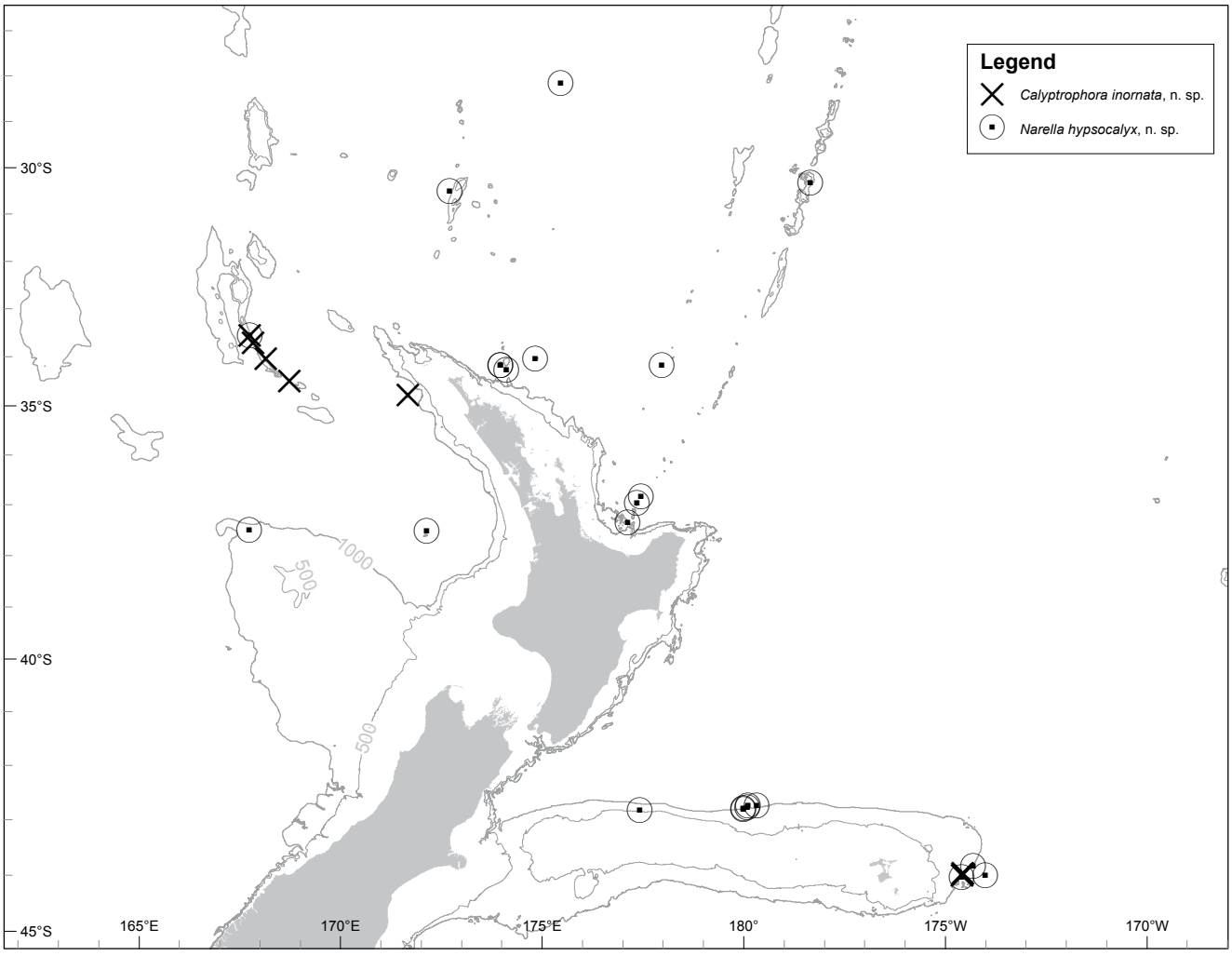

Figure 1. Distribution of *Calyptrophora inornata* and *N. hypsocalyx*.

quite stiff. The first-described shape and arrangement of thin coenenchymal scales is herein termed **imbricate**, the latter inflexible arrangement **mosaic**. Mosaic coenenchymal arrangements are found in other octocoral genera, such as *Keroeides* and *Microprimnoa*.

Colonial morphology of various species is shown in Figures 8 and 9.

The relative lengths of the three pairs of abaxial body-wall scales found in species of *Narella* can be used for taxonomic discrimination (see Table 1). Thus, a ratio of the lengths of these three major body-wall scales can be calculated for the species described in that genus, in which the height of the basal scale is always assigned a value of 1 and the approximate lengths of the other two types of scales (medial and buccal in that order) as a percentage of the basal height.

When there is more than one pair of medial scales (e.g. genera *Narelloides, Paranarella, Metanarella*), the pair most proximal is termed the **primary medial**, the next **secondary**, with the distalmost being the **tertiary medial pair**.

In colonies having a lyrate growth form, the original upright stem that is attached to the substrate, and which may be quite short, is termed the **main stem**; the main stem usually bifurcates into two **lateral stems**, which forms a planar colony; and branches that originate from the lateral stem, usually standing parallel to one another, directly upward, and unbranched or subsequently dichotomously branched, are termed the **ascending branches**.

SEM stub numbers (see sections on Material Examined or Types) are in the series established by the author, and are all deposited at the NMNH.

ABBREVIATIONS USED

The following abbreviations are used in the text:

L:W – Ratio of length to width of a scale

NIWA – National Institute of Water & Atmospheric Research, Kilbirnie, Wellington

MNHNP – Muséum National d'Histoire Naturelle, Paris

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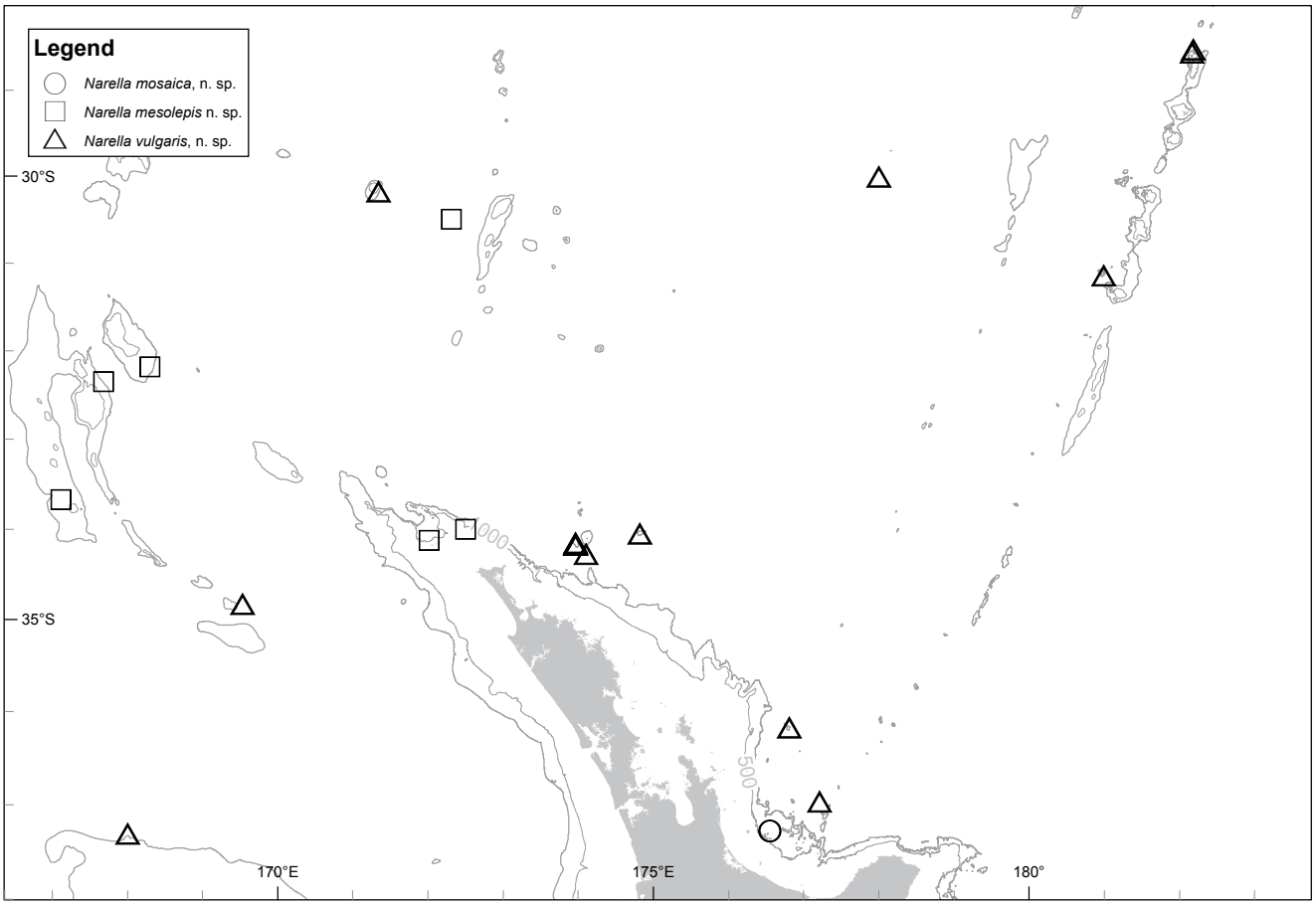

Figure 2. Distribution of *Narella mosaica, N. mesolepis* and *N. vulgaris*.

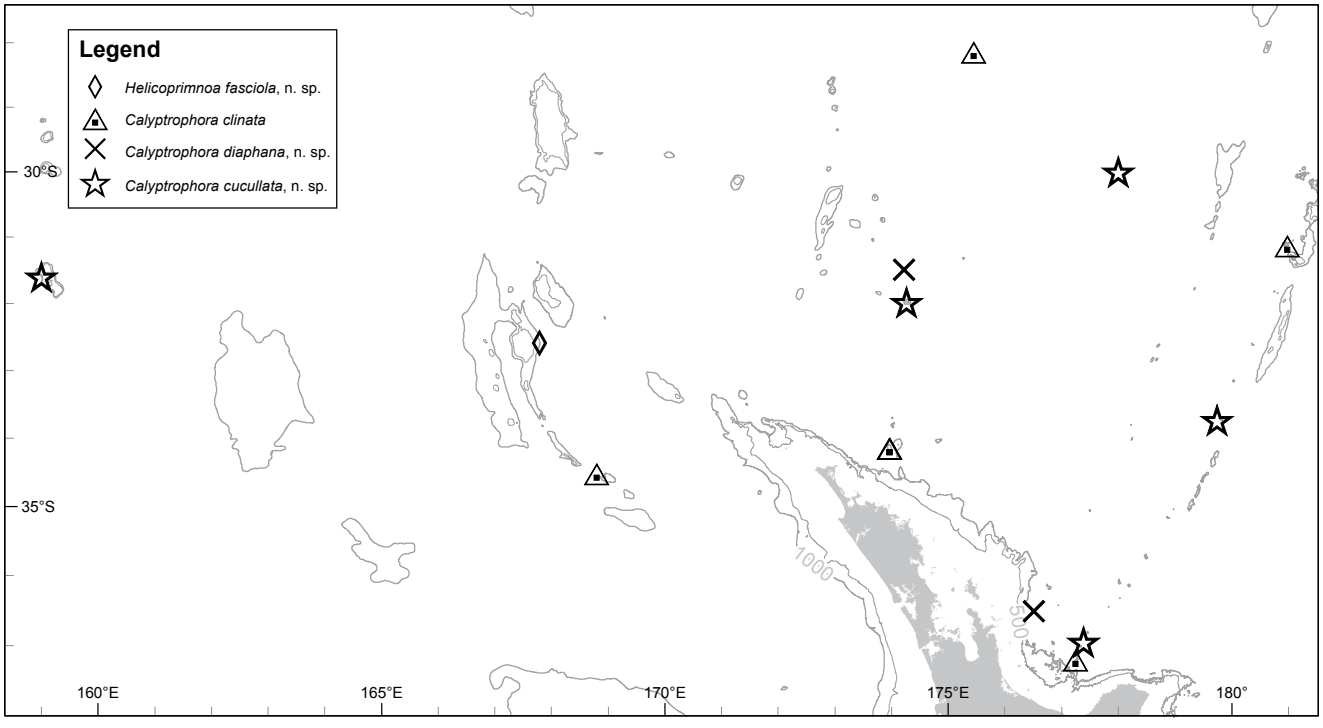

Figure 3. Distribution of *Helicoprimnoa fasciola, Calyptrophora clinata, C. diaphana* and *C. cucullata*.

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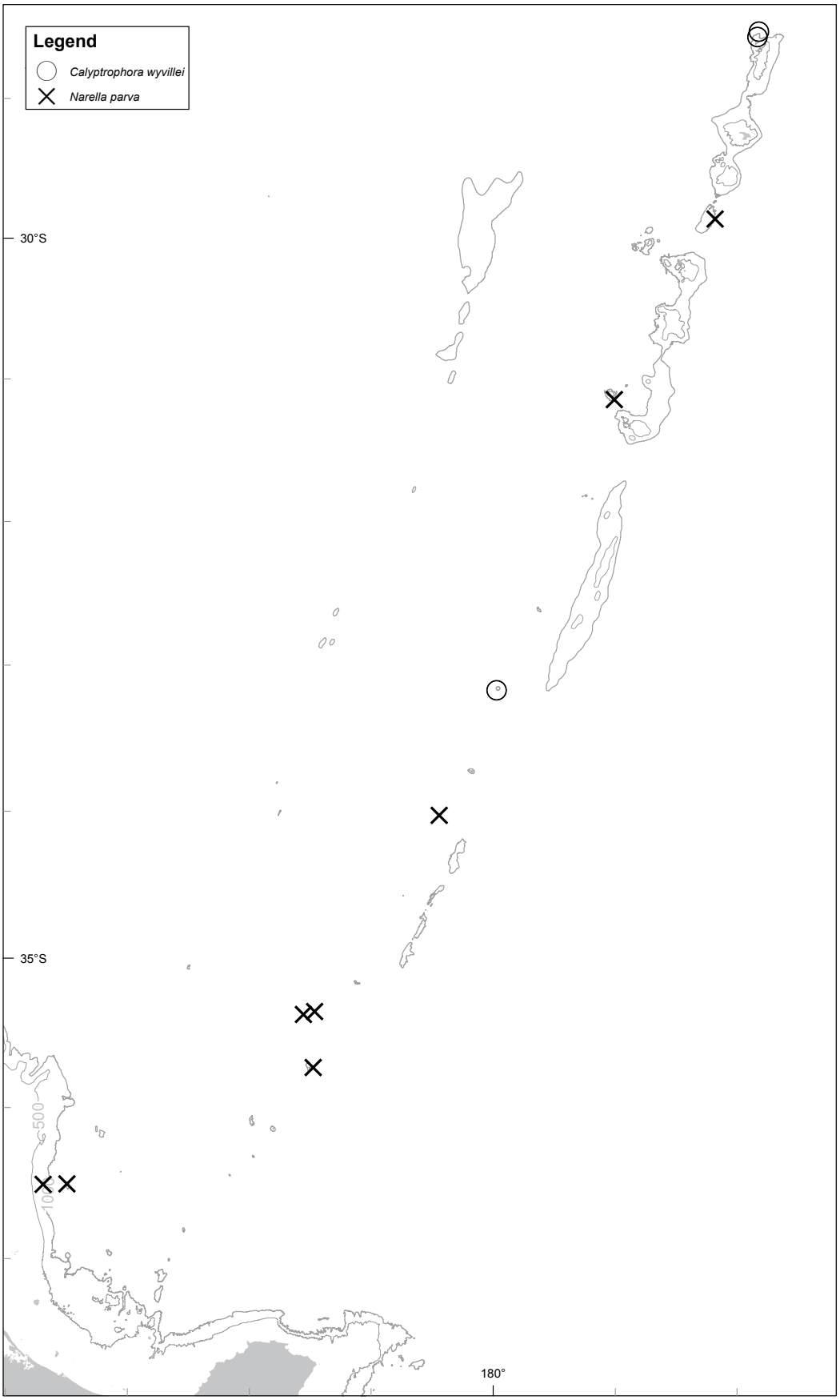
Figure 4. Distribution of *Calyptrophora wyvillei* and *Narella parva*.



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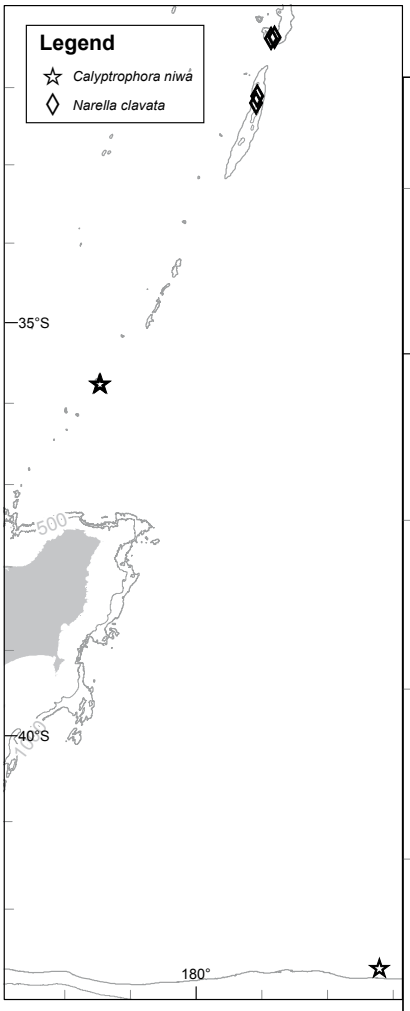

Figure 5. Distribution of *Calyptrophora niwa* and *Narella clavata*.

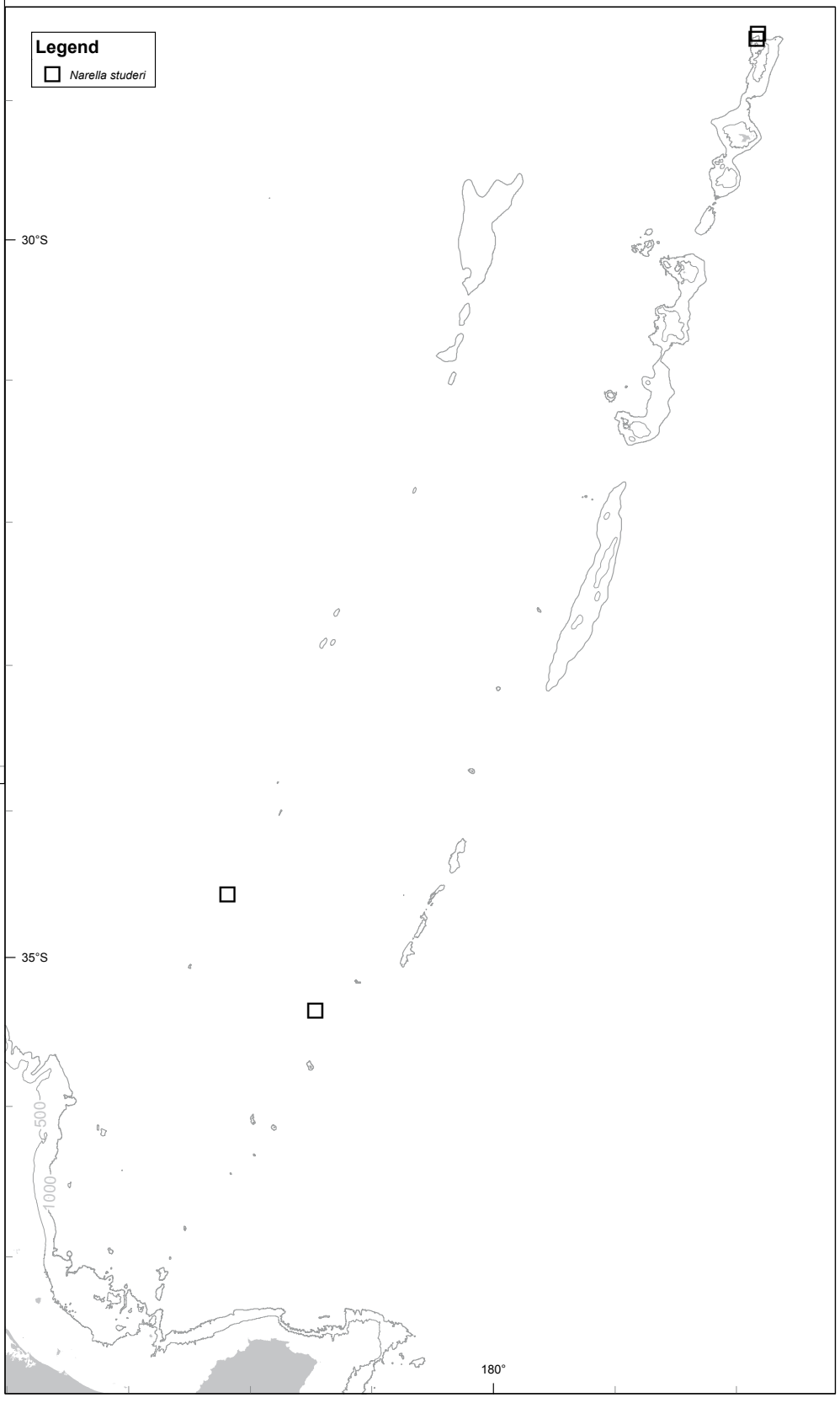

Figure 6. Distribution of *Narella studeri*.

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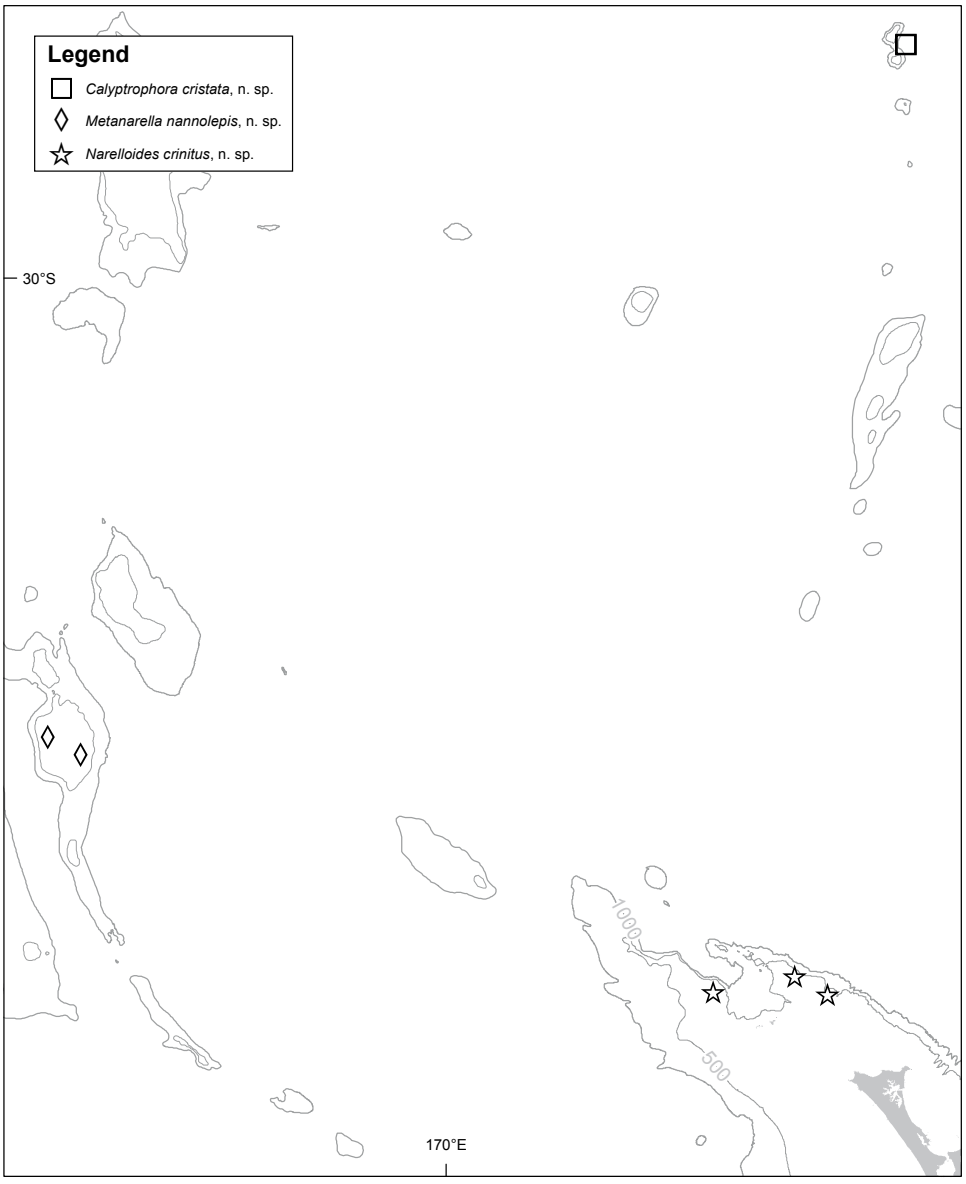
Figure 7. Distribution of *Calyptrophora cristata*, *Metanarella nannolepis*, and *Narelloides crinitus*.



NMNH – National Museum of Natural History, Smithsonian Institution, Washington, DC

SEM – Scanning Electron Microscope, used to identify stub number

USNM – United States National Museum (now known as the NMNH, but still used to preface their catalogue numbers)

ZMA – Zoological Museum of Amsterdam.

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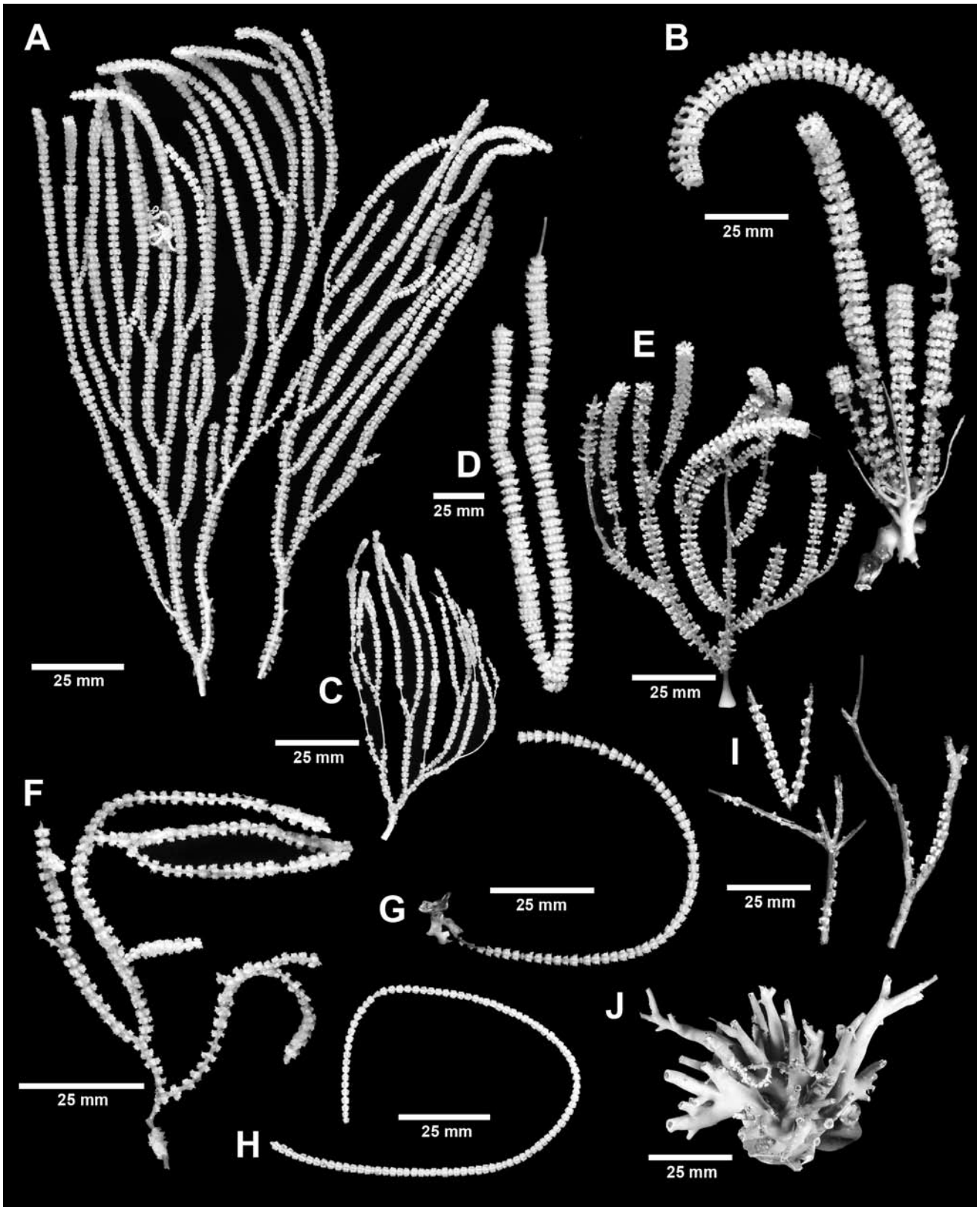

Figure 8. Colonial morphology of various species: A, two fragments of holotype of *Narella vulgaris*; B, holotype of *N. hypsocalyx*; C, *N. parva* from NIWA 11110; D, *N. clavata* from NIWA 11101; E, holotype of *N. dampieri*; F, holotype of *N. mosaica*; G, holotype of *N. mesolepis*; H, holotype of *Narelloides crinitus*; I, three branches of *Narella studeri* from NIWA 11316; J, calcified base of paratype of *N. hypsocalyx* from NIWA 54729.

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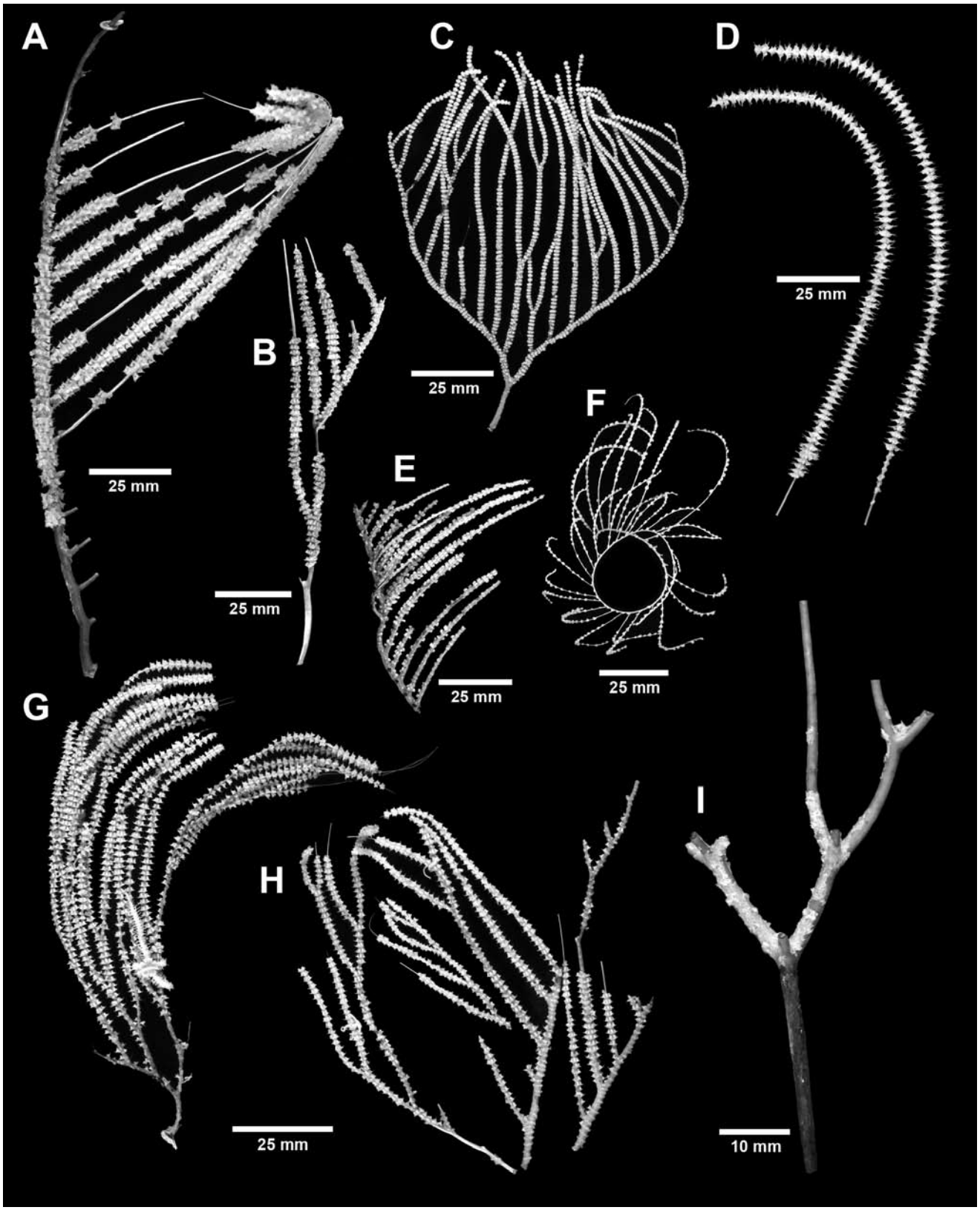

Figure 9. Colonial morphology of various species: A, holotype of *Calyptrophora diaphana*; B, holotype of *C. inornata*; C, holotype of *Metanarella nannolepis*; D, two colonies of *C. clinata* from NIWA 11136; E, holotype of *C. cristata*; F, holotype of *Helicoprimnoa fasciola*; G, holotype of *C. niwa*; H, two syntypes of *C. cucullata* from NIWA 14760 ; I, *C. wyvillei* from K806.

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SYSTEMATICS

Phylum **CNIDARIA**
Class **ANTHOZOA**
Order **ALCYONACEA**
Family **PRIMNOIDAE** Milne Edwards, 1857

Narella Gray, 1870

Narella Gray, 1870: 49.—Cairns & Bayer 2003: 618–619; 2007: 84–86 (list of species); 2009: 43, figs. 14A–G (revision, list of species).—Cairns & Baco 2007: 392–393 (list of species).

Stachyodes Wright & Studer, 1889: 49.—Versluys 1906: 86–88.—Kinoshita 1908: 45–47.—Kükenthal 1919: 452–456.

Diagnosis (amended from Cairns & Bayer 2009): Colonies dichotomously branched, pinnate, or unbranched (flagelliform). Polyps arranged in whorls, the polyps always facing downward. Polyps covered by three (rarely four) pairs of abaxial body-wall scales (1 pair of basals, 1–2 pairs of medials, and 1 pair of buccals), 1–3 pairs of much smaller adaxial body-wall scales, and sometimes additional scattered adaxial scales, nonetheless resulting in a partially naked adaxial face; one species also has unpaired infrabasal scales. Distal margins of body-wall scales often spinose, toothed, or lobate, sometimes extending as a protective buccal cowl. Opercular scales usually prominently keeled. Coenenchymal scales arranged in one layer, often quite thick, and often ridged. Flattened, curved tentacular platelets often present.

Type Species: *Primnoa regularis* Duchassaing & Michelotti, 1860, by monotypy.

Discussion: *Narella* is the most species-rich among the 43 primnoid genera, consisting of 43 species. As noted by Cairns and Bayer (2009), each oceanographic region seems to host a distinctive set of sympatric species, but when all species are examined simultaneously it appears that at least some species have a more cosmopolitan distribution, for instance three of the New Zealand species having been previously described by Versluys (1906) from Indonesian waters, including one that may have a broad Indo–West Pacific distribution (*N. clavata*). As a basis for comparison, of the 46 nominal *Narella* species (including three junior synonyms), I have examined the types of 38 of those species (35 of which are deposited at the NMNH) and non-types of five more species, depending exclusively on the literature for only three species.

In order to better understand the genus, Versluys (1906) divided it into two groups of species, one having basal scales united adaxially (closed), the others not (open). Kinoshita (1908) added a third group that included a species that had both basal and medial scales united adaxially. Kükenthal (1919) reviewed the species in the genus and provided a key for their distinction. Although Bayer devoted much attention to this genus throughout his career, even writing summary descriptions of most species and composing plates, he did not publish his results. Information about the history of the genus and characters used to distinguish species can be found in the references listed above in the synonymy.

Distribution: All ocean basins, 128–4594 m. (The depth range of 55 m listed by Cairns and Bayer (2009) was based on the misidentification of a species of *Perissogorgia*.)

Key to the New Zealand species of *Narella*

1 Colonies unbranched (flagelliform); infrabasal scale unpaired ..... *N. mesolepis*

1′ Colonies branched (lyrate, dichotomous, or from a common base); if present, infrabasal scales paired 2

2 Colonies bushy, long undivided branches originating from a basal calcareous mass; whorl diameter over 10 mm; adaxial body-wall scales elongate rectangular ..... *N. hypsocalyx*

2′ Colonies having equal dichotomous branching; whorl diameter less than 10 mm; adaxial body-wall scales elliptical to square 3

3 Axis of colony always modified by commensal polychaete worm tube 4

3′ Polychaete worm tubes not present 7

4 Basal scales in open position, not touching adaxially ..... *N. vulgaris*

4′ Basal scales in closed position, touching adaxially 5

5 Polyps tips hang above branch surface; polyps < 2 mm in length..... *N. dampieri*

5′ Polyp tips adjacent to branch surface; polyps > 2.2 mm 6

6 3–5 polyps/whorl; polyps not laterally fused ..... *N. mosaica*

6′ 4–14 polyps/whorl; polyps laterally fused ..... *N. clavata*

7 Polyps less than 3 mm in length; basal scales with ridged dorsolateral edge ..... *N. parva*

7′ Polyps over 3 mm in length; dorsolateral edge of basals rounded..... *N. studeri*

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Narella mesolepis n. sp. Figs 2, 8G, 10, 11

MATERIAL EXAMINED: Types.

DISTRIBUTION: Three Kings Ridge (including off Three Kings Island), West Norfolk Ridge (off Wanganella Bank) (Fig. 2), 157–1246 m.

DESCRIPTION: Colonies unbranched, the longest stem (NIWA 76204) 30 cm long; holotype (Fig. 8G) 17 cm long, the only specimen complete with holdfast, which is attached to a dead stylasterid colony of the genus *Crypthelia*. Axis straw coloured or dark bronze; 1.2 mm in diameter in holotype. Polyps arranged in whorls (Fig. 10A) of 6–11, depending on branch diameter; whorls in very close proximity (3/mm), not allowing view of coenenchyme. Polyps within whorls also laterally contiguous. Whorl diameter 3.5–6.0 mm; horizontal length of polyps 2.7–3.1 mm.

Basal scales massive (thick), up to 1.9 mm in height, the distal 0.35–0.55 mm constituting a projecting lobe, which is finely ridged on its inner surface (Fig. 11E); adaxially they are open. Medial scales (Fig. 10B, D) elongate (up to 1.75 mm in length), slightly concave above, and often slightly flared distally, their distal edge also finely ridged beneath. Lateral sides of medial scales extend around polyp to adaxial side, where they join (in a closed position) forming continuous platform or bridge just beneath adaxial buccal pair of scales (Figs 10C, 11D). Buccal scales similar to medial scales although usually slightly longer (up to 2.0 mm), having a smooth, lobate distal edge extending as a translucent cowl (Figs 11A, C) up to 0.55 mm in length; distal edge also ridged beneath. Outer surface of all body-wall scales fairly smooth, bearing only sparse low granules; dorsolateral edges of all body-wall scales rounded. Ratio of major body-wall scales approximately: 1:1:1.05. Adaxial side of polyp bordered by one pair of wide (up to 0.8 mm wide) rectangular adaxial buccals, each of which borders not only adjacent adaxial opercular but adaxial portion of the broad adjacent inner lateral opercular (Figs 10C, 11D). A medial or sagittally-placed, slightly concave, elliptical infrabasal scale occurs at adaxial base of basal scales (Figs 11F–H), this scale up to 1.2 mm in greater diameter. Sometimes a second smaller (up to 1.0 mm in greater diameter) infrabasal occurs proximal to first, slightly overlapping the larger one (Fig. 11G).

Operculum easily seen in lateral view (Fig. 10D), opercular scales ranging from 1.1–1.5 mm in length,

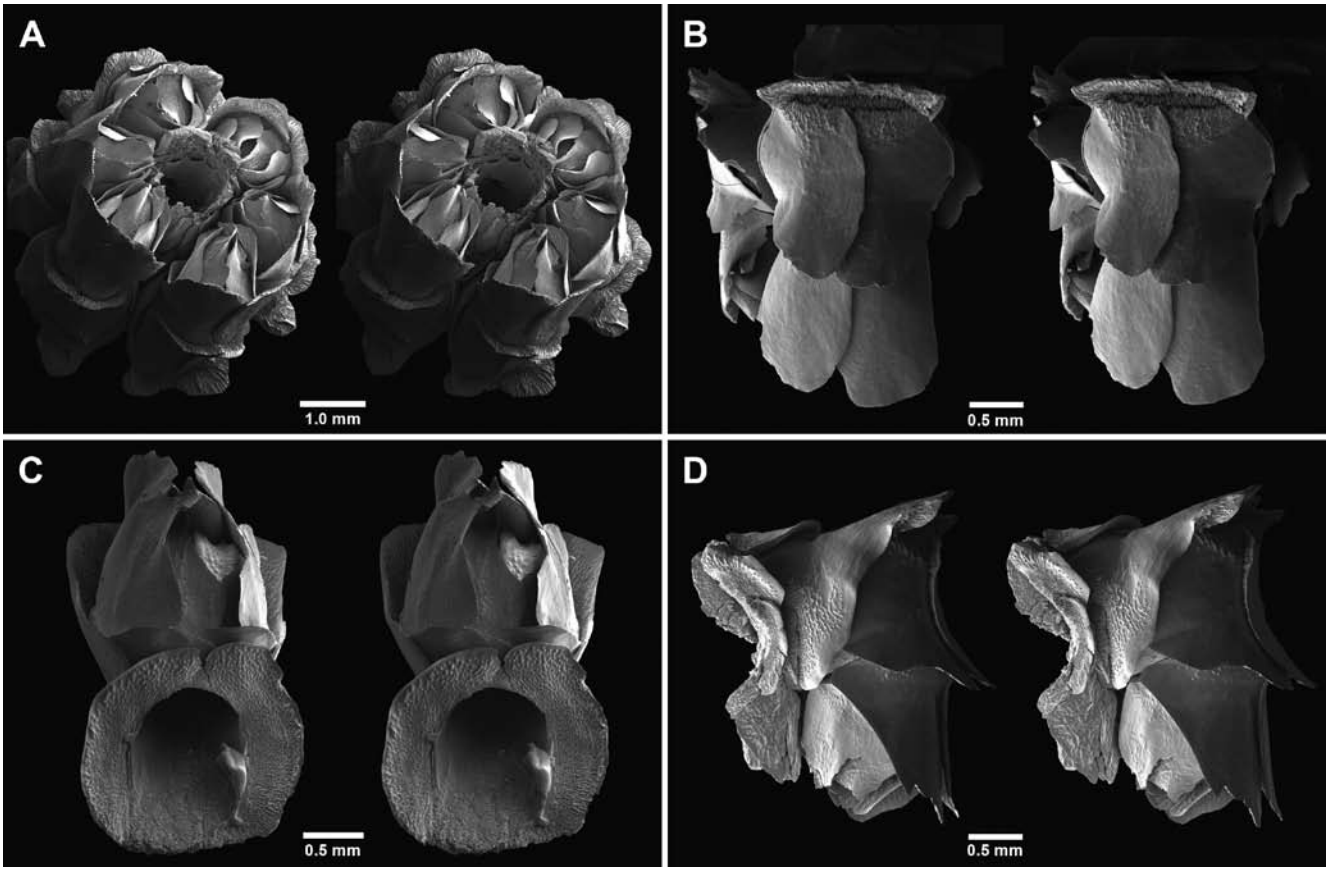

Figure 10. Holotype of *Narella mesolepis*: A, apical view of a whorl of six polyps; B, abcauline view of a polyp; C, adcauline view of a polyp showing one pair of adaxial buccal scales; D, lateral view of a polyp showing infrabasal scale and some coenenchymal scales. All views are in stereo.

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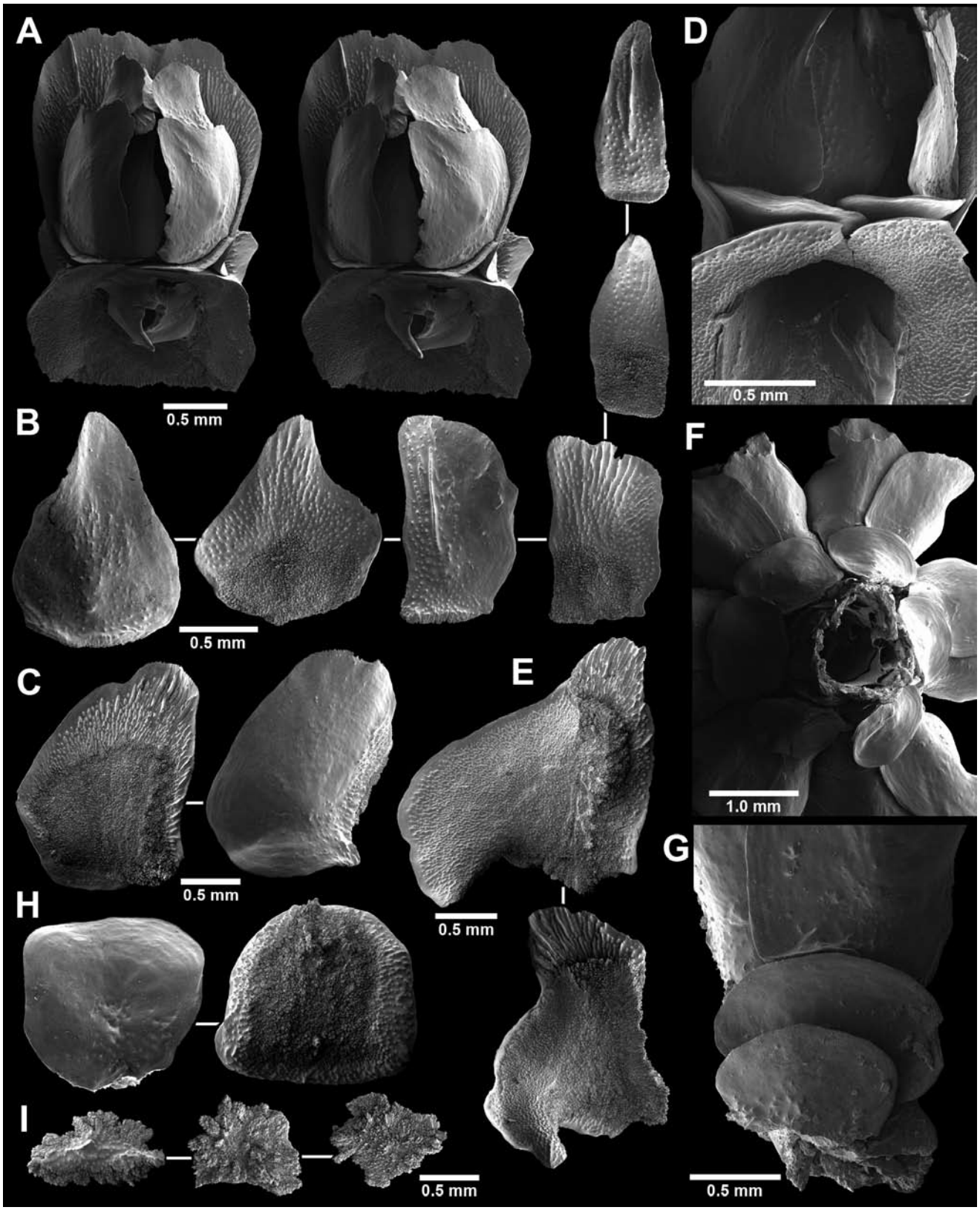

Figure 11. Polyp and sclerites from holotype of *Narella mesolepis*: A, adaxial view of polyp, stereo view; B, six opercular scales; C, two buccal scales; D, adaxial view of polyp showing shelf created by medial scales, and the adaxial pair of scales; E, two basal scales; F, polyp whorl from underside, showing the medial infrabasal scales; G, a pair of medial infrabasal scales *in situ*; H, two infrabasal scales; I, three coenenchymal scales. (Figs 11E and H share a common scale bar of 0.5 mm.)

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but unlike most congenerics, the size does not progressively decrease from ab– to adaxial side, the inner lateral operculars being unusually wide (Fig. 11B). Abaxial and inner lateral operculars up to 1.4 mm in length and symmetrical, with an L:W of 1.1–1.4. Outer lateral operculars up to 1.3 mm in length and asymmetrical, with an L:W of 1.1–1.6. Adaxial operculars 1.1–1.2 mm in length and symmetrical, having an L:W of about 2.2–2.5. Outer face of operculars sometimes bear a single, low, medial ridge; distal inner surface covered with numerous low spiny ridges (not keeled). Tentacular platelets not observed.

Coenenchymal scales elongate to irregular (amoeboid, with digitate margins) in shape (Fig. 11I) (L:W = 1.2–3.1), rarely larger than 0.9 mm, and thin (about 0.15 mm), arranged in an imbricate fashion, although because of the close placement of whorls there is little free space on the branch for coenenchymal scales; outer surface flat and finely granular.

Types: Holotype: E856, colony 17 cm long, NIWA 11111, and branch fragment and SEM stubs 1610–1615, 1649 (USNM 1179803). Paratypes: E856, four branches, NIWA 76204, and one colony, USNM 1179804; E336, 12 branches, NIWA 11232; E845, four branches, NIWA 11210; E860, two branches, NIWA 11334; S573, four branches, NIWA 11224, and one branch fragment, USNM 1179802; TRIP 2918/17, two branches, NIWA 66294.

Type Locality: 32.1833°S, 168.30°E (off Wanganella Bank, southern Norfolk Ridge), 1169 m.

Comparisons: *Narella mesolepis* is the only species among the 43 in the genus known to be unbranched. At one time *N. versluysi* was thought to be unbranched (Cairns & Bayer 2007), but subsequently collected specimens have shown it to be sparsely branched like *N. macrocalyx*. Individual, long, undivided branches broken from branching colonies might be confused as being from an unbranched colony, especially those of *N. muzikae* and *N. hypsocalyx*, both of which form long undivided branches from a low basal region, but *N. mesolepis* is the only species verified to be unbranched, an observation supported by the holotype, which is a complete specimen with its attachment. It should also be noted that the branching pattern (if any) of *N. spectabilis* and *N. ornata*, is unknown. *Narella mesolepis* is also unique within the genus in having one large, unpaired, medial infrabasal scale at the base of each basal. Also, it is unusual, but not unique, in that its opercular scales do not have keels, and its medial scales are in the closed position (see Table 1).

Etymology: Derived from the Greek *meso* (meaning middle, medial) and *lepis* (meaning scale), an allusion to the unpaired sagittal infrabasal scale of each polyp.

Narella hypsocalyx n. sp. Figs 1, 8B, 8J, 12, 13

Material Examined: Types.

Distribution: Widespread in New Zealand region: Kermadec, Three Kings, and southern Norfolk Ridges, Challenger Plateau, Aotea Seamount, off North Cape (Cavalli Seamount), off Bay of Plenty, northern Chatham Rise (Zombie, Scroll, Dead Ringer, Aloha Seamounts, Ghoul Hill), east of Chatham Island (Fig. 1), 510–1118 m.

Description: Colonies bushy only in basal 3–5 cm, with frequent branching from a common heavily calcified bolus up to 6 cm in diameter, above which multiple (up to 30, NIWA 54354 and 54329), elongate (up to 40 cm, NIWA 11075), undivided branches emerge (Figs 8B, J). Basal region of colony, including proximal regions of branches, heavily calcified (Fig. 8J), often firmly attached to a scleractinian coral, often *Solenosmilia variabilis*. Axis straw coloured. Holotype (Fig. 8B) 30 cm tall and 5.2 mm in calcified basal diameter, consisting of 11 branches, only four of which are developed and bear polyps. Polyps usually arranged in whorls of nine, consisting of two sets of four polyps, each set flanking one side of a commensal worm tube and having closely adjacent, fused basal scales. An additional smaller isolated polyp often present on branch opposite worm tube (Fig. 12A). Whorls well spaced (only three whorls per cm) allowing view of underlying coenenchymal scales. Whorl diameter up to 13 mm; horizontal length of polyps up to 2.7 mm and height up to 4.8 mm.

Basal scales tall (up to 3.8 mm) and slender (rectangular, much longer than wide), standing perpendicular to the branch, a pair together forming a slender tubular foundation for upper polyp (Figs 12B, 13D). Distal edges of basal scales lobate and flared outward; dorsolateral edges rounded; adaxially they are open (Fig. 12C), their adaxial edges being separated by a pair of elongate adaxial body-wall scales. Basal scales that form worm tube significantly larger, up to 7.5 mm in length and curving 180° to overlap with the basal of the adjacent polyp, forming a circular tube about 3.0 mm in diameter for the commensal polynoid polychaete (Figs 12A, B, 13D, right). Medial scales (Figs 12D, 13C) also rectangular, up to 1.4 mm in length and about 0.9 mm in width, corresponding in position to the abaxial opercular scales; medial scales diverge from basal scales at a 45–90° angle. Abaxial buccal scales (Fig. 13B) squarish in shape, up to 1.6 mm in length, their distal edges forming a cowl around abaxial, outer- and inner lateral operculars; buccals also diverge from the medials at 45–90°, thus resulting in polyps facing either downward or toward branch surface, but because of the tall basal scales, the operculum does not touch branch surface. Ratio of major body-wall scales: 1:0.25:0.43 (Fig. 12D). Outer faces of all body-wall scales finely

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Table 1. Diagnostic characters of the eight species of New Zealand *Narella.*

	N. mesolepis	*N. hypsocalyx*	*N. vulgaris*	*N. mosaica*	*N. dampieri*	*N. clavata*	*N. parva*	*N. studeri*
Colony shape and branching mode	unbranched	bushy, branching from basal bolus	uniplanar, equal dichotomous	uniplanar, equal dichotomous	uniplanar, equal dichotomous	uniplanar, sparse equal dichotomous	uniplanar, equal dichotomous	uniplanar, equal dichotomous
Polychaete commensal	no	yes	yes	yes	yes	yes (and no)	no	no
Whorls: polyps/whorl; whorls/cm; whorl diam.	6–11; 3; 3.5–6.0 mm	9; 3; 13 mm	4–6; 4–4.5; 4.0–4.5 mm	3–5; 3; 5–6 mm	5–8; 3–4; 6.5–7.5 mm	4–14; 3.5–4; 7–8 mm	4–6; 4–5; 2.5–3.2 mm	4–6; 3; 4–5 mm
Maximum polyp length (mm)	2.7–3.1	2.7	2.0–2.4	2.7–3.1	1.4–1.9	2–3	2.0–2.4	3.0–3.3
Ratio of abaxial body-wall scales	1:1:1.05	1:0.25:0.43	1:0.65:0.75	1:0.52:0.65	1:0.43:0.52	1:0.43:0.54	1:0.57:0.80	1:0.45:0.75
Basal scales: adaxial closure; dorsolateral edge; max height; outer texture	open; rounded; 1.9 mm; smooth	open; rounded; 3.8 mm; granular	open; rounded; 1.4 mm; granular	closed; rounded; 2.2 mm; granular	closed; rounded; 2.5 mm; granular	closed; rounded or obliquely ridged; 2.8 mm; granular	closed; crested; 1.3 mm; granular	open; rounded; 2.3 mm; smooth
Adaxial scales	1–2 pair, squarish	elongate rectangular pair of scales	1–2 pair, squarish, ridged	2–3 pair, scattered	1 pair and scattered, small, discoidal	squarish or vermiform in shape	pairs of squarish scales	1 pair of small elliptical scales
Inner opercular face	several ridges (not keeled)	smooth, undulates	sharp keel	keeled	keeled	keeled	sharp keel	undulate
Coenenchymal scales	imbricate, amoeboid (L:W = 1.2–3.1), thin, granular	imbricate, irregular (L:W = 1.7–2.7), thin, granular	imbricate, elongate (L:W = 1.3–3.7), thin, granular	mosaic, thick, polygonal (L:W = 1.7–3.6), granular	mosaic, moderately thick, elliptical (L:W = 1.5–2.3), granular	mosaic, thick, polygonal (L:W = 1–2), granular and/or ridged	imbricate, thin, elongate (L:W = 5–7 , ridged	imbricate, thin, elongate (L:W = 3–5, granular
Unique characteristics	unpaired medial infra-basal scale; medial scales in closed position	basals so tall polyp tips held above branch surface	ridged adaxial scales			inner distal edge of basal scales sometimes ridged; colony brittle	lateral face of basal scale quite wide	glossy outer surface of body-wall scales
Distribution	Western Norfolk and Three Kings Ridges, 157–1246 m	Widespread in New Zealand region, 510–1118 m	Northern New Zealand Region, 335–1165 m	Bay of Plenty, 278–294 m	Dampier Ridge, off Lord Howe Islands, 342 m	Indonesia, Philippines, Kermadecs, 128–335 m	Kermadec Ridge and Indonesia, 920–2400 m	Kermadecs, Colville Ridge, Makassar Strait, and Celebes Sea, 732–1392 m

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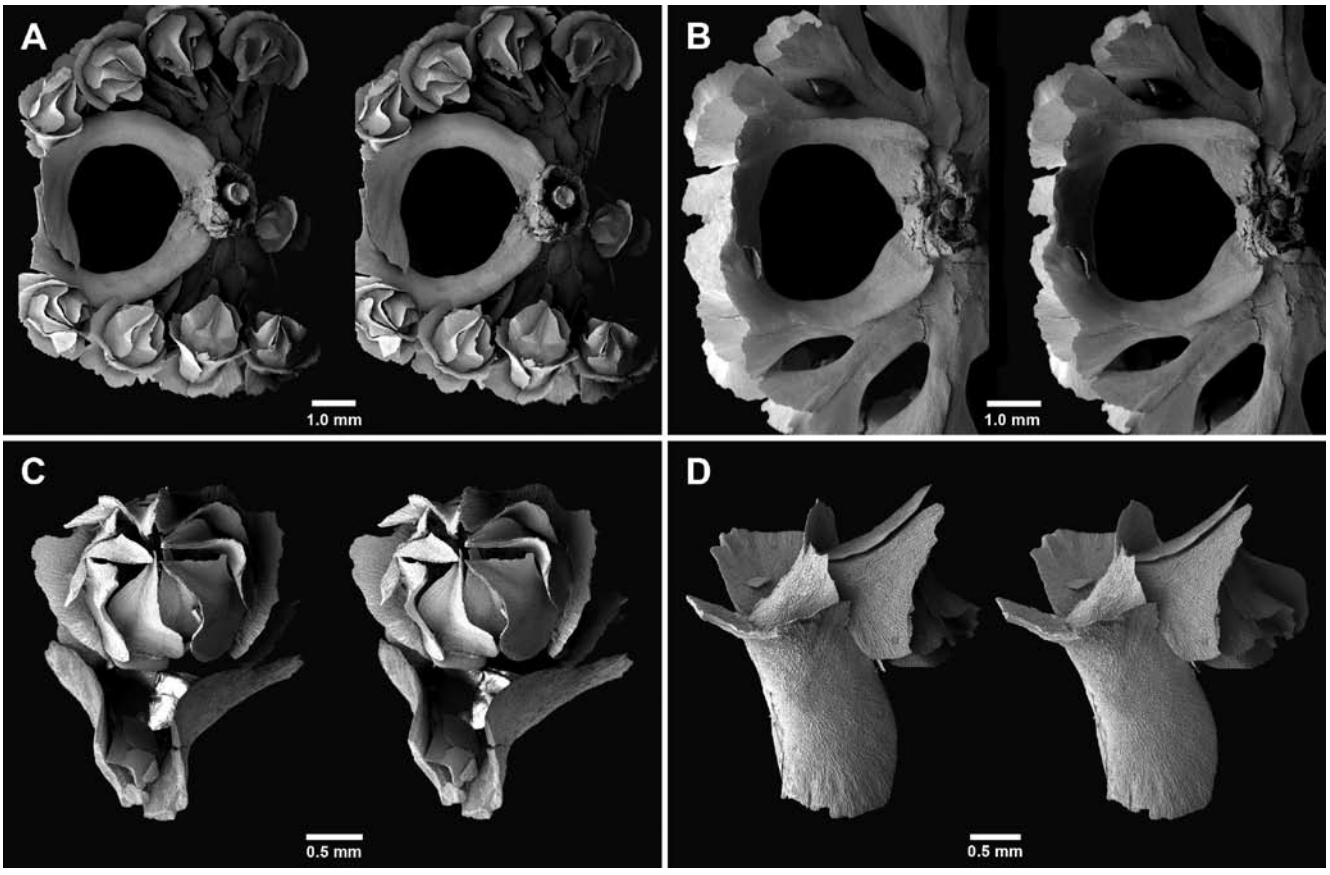

Figure 12. Holotype of *Narella hypsocalyx*: A, apical view of nine polyps, showing worm tube in centre; B, abaxial view of part of a polyp whorl showing how two greatly enlarged basal scales from adjacent polyps form the worm tube; C, adaxial-apical view of polyps showing several elliptical adaxial body-wall scales; D, lateral view of a polyp. All views are in stereo.

granular. Adaxial side of polyp covered with a pair of square (about 0.6 mm in width) adaxial marginals, followed by two or three pairs of elliptical, slightly concave adaxial body-wall scales (0.38–0.66 mm in greater diameter) (Fig. 13F, right); proximal to this is a pair of elongate, rectangular, flat scales up to 1.6 mm in length and 0.3 mm in width, which cover most of the adaxial side of the polyps (Fig. 13F, left).

Operculum easily seen in lateral view, opercular scales ranging from 0.65 to 1.6 mm in length, progressively decreasing in length from ab– to adaxial side (Figs 12C, 13A). Abaxial operculars up to 1.6 mm in length and symmetrical (L:W = 1.2–1.4); lateral operculars asymmetrical, 1.2–1.5 mm in length, and having a lobe on their adaxial side (L:W = 1.2–1.7); adaxial operculars symmetrical and slender, 0.65–1.25 mm in length, and having an L:W = 2.3–2.7. Outer opercular faces highly creased longitudinally, corresponding to a broad but not keeled undulation on inner surface. Curved tentacular platelets (Fig. 13G) elongate and flat, 70–102 μm in length, about 28 μm in width, and about 6 μm thick.

Coenenchymal scales elongate to squarish (Fig. 13E), often with an irregular margin (L:W = 1.7–2.7), up to 1.2 mm in length, and thin (about 0.15–0.2 mm), arranged in an imbricate fashion; outer faces finely granular, like all other sclerites.

TYPES: Holotype: Trip 1152/06, one colony, NIWA 11235, and SEM stubs 1591–1597, 1627–1628 (USNM 1180226). Paratypes: Stn S573, one dry branch, NIWA 76205; Stn T235, one branch, NIWA 11107; Stn X494, one branch, NIWA 11223; Stn X495, one branch, NIWA 11222; KAH 0006/45, one dry branch, NIWA 11193; KAH 0204/29, two colonies, NIWA 11081, 11199; KAH 0204/32, branches, NIWA 11080, 11196, and two branches, USNM 1180223; KAH 0204/40, five colonies, NIWA 11075, 11218, 11190, 11192, 9666; KAH 0204/44, one branch, NIWA 11083; KAH 204/47, one colony, NIWA 11082; TAN 0104/153, one colony, NIWA 9697; TAN 0104/336, one branch, NIWA 11188; TAN 0104/391, one colony, NIWA 9699; TAN 0408/23, one dry colony, NIWA 25510; TAN 0413/21, six colonies, NIWA 15489, 15636; TAN 0413/39, one colony, NIWA 15665; TAN 0604/111, two colonies, NIWA 25327, 25328; TAN 0905/70, one branch, NIWA 53456; TAN 0905/121, three colonies, NIWA 54329, 54354; TAN 9912/DR3, one branch, NIWA 27980; Trip 2889/48, three branches, NIWA 66303.

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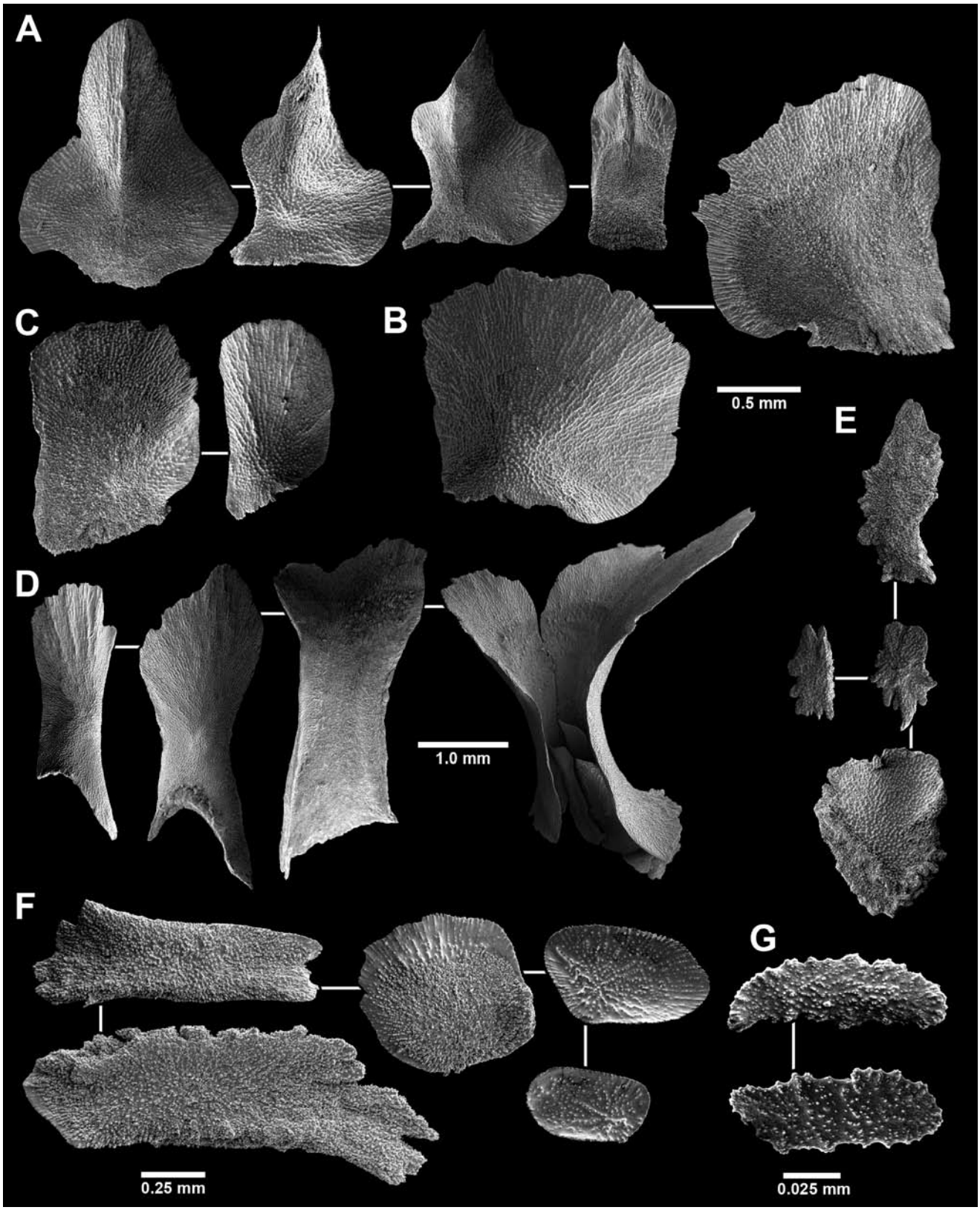

Figure 13. Sclerites from holotype of *Narella hypsocalyx*: A, four opercular scales; B, two buccal scales; C, two medial scales; D, basal scales, pair at right contributing to worm tube; E, four coenenchymal scales; F, adaxial scales; G, two tentacular platelets. (Figs 13A, B, C, and E share a common scale bar of 0.5 mm.)

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TYPE LOCALITY: 37.4833°S, 167.7171°E (Challenger Plateau, west of North Island), 883 m.

COMPARISONS: The branching of *N. hypsocalyx* resembles that of *N. versluysi* (Hickson, 1909) and *Paranarella watlingi* Cairns, 2007(both known only from the Northwest Atlantic) in that both species have a highly calcified, basal, bolus-like region from which numerous elongate branches emerge, but beyond that similarity the species are quite different. *Narella hypsocalyx* has extraordinarily tall basal scales, which elevate the polyp well above the branch surface (Fig. 12B), resulting in a very high whorl diameter (see Table 1). Another consequence of a tall polyp is a long, vulnerable adaxial region, which this species has uniquely solved by having a pair of quite elongate (up to 1.6 mm long), brittle, rectangular adaxial scales that cover most of this region (Fig. 13F, left). And although unusual, but not unique, the opercular of this species are not keeled.

ETYMOLOGY: Named *hypsocalyx* (Greek *hypsos* = high + *kalyx* = polyp or calyx), an allusion to the elevated polyps.

Narella vulgaris n. sp. Figs 2, 8A, 14, 15

MATERIAL EXAMINED: Types.
Non–types: TAN 0205/73, branches, NIWA 14767; T226, 3 colonies, NIWA 11108.

DISTRIBUTION: off Kermadec Islands, Three Kings Ridge, off North Cape (including Cavalli Seamount), Bay of Plenty, Challenger Plateau (Fig. 2), 335–1165 m.

DESCRIPTION: Colonies uniplanar, up to 24 cm in height and 3.6 mm in basal stem diameter (holotype, Fig. 8A); branching equal and dichotomous, branching occurring every 11–23 mm, but some terminal branches quite long (up to 19 cm). Base of colony heavily calcified, often attached to a dead scleractinian coral; axis straw coloured. Polyps arranged in whorls of 4–6, sometimes more on larger-diameter branches, a worm tube occupying about one-third of the side of each branch (Fig. 14A); polyps not crowded or contiguous within a whorl. Whorls fairly closely spaced (4–4.5 per cm), but still allowing some view of intervening coenenchymal scales below. Whorl diameter 4.0–4.5 mm; horizontal length of polyps 2.0–2.4 mm.

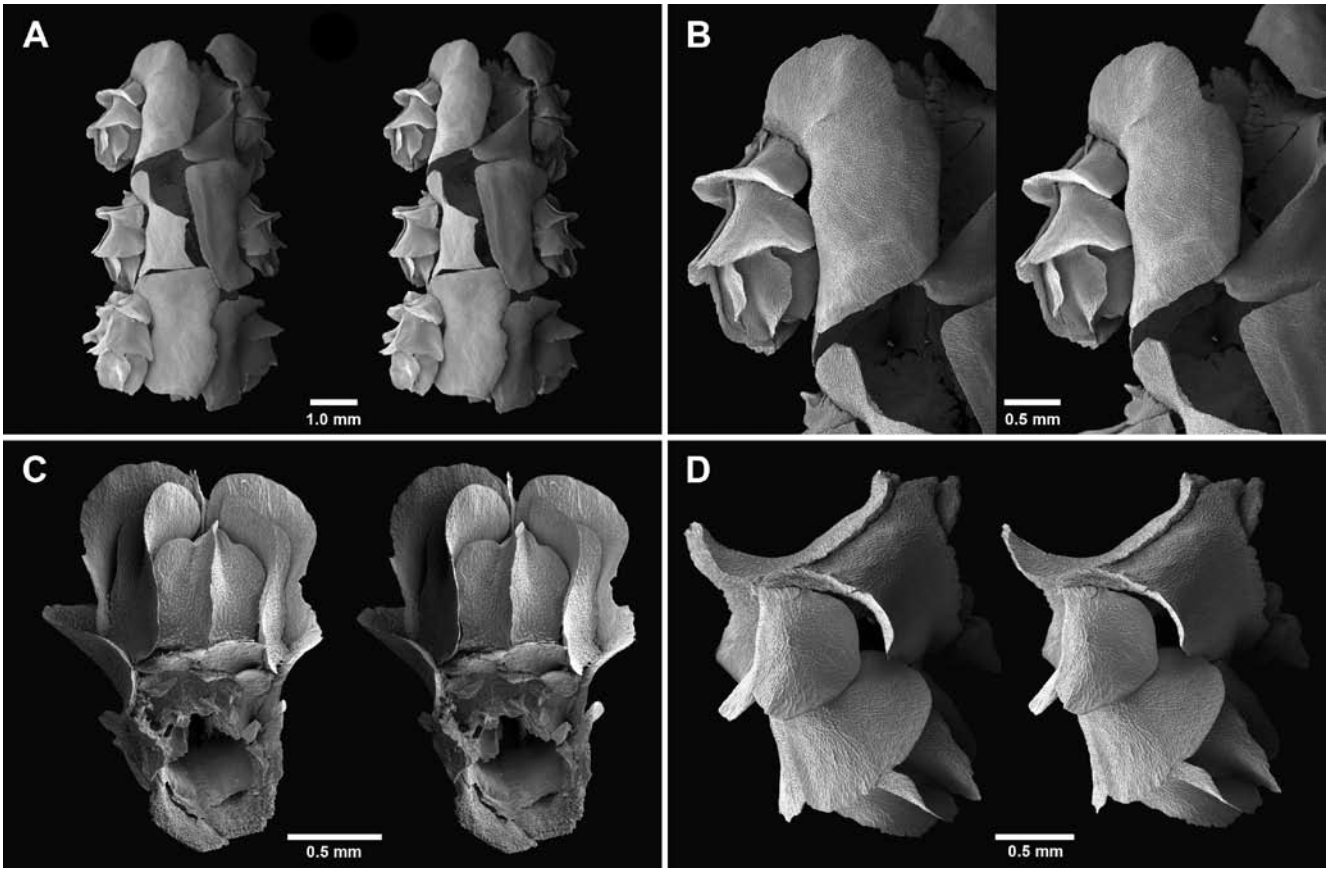

Figure 14. Holotype of *Narella vulgaris*: A, section of branch consisting of three whorls and their modified basal scales forming the worm tube; B, lateral view of a polyp showing a modified basal scale forming the worm tube; C, adaxial view of a polyp showing the paired and unpaired carinate adaxial body-wall scales; D, lateral view of a polyp. All views are in stereo.

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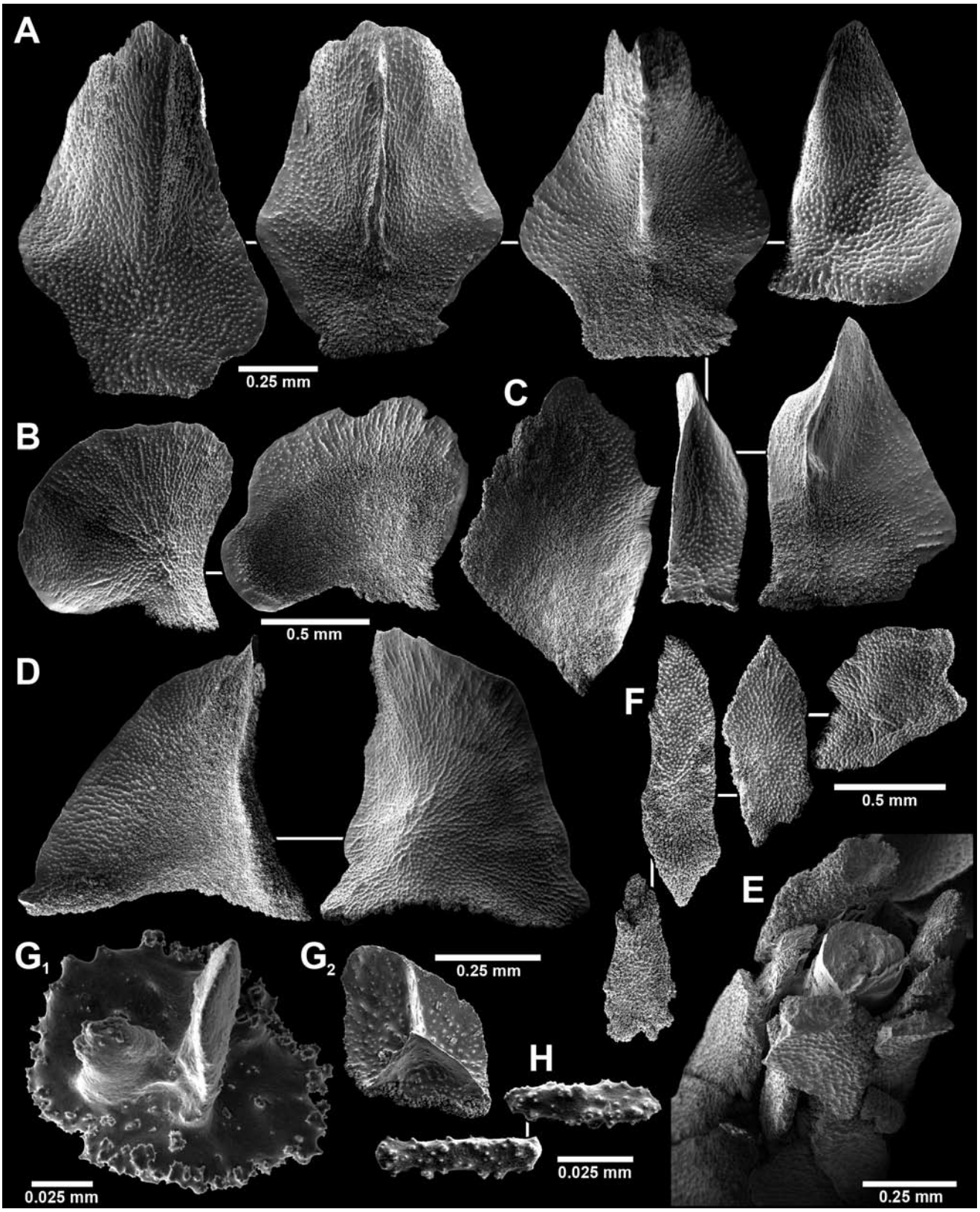

Figure 15. Sclerites from holotype of *Narella vulgaris*: A, six opercular scales; B, two buccal scales; C, a medial scale; D, two basal scales; E, coenenchymal scales *in situ*; F, four coenenchymal scales; G, two crested adaxial buccal scales; H, two tentacular rodlets. (Figs B, C, and D share a common scale bar of 0.5 mm.)

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Typical basal scales up to 1.4 mm in height, standing perpendicular to branch, and with a lobate, flared distal edge and curved dorsolateral edge (Figs 14D, 15D); adaxially they are in the open position, but fairly close (Fig. 14C). modified basal body-wall scales that contribute to polychaete worm tube significantly larger (up to 3.0 mm tall and 2.9 mm wide – wider than the polyp, Figs 14A, B) and strongly curved forming a tube round to elliptical in cross-section of 1.1–1.8 mm diameter. medial scales (Figs 14D, 15C) rectangular in shape, slender, 0.7–1.0 mm in length, and also flared distally, diverging from basal scale at about a 45° angle. Abaxial buccal scales 0.8–1.0 mm in length, wider than medial scales, flared distally producing a short cowl around operculum (Figs 14D, 15B), and diverge about 45° from medial scales, resulting in the operculum being directed downward along branch surface. Outer surfaces of all body-wall scales finely granular, with no ridging or other ornamentation; dorsolateral edges of all scales rounded. Ratio of major body-wall scales: 1:0.65:0.75 (Fig. 14D). Adaxial side of polyp bordered by a pair of square marginals about 0.35 mm on side (Fig. 14C), proximal to which are a scattering of small (0.05–0.12 mm diameter) circular to elliptical scales that partially cover the otherwise bare adaxial polyp side, the small scales usually highly ridged (Fig. 15G).

Operculum easily seen in lateral view (Fig. 14D), opercular scales ranging from 0.65–1.2 mm in length, progressively decreasing in length from ab– to adaxial side (Fig. 15A). Abaxial operculars about 1.05–1.1 mm long, and symmetrical (L:W = 1.4–1.8); lateral operculars 0.9–1.2 mm in length, asymmetrical, often longer than abaxial operculars (L:W = 1.4–1.9); adaxial operculars 0.65–0.75 mm in length, symmetrical, and with an L:W of 2–3. Outer opercular surfaces highly creased longitudinally, corresponding to a sharp keel on inner side. Tentacular rodlets quite small (only 53–55 µm in length), straight, and cylindrical (Fig. 15H).

Coenenchymal scales elongate and irregular in outline (L:W = 1.7–3.7), up to 1.4 mm in length, and about 0.15 mm thick, arranged in an imbricate pattern; outer surface flat, and finely granular (Figs 15E, F).

Types: Holotype: KAH 0204/29, a colony now in three pieces, NIWA 11060, one branch and SEM stubs 1598–1602, 1629 (USNM 1179805). Paratypes: KAH 0204/30, one branch, NIWA 11070; KAH 0204/32, several colonies, NIWA 11061, 11203; KAH 0204/38, one colony and branches, NIWA 11106, 11185, 11197; KAH 0204/40, eight colonies and branches, NIWA 11062, 11063, 11195, 11226; KAH 0204/44, one branch, NIWA 11072; KAH 0204/47, one colony, NIWA 11064, and one colony, USNM 1179806; K806, one branch, NIWA 11314; S568, one branch, NIWA 11208; TAN 0205/47, one dry branch, NIWA; TAN 0413/129, branches, NIWA 16029; TRIP 2419/23, branches, NIWA 44153; TRIP 3178/12, two branches, NIWA 65897; X152, one colony, NIWA 11100.

Type Locality: 34.1632°S, 173.9625°E (Bay of Plenty, North Island, New Zealand), 782–790 m.

Comparisons: Half of the eight species of New Zealand *Narella* have equal, dichotomous branching as well as having a polychaete commensal (see Table 1 (p. 18) and Key to species), including *N. vulgaris*, but *N. vulgaris* differs from the other three in having thin, imbricate coenenchymal scales, and in having basal scales that are open adaxially. *Narella vulgaris* also differs from all New Zealand species by having prominently ridged adaxial body-wall scales (Fig. 15G).

Etymology: Derived from the Latin *vulgaris* (meaning commonplace), at least in the New Zealand region, as well as for its generic character states, having no exceptional characters.

Remarks: Numerous symbiotic polynoid polychaetes may infest a single colony.

Two lots, those listed as non-types, differ from the others in having a small delicate colony, and slightly larger polyps (up to 3 mm) and thus fewer polyps per cm (about 3), but otherwise resemble this species in morphology, distribution, and depth range.

Narella mosaica n. sp. Figs 2, 8F, 16, 17

Material Examined: Types.

Distribution: Bay of Plenty, New Zealand (Fig. 2), 278–294 m.

Description: Colonies uniplanar, largest colony (the holotype, Fig. 8F) 15 cm tall and 12 cm broad, with a basal branch diameter of 2.1 mm, although it is missing its holdfast. Axis gold in colour, branches of larger diameter having numerous (about 9/mm) closely spaced, transverse ridges that encircle the branch; however, this transverse banding is probably due to differential shading of the branch due to pigment beneath surface of axis, and thus not visible to the SEM. Branching equal and dichotomous, but sparse, the holotype having only 10 terminal branches. Polyps arranged in whorls of 3–5 (Fig. 16A), the polyps within a whorl and the distance between whorls fairly well spaced (3 whorls/cm), such that coenenchymal scales are visible between whorls, and there is ample space for one if not two worm tubes (diameter 1.4–1.7 mm) on any branch segment. Whorl diameter 5–6 mm; horizontal length of polyps 2.7–3.1 mm.

Basal body-wall scales quite robust, up to 2.2 mm in height, standing perpendicular to branch; basal

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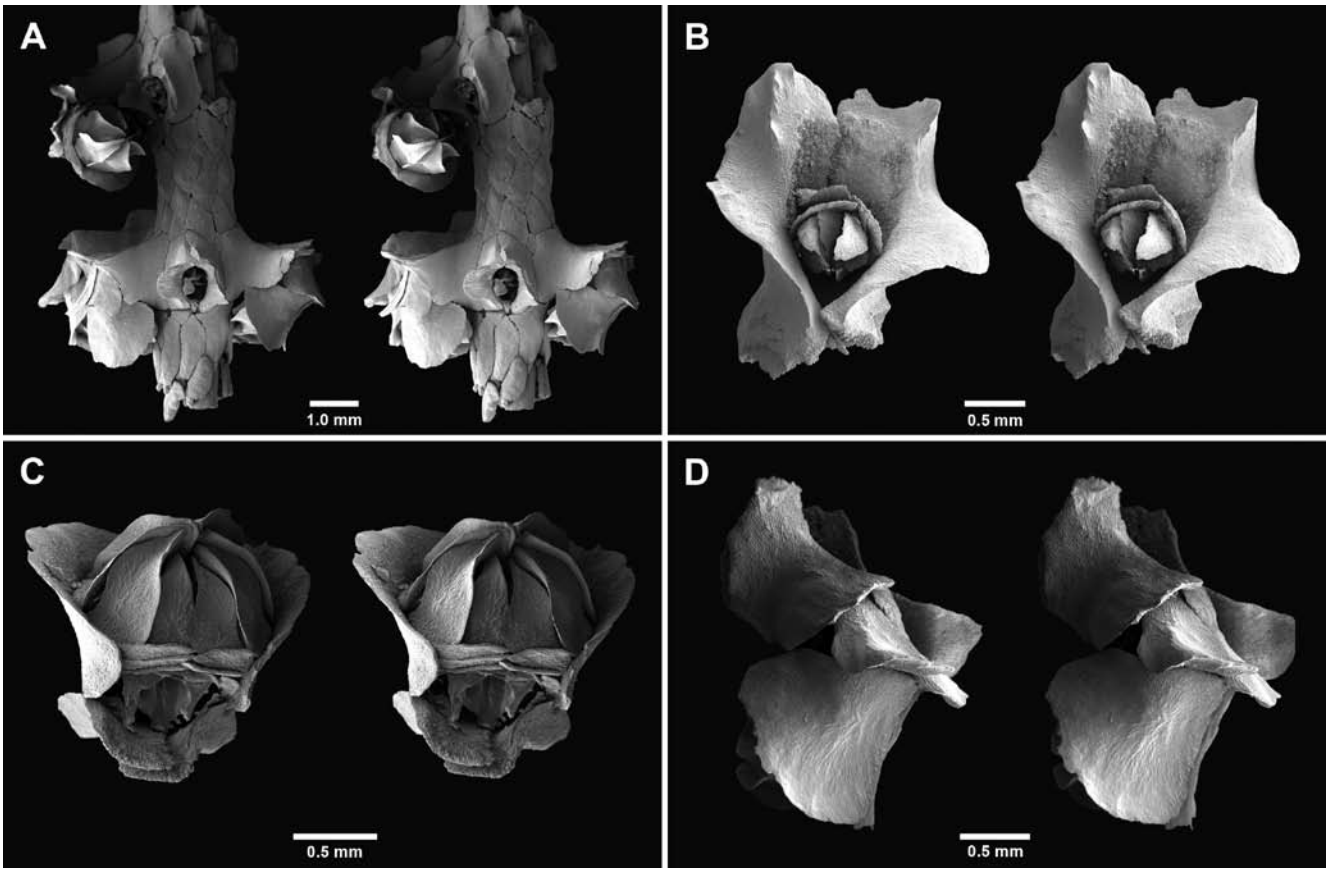

Figure 16. Holotype of *Narella mosaica*: A, branch fragment consisting of two damaged whorls of polyps; B, adaxial view of a stunted polyp with normal-sized basal scales but with all other scales reduced in size; C, adaxial view of a polyp showing paired adaxial body-wall scales; D, oblique lateral view of a polyp. All views are in stereo.

scales have a curved dorsolateral edge, narrow lobate distal margin, and a thick base (Figs 16B, 17 D,E); adaxially these scales are closed (Fig. 16B). Despite height of basal scales, the tips of the downward directed polyps do reach branch surface. Edges of basal scales may become greatly modified and enlarged to produce the worm tube. Medial body-wall scales up to 1.2 mm in length but quite narrow (Figs 16D, 17C), occupying only the abaxial surface. Abaxial buccal scales (Figs 16D, 17 B) longer (up to 1.5 mm) and wider than medials, also with gently curved dorsolateral edges; distal edge of buccals thin and straight, projecting as a thin cowl about 0.45 mm beyond operculum base. All body-wall scales covered with a fine granulation, and lack ridges. Ratio of major body-wall scales: 1:0.52:0.65. Two to three pairs of thin, square to rectangular (0.6 mm in greatest width) adaxial buccal scales border adaxial operculars (Fig. 16C), below which are a scattering of round to elliptical platelets (0.10–0.32 mm in diameter) (Fig. 17H).

Operculum not easily seen in lateral view, opercular scales ranging from 0.62–1.15 mm in length (Fig. 17A). Abaxial operculars 1.12–1.24 mm in length, symmetrical but lacking lateral wings, and having an L:W of 1.05–1.26. Lateral operculars 0.9–1.17 mm in length, asymmetrical, with an L:W of 1.5–2.1. Adaxial operculars only 0.62–0.78 mm in length, with an L:W of 1.8–2.1. Outer opercular faces creased, inner faces prominently keeled. Tentacular platelets flattened and curved, about 73–82 µm in length (Fig. 17I).

Coenenchymal scales massive, polygonal in shape (L:W = 1.7–3.6), and up to 2.4 mm in length, although small round forms (0.3 mm in diameter) also occur to fill spaces between larger scales; scales arranged in a single-layered mosaic pattern. Scales extremely thick, up to 0.75 mm, having tubercles not only on inner edges but also on lateral edges (Fig. 17G, right). Outer surface smooth to very finely granular, lacking ridges. Due to thickness of coenenchymal scales there is little flexibility to branches, and basal scales are well anchored, making it difficult to cut through a branch or remove a polyp from the coenenchyme, and even time-consuming to disarticulate a polyp in bleach.

Types: Holotype: TAN 0413/170, NIWA 15484, and one branch and SEM stubs 1636–1640, and 1653–1655 (USNM 1179801). Paratypes: TAN0 413/170, two colonies and 12 branch fragments, NIWA 76208; TAN 0413/160, one colony and eight branch fragments, NIWA 15626.

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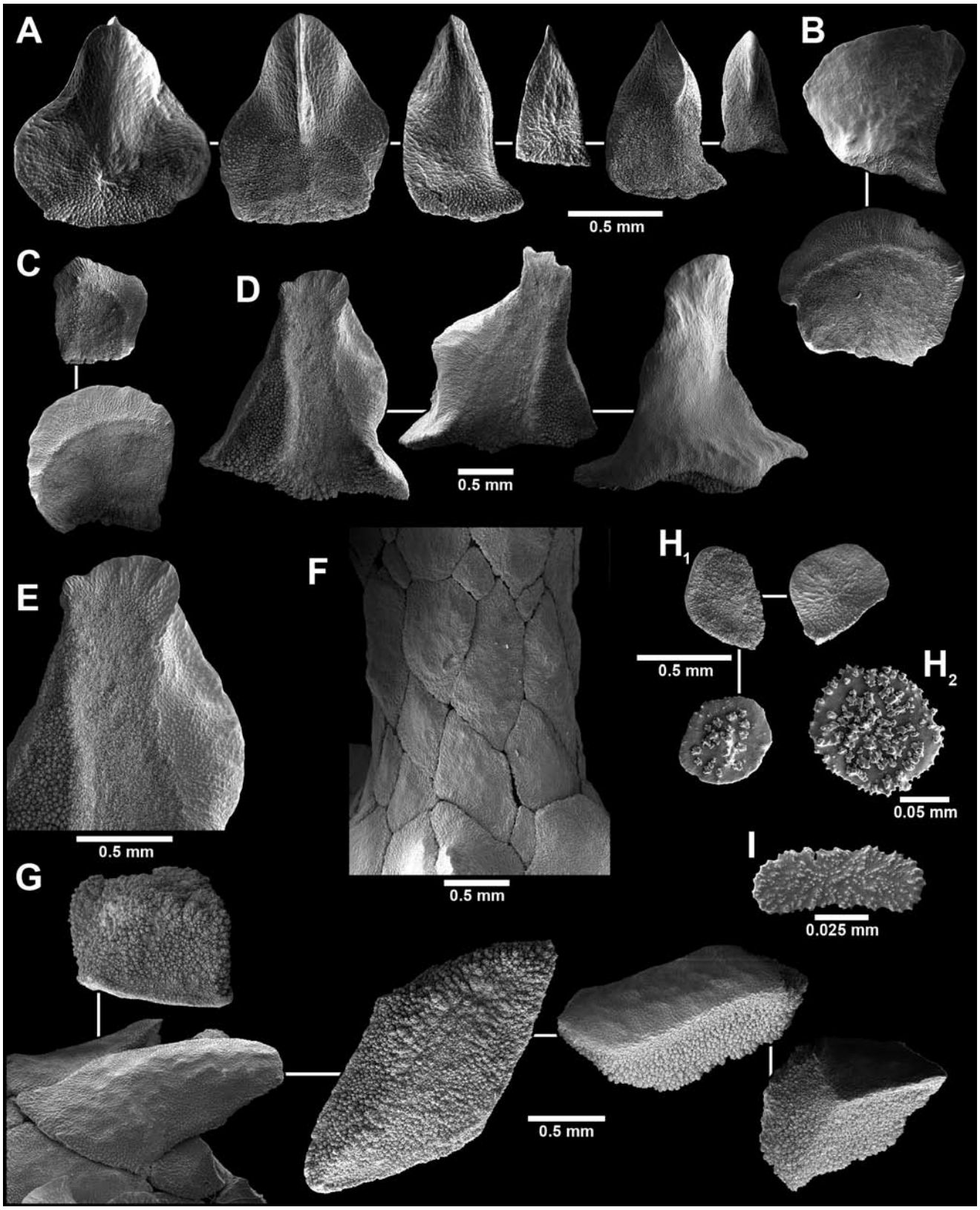

Figure 17. Sclerites from holotype of *Narella mosaica*: A, six opercular scales; B, two buccal scales; C, two medial scales; D, three basal scales; E, apical lobe of a basal scale; F, coenenchymal scales *in situ*; G, several massive coenenchymal scales; H, four adaxial body-wall scales; I, a tentacular platelet. (Figs B, C, and D share a common scale bar of 0.5 mm.)

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TYPE LOCALITY: 37°27.69′S, 176°54.80′E (Umokemoke Knoll, Bay of Plenty, North Island, New Zealand), 247–294 m.

COMPARISONS: Among those species from New Zealand, *N. mosaica* is most similar to *N. clavata* but can be distinguished using Table 1 (p. 18), the Key to *Narella* species, and the account of *N. clavata*. *N. mosaica* is also similar to *N. orientalis* (Versluys, 1906) but differs in having thicker, mosaic–style coenenchymal scales, fewer polyps per whorl, and a very short operculum.

ETYMOLOGY: From *mosaicus* (Latin, meaning mosaic–like), an allusion to the coenenchymal scale arrangement.

Narella dampieri n. sp. Figs 8E, 18, 19

MATERIAL EXAMINED: Types.

DISTRIBUTION: Known only from type locality.

DESCRIPTION: Colonies uniplanar and relatively small, one of the largest colonies (the holotype, Fig. 8E) measuring only 13 cm tall, 10 cm wide, and having a basal stem diameter of 2.4 mm, but reinforced by a thicker, white, calcareous base up to 6 mm in diameter and equally elongate. Axis straw yellow in colour. Branching equal and dichotomous, but sparse, the holotype having only 12 terminal branches; branching begins low in colony, only about 13 mm above attachment. Polyps arranged in whorls of 5–8, but five and seven are the most common numbers, seven achieved by having two polyps flanking the worm tube, one directly opposite the tube, and two pairs on either side between this trio. Whorls of five polyps have only one pair of polyps between the worm-flanking polyps and the opposite one. Polychaete worm tube elliptical in cross-section, the greater axis up to 2.4 mm. Polyps within whorls and whorls themselves fairly well spaced (3–4 whorls/cm) such that coenenchymal sclerites can be seen between whorls. Whorls diameter 6.5–7.5 mm due to the tall basal scales; horizontal length of polyps relatively short (1.4–1.9 mm) due to downward projecting aspect of the basal scales and operculum (Figs 18C, D).

Basal body-wall scales quite tall (up to 2.5 mm) and slender (0.7 mm), stand perpendicular to the branch, and resemble in shape and curvature a shoehorn (Figs 18C, D, 19C); basal scales have a curved dorsolateral

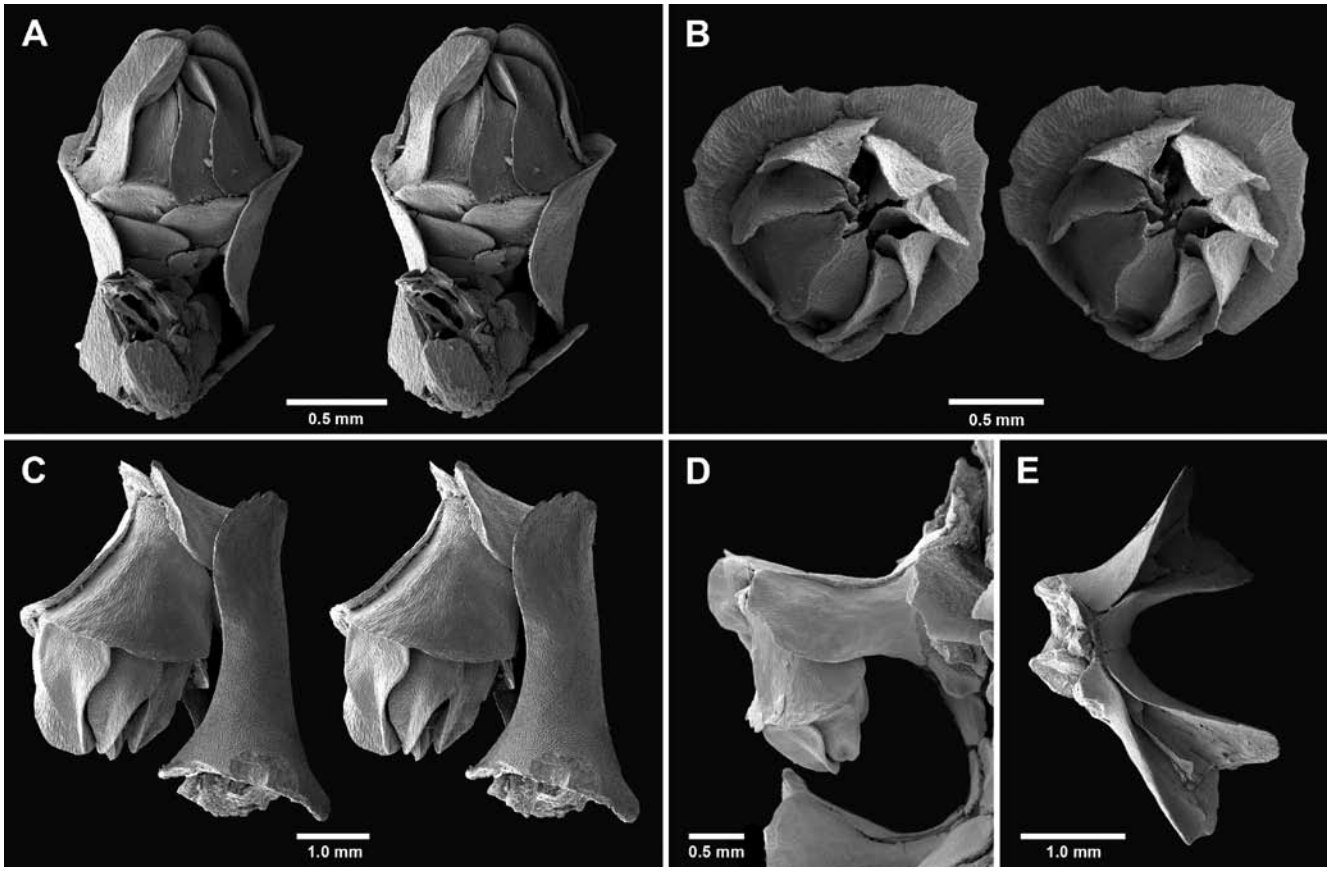

Figure 18. Holotype of *Narella dampieri*: A, adaxial view of a polyp showing paired adaxial body-wall scales; B, apical view of a polyp; C, lateral view of a polyp showing its tall basal scales; D, lateral view of a polyp showing height of polyp tip above coenenchymal scales; E, two pairs of basal scales showing the closed position. Figs A–C are stereo views.

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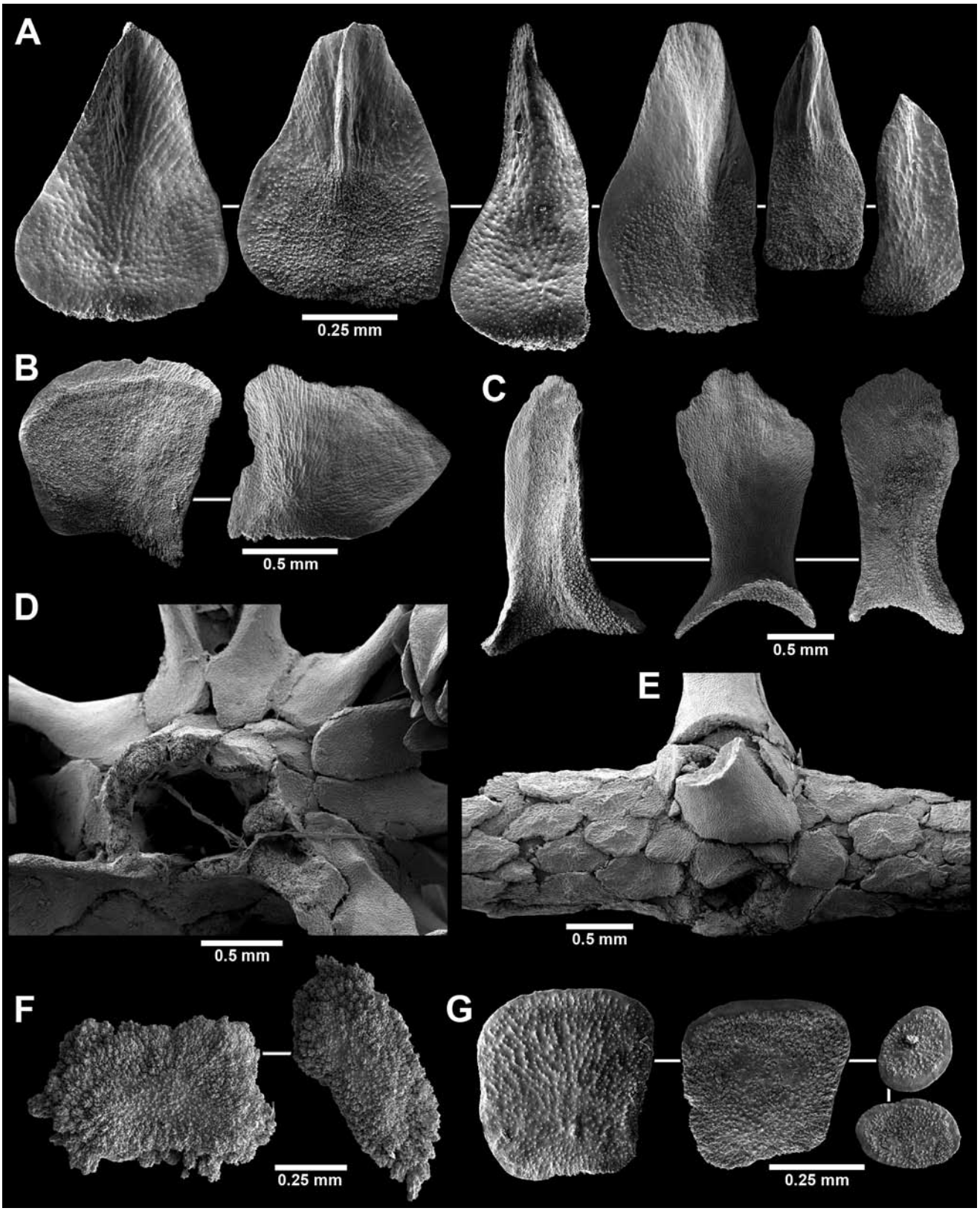

Figure 19. Sclerites from holotype of *Narella dampieri*: A, six opercular scales; B, two buccal scales; C, three basal scales; D, thick coenenchymal scales surrounding branch axis and closed basal regions of paired basal scales; E, coenenchymal scales *in situ*; F, inner surface of two coenenchymal scales; G, four adaxial body-wall scales.

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edge, a lobate distal margin, and a C–shaped base; adaxially they are closed (Figs 18E,19D). Basal scales so tall that the tips of the down–hanging polyps do not reach the branch surface (Fig. 18D). medial body-wall scales (Fig. 18C) much shorter (up to 1.0 mm) and less wide, usually oriented parallel to the branch surface. Abaxial buccal scales (Figs.18B, C, 19B) larger (up to 1.3 mm) and wider than medials, with gently curved dorsolateral edges; buccals and enclosed opercular crown oriented directly downward toward branch surface. All body-wall scales covered with low granules, never with ridges. Ratio of major body-wall scales approximately: 1:0.43:0.52 (Fig. 18C). A pair of square (0.43–0.48 mm wide), thin, slightly curved adaxial buccal scales borders the adaxial operculars (Figs 18A, 19G, left) and smaller (0.14–0.30 mm in greater diameter), flat, elliptical scales cover remainder of adaxial side of polyp (Fig. 19G, right).

Operculum easily seen in lateral view, opercular scales ranging from 0.58–0.86 mm in length (Fig. 19A). Abaxial operculars 0.73–0.78 mm in length, symmetrical but lacking lateral wings, and with an L:W of 1.3–1.5. Lateral operculars 0.70–0.86 mm in length, asymmetrical in shape, having an L:W of 1.7–2.3. Adaxial operculars 0.58–0.76 mm in length, symmetrical, with an L:W of 1.9–2.5. Outer opercular surface creased, inner surface prominently keeled. Tentacular platelets 50–55 μm in length, slightly flattened or cylindrical in shape.

Coenenchymal scales elliptical to rectangular in shape (L:W = 1.5–2.3), up to 1 mm in length, and moderately thick (0.20–0.25 mm), arranged in a mosaic pattern (Figs 19D–F). Outer face granular (never ridged), often with a low boss in centre of scale.

Types: Holotype: U–210, NIWA 11098. Paratypes: same station, 13 additional colonies and 60 branch fragments, NIWA 76203, one branch, numerous individual polyps, and SEM stubs 1630–1635 (USNM 1179534).

Type Locality: 33.465°S, 155.945°E (Dampier Ridge), 342 m.

Comparisons: Among the New Zealand *Narella* species, *N. dampieri* is most similar to *N. mosaica* and *N. clavata*, those species having closed basal scales (Fig. 19D)(See Table 1 (p. 18) and Key to *Narella* species). *N. dampieri* is distinguished by having such tall basal scales that the polyp's tips do not reach the branch surface (Fig. 18D), and by having polyps that are quite short in horizontal length.

Etymology: Named for the renowned navigator–naturalist–privateer of the late 17th and early 18th centuries, William Dampier (see Williams 2008); also the type locality of the species: Dampier Ridge.

Narella clavata (Versluys, 1906)

Figs 5, 8D, 20, 21

Stachyodes clavata Versluys, 1906: 98–101, pl. 10, fig. 26, text–figs. 123–128.—?Thomson & Russell 1910: 143.—Kükenthal 1919: 464; 1924: 314, fig. 172.—van Soest 1979: 103 (type deposition).

Not *Narella clavata*: Tixier–Durivault, 1966: 432, fig. 388.

Narella clavata: Cairns & Bayer, 2007: 86 (listed).—Cairns & Baco 2007: 393 (listed).—Cairns & Bayer 2009: 30 (listed).

Material Examined: K842, one purported colony, now in 34 branch fragments, seven branches showing evidence of branching, NIWA 11101, and SEM stubs 1604–1609, 1647–1648 (USNM 1179320); K868, 12 branch fragments, two showing evidence of branching, NIWA 11333; K872, 12 branch fragments, two showing evidence of branching, NIWA 11315, and one branch, USNM 1179318; TRIP 1099/12, one colony with eight terminal branches, NIWA 11103, and one branch and SEM stubs 1641–1646 (USNM 1179339); TRIP 1099/15, four branches, NIWA 11102; *Albatross* 5543, one colony, USNM 44167; a syntype (see Types); specimen reported by Tixier–Durivault (1966) from Madagascar, MNHNP.

Distribution: off Kei Island, Banda Sea; Bohol Sea, Philippines; ?Providence, Indian Ocean (Thomson & Russell 1910); ?Japan (Kinoshita 1908); ? S. Africa (Thomson 1911)(see Comparisons); southern Kermadec Ridge, including off Macauley Island and Esperance Rock (Fig. 5),128–335 m.

Description: Colonies uniplanar, branched equally and dichotomously but sparsely, often collected as individual branches from a broken colony and thus appearing to be unbranched (see Remarks and Types). Largest colony (NIWA 11103) 21 cm in height, consisting of 8 terminal branches. Terminal branches often quite long, the longest branch 15 cm long (NIWA 11101), with a subsidiary branch 12 cm in length (Fig. 8D). Branching axils acute, subsequent branches growing parallel to one another in close proximity. Attached base of colony never observed. Axis straw coloured. Polyps arranged in discrete whorls usually of 4–9, up to 14 on larger-diameter branches; polyps within a whorl contiguous (fused) laterally, increasing rigidity of colony. Whorls fairly closely spaced, 3.5–4 whorls per cm. Whorl diameter 7–8 mm; horizontal length of polyps 2.0–3.0 mm.

Basal scales massive (Figs 20A, E, 21E), up to 2.8 mm in height, standing perpendicular to branch and having a lobate distal edge that may extend as much as 1.0 mm beyond its junction with medial scale (Fig. 21A). Base and especially adaxial basal side of basal scales greatly thickened into massive lobes that abut with lobe of opposing basal scale (closed position) forming a cradle

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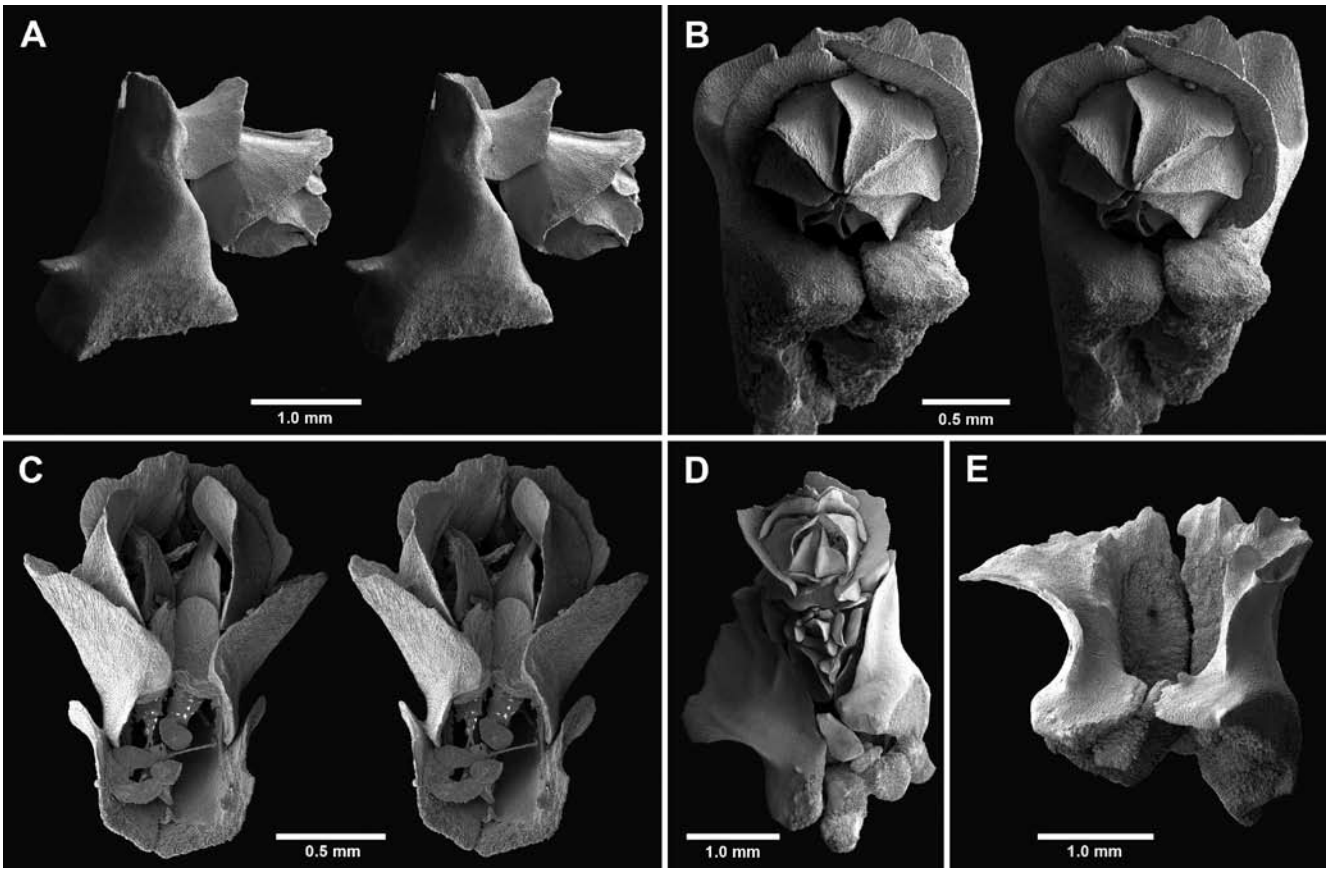

Figure 20. *Narella clavata* (A–C, K842; D–E, TRIP 1099/12): A, lateral view of a polyp showing the massive basal scales; B, adaxial view of polyp showing the massive basal scales in the closed position; C, adaxial view of a polyp showing the adaxial body-wall scales; D, adaxial view of polyp showing adaxial body-wall scales in the form of ridged rods; E, a pair of massive basal scales in closed position showing ridges on inner faces. Figs A–C are stereo views.

for the polyp (Figs 20 B,E). Outer surface of basal scales finely granular; inner surface tuberculate proximally and granular distally but in some polyps prominently ridged (Figs 20E, 21E, lower right). Modified basal scales forming worm tube (Fig. 20E), highly modified and much larger, often bearing an oblique ridge on their dorsal outer surface, although the presence of these ridges is not constant; worm tube 1.0–1.6 mm in diameter. Basal scales so tall that tips of down-hanging polyps usually do not reach branch surface. Medial scales somewhat rectangular, about 1.2 mm in length, and slightly flared; occasionally absent and occasionally having inner ridges (Fig. 21D). Buccal scales (Fig. 21C) up to 1.35 mm in length, broader than medials, and also slightly flared, forming a cowl up to 0.24 mm around operculum. Outer surface of medial and buccal scales minutely granular, the granules formed into low ridges that radiate from centre of scale. Dorsolateral edges of all scales rounded. Ratio of major body-wall scales approximately: 1:0.43:0.54 (Fig. 20A). Adaxial side of polyp bordered by a pair of square adaxial marginal scales (Fig. 21H, upper) 0.45–0.50 mm in width, proximal to which are numerous smaller, thin, often ridged, elliptical scales 0.15–0.40 mm in greater diameter (Fig. 21D, middle). Adaxial faces of one specimen (NIWA 11103) covered with thick, curved, sometimes ridged rods up to 0.9 mm in length (Figs 20D, 21H, lower right).

Operculum easily seen in lateral view, opercular scales ranging from 0.65–1.10 mm in length (Fig. 21B). The single abaxial and single adaxial operculars are symmetrical and aligned on the sagittal plane (Fig. 20B), the other six lateral operculars are asymmetrical and form three pairs across the sagittal plane. Abaxial operculars up to 0.95 mm in length with a low L:W of about 1.2–1.3; lateral operculars range from 0.75–1.10 in length, having an L:W of 1.5–2.3; the adaxial opercular is only about 0.65–0.70 mm in length, having an L:W of about 2–2.5. Outer opercular surface highly creased longitudinally, corresponding to a blunt keel on inner surface. Outer surface covered with small granules aligned in low ridges radiating from scale midline, similar to those of body-wall scales. Tentacular rodlets cylindrical, 55–65 μm in length (Fig. 21I).

Coenenchymal scales massive (Figs 21G ,F), up to 1.9 mm in length and 0.50–0.65 mm thick, arranged in

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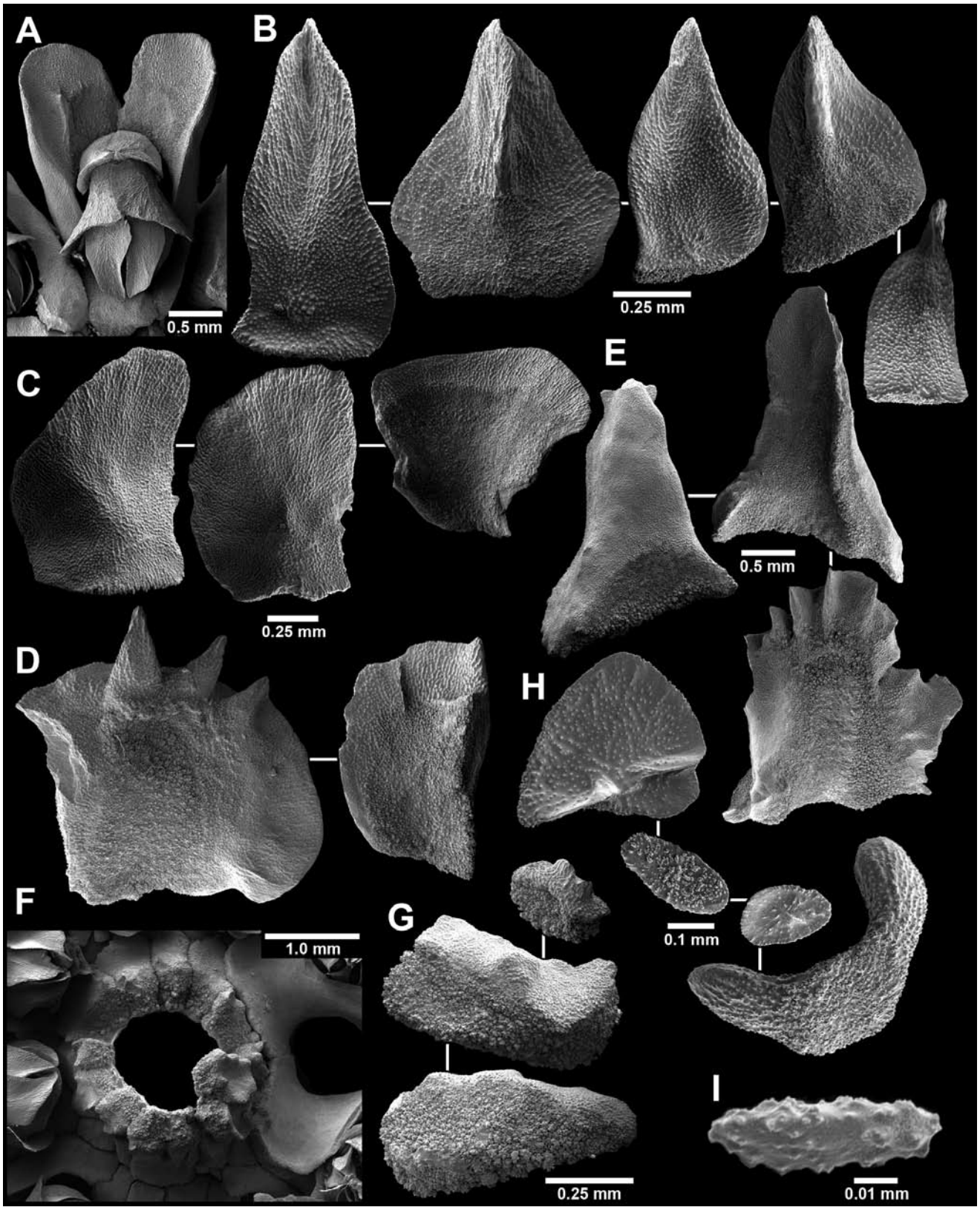

Figure 21. Polyp and sclerites of *Narella clavata* from K842: A, abaxial view of a polyp; B, five opercular scales; C, three buccal scales; D, two medial scales, showing coarse ridging on inner face; E, three basal scales; F, thick coenenchymal scales surrounding branch axis; G, three coenenchymal scales; H, four adaxial body-wall scales; I, tentacular rodlet. (Figs C and D share a common scale bar of 0.25 mm.)

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a one-layered mosaic pattern around axis, abutting as in a Roman arch (Fig. 21F), and conferring great rigidity to branch. Outer surface finely granular to warty, sometimes bearing a medial ridge; inner and lateral surfaces tuberculate.

TYPES: Two syntypes of *Stachyodes clavata* were deposited at the ZMA (Coel. 3421)(van Soest 1979), but are now transferred to Naturalis Biodiversity Center, Leiden. A syntype fragment is also deposited at the NMNH (USNM 1097267).

TYPE LOCALITIES: *Siboga*–251: 5°28.4'S, 132°0.2'E (Bohol Sea, Philippines), 296 m.

COMPARISONS: *Narella clavata*, characterised by a rigid colony, extremely thick mosaic-like coenenchymal scales, and massive closed (Fig. 20E) basal scales, is known from the South Pacific at relatively shallow depths (128–335 m) and may even extend to Japan reported as *Narella compressa* (Kinoshita, 1908), and the southwest Indian Ocean under the name *N. gilchristi* JS Thomson, 1911, although those synonymies have not been confirmed. The latter similarity might explain Thomson and Russell's (1910) identification of *N. clavata* from Providence.

Among the New Zealand *Narella*, *N. clavata* is most similar to *N. mosaica* (see Table 1 (p. 18) and Key to *Narella* species), but can be distinguished by having more polyps per whorl, the basals of which are so thick that they laterally fuse to one another. Also, occasionally its thick basal scales will have ridges on their distal inner margin and oblique ridges on its outer surface.

REMARKS: The rigidity conferred to the colonies by its thick coenenchymal and massive basal scales also makes the colony inflexible, such that when blindly collected by net the colony does not bend but rather breaks like brittle plastic, accounting for the highly fragmented nature of most colonies reported herein. The massive, laterally fused basals also make it very difficult to reveal the adaxial body-wall scales for examination.

Two colonies (K868, K872) are identical to this species but lack polychaete tubes, which is usually considered to be a species level indicator. They also have massively thick basal and medial scales.

Narella parva (Versluys, 1906) Figs 4, 8C, 22, 23

Stachyodes parva Versluys, 1906: 96–98, text-figs. 118–122, pl. 6, fig. 19.—?Thomson & Russell 1910: 142–143.—Kükenthal 1919:463–464; 1924: 314.—van Soest 1979: 104 (type deposition).

Narella parva: ?Pasternak, 1981: 48.—Cairns & Bayer 2007: 86 (listed).—Cairns & Baco 2007: 393 (listed).—Cairns & Bayer 2009: 30 (listed).

MATERIAL EXAMINED: K831, 1 colony now in four pieces, NIWA 11110, and SEM stubs 1616–1620 (USNM 1179319); KAH 9907/51, 2 branches, NIWA 9760 and 14685; KAH 9907/53, 7 branches, NIWA 11308, and 1 branch, USNM 1179340; TAN 0107/219, 1 branch, NIWA 11191; TAN 0205/51, 1 branch, NIWA 14763; TAN 0205/88, 2 branches, NIWA 14762, and SEM stubs 1621–1624; X628, 3 branches, NIWA 11302; TAN 1007/111, 3 branches, NIWA 64892; a syntype (see Types).

DISTRIBUTION: Kermadec Ridge from off Raoul Island southward (including Rumble II Seamount), Bay of Plenty (Fig. 4), 920–2400 m. Elsewhere: Indonesia, 1300–1633 m; ?Saya de Malha, Indian Ocean, 548–914 m (Thomson & Russell 1910); ?Marcus Necker Ridge, 3500 m (Pasternak 1981).

DESCRIPTION: Colonies uniplanar, up to 20 cm in height (NIWA 11308), the illustrated specimen (NIWA 11110, Fig. 8C) being 11 cm tall and 5 cm wide, with a calcified basal stem 2.3 mm in diameter. Branching equal and dichotomous, terminal branches quite long. Base of colony heavily calcified; axis yellow in colour. Polyps arranged in whorls of 4–6, the higher number on larger-diameter branches. Polyps fairly closely spaced, both within a whorl and between whorls, 4–5 whorls occurring per cm. Whorl diameter small, 2.5–3.2 mm; horizontal length of polyps 2.0–2.4 mm.

Basal scales robust (Fig. 23D), 1.0–1.3 mm in height, their flat abaxial faces tilted slightly downward, making a 60° angle with branchlet. Distal margin of basal scales lobate; each dorsolateral edge projecting as a thin crest up to 0.15 mm in height (Figs 22A, B, D, 23D, lower) before turning at a right angle to form its lateral face, the latter of which is quite long (longer than height of scale) and tall, often bearing a short basolateral ridge; adaxially they are closed. Medial body-wall scales (Figs 22A, B, D) much shorter (0.6–0.8 mm in length), having gently rounded dorsolateral edges, a slightly upturned distal edge, and occasionally bear a low medial ridge (Fig. 22D). Abaxial buccal body-wall scales Figs 22B, 23C) 0.8–1.1 mm in length, also having gently rounded dorsolateral edges and a thin rounded distal edge that is somewhat translucent; outer face of buccal scales covered with radiating rows of low granules and sometimes 1–3 low ridges. Ratio of major body-wall scales approximately: 1:0.57:0.80 (Fig. 22D). A pair of large (0.5–0.6 mm wide), square, obliquely-ridged adaxial body-wall scales protects adaxial polyp surface (Figs 22C, 23G, right); this side also bears a scattering of smaller (0.35–0.45 mm in lager diameter), flat, circular to elliptical adaxial scales (Fig. 23G, left).

Operculum easily seen in lateral view, opercular scales roughly the same length (0.67–0.95 mm) but differing in width depending on their position in operculum (Figs 23A–B). A single large abaxial oper-

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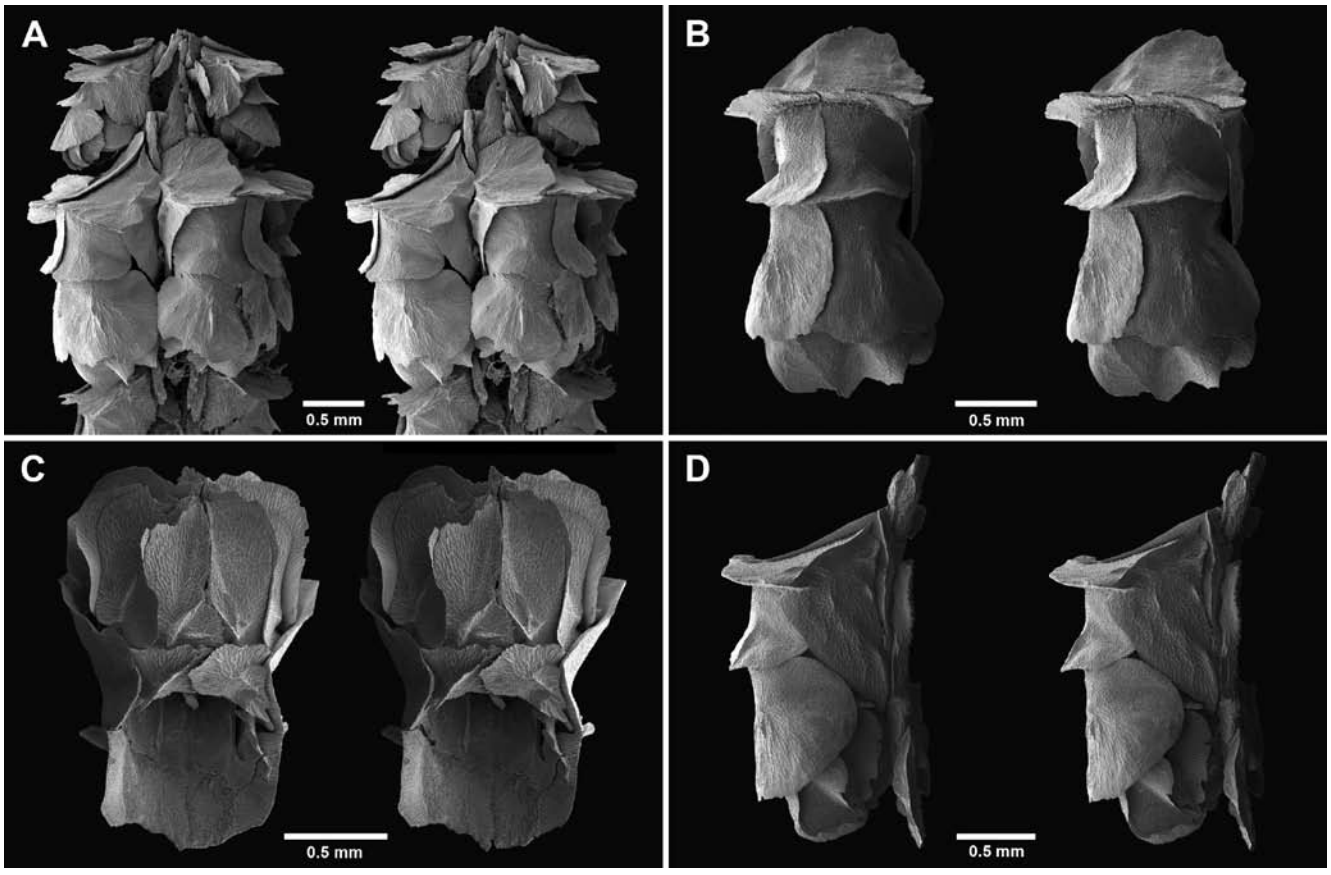

Figure 22. *Narella parva* from K831: A, lateral view of two whorls of polyps, the uppermost whorl not yet fully developed; B, abaxial view of a polyp; C, adaxial view of a polyp showing the ridged adaxial opercular and body-wall scales; D, lateral view of a polyp showing dorsolateral ridges. All views are in stereo.

cular measures 0.81–0.95 mm in height, having symmetrical, broad lateral wings that produce a low L:W of 0.87–1.06. Two adaxial operculars, also symmetrical but without the lateral wings, are 0.74–0.85 mm in height but with an L:W of 2.0–2.1; these scales sometimes bear short, oblique ridges at their base (Figs 23A, B, lower right). The five lateral operculars are asymmetrical (having only one lateral wing), 0.67–0.93 mm in length, and an L:W of 1.6–1.9. Outer surface of operculars highly creased, corresponding to a sharp keel on inner surface. Tentacular platelets not observed.

Coenenchymal scales elongate (up to 1.1 mm), slender (L:W = 5–7), and thin (about 0.1 mm), having pointed distal ends, sometimes bifid in shape; scales arranged in an imbricate fashion. Outer surface of coenenchymals usually bear a low, elongate, prominent ridge (Fig. 23F).

Types: Several syntypes were deposited at ZMA (Coel. 3427, 3428)(van Soest 1979: 104), but have been transferred to Naturalis Biodiversity Centre, Leiden. A syntype fragment is also deposited at the NMNH (USNM 1097269).

Type Localities: *Siboga*-177 and 226: Ceram Sea and Banda Sea, Indonesia, 1300–1633 m.

Comparisons: Among the New Zealand species of *Narella* that have equal dichotomous branching, *N. parva* is the only one to lack a polychaete commensal, have ridged basal scales, have such elongate coenenchymal scales (L:W up to seven), and to have such a small whorl diameter (Table 1, Key to *Narella* species). It is similar to *N. muzikae* Cairns & Bayer, 2007 (known only from the Hawaiian Islands from 321–381 m), as discussed in the account of that species.

Narella studeri (Versluys, 1906) Figs 6, 8I, 24, 25

Stachyodes regularis Wright & Studer, 1889: 55–56, pl. 11, figs. 2, 2a, pl. 20, fig. 3 (junior secondary homonym). — Not Nutting, 1908: 577 (= *N. hawaiinensis* Cairns & Bayer, 2007). — van Soest 1979: 119 (type specimens).

Stachyodes studeri Versluys, 1906: 94–96, text figs. 112–117 (replacement name). — ?Thomson & Mackinnon 1911: 680. — Kükenthal 1919: 463; 1924: 313–314, text fig. 171.

Not *Narella regularis*: Bayer, 1956: F222, fig. 159–5.

Narella studeri: Not Grigg & Bayer, 1976: 172 (= *N. hawaiinensis* Cairns & Bayer, 2007). — Cairns & Baco 2007: 393 (listed). — Cairns & Bayer 2008[2007]: 86 (listed). — Cairns & Bayer 2009: 30 (listed).

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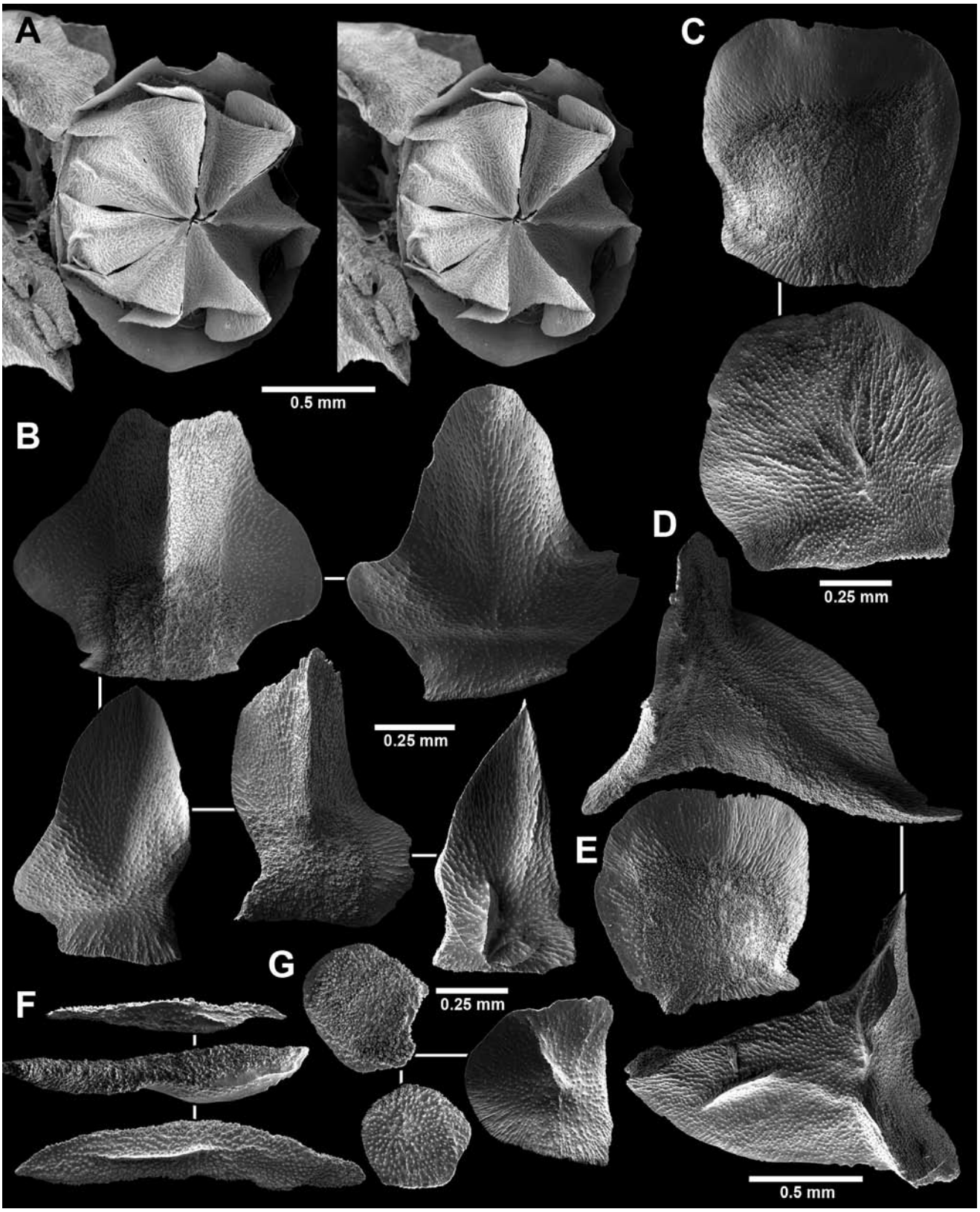

Figure 23. Polyp and sclerites of *Narella parva* from K831; A, stereo opercular view of polyp; B, five opercular scales; C, two buccal scales; D, two basal scales; E, a medial scale; F, three coenenchymal scales; G, three adaxial body-wall scales. (Figs E, F, and H share a common scale bar of 0.25 mm.)

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MATERIAL EXAMINED: K806, 17 branches may be all from same colony, NIWA 11316, and SEM stubs 1659–1661 (USNM 1179341); TAN 1007/19, three branches, NIWA 64400; TAN 1007/111, seven branches, NIWA 64884; *Albatross* 5664, one branch, USNM 1015446.

DISTRIBUTION: Kermadec Ridge; southern Coleville Ridge; Celebes Islands; Makassar Strait (Fig. 6), 732–1392 m.

DESCRIPTION: Colonies uniplanar, with equal dichotomous branching; however, there is at least one case of tetrachotomous branching (NIWA 11316, Fig. 8I, lower left). Largest colony only 17 cm in length (NIWA 64884), with a basal branch diameter of 3.7 mm; holotype only 14 cm in length; worm tubes not present; axis bronze in colour. Polyps arranged in whorls of 4–6 (usually five), the whorls being closely spaced, about 3 whorls per cm. Whorl diameter 4.0–5.0 mm; horizontal length of polyps 3.0–3.3 mm.

Basal scales thick (Fig. 25D), up to 2.2 mm in height, with rounded distal and dorsolateral edges; distal edges slightly flared; adaxially they are in an open position (Fig. 24C). Abaxial (medial) edges of basal scales slightly overlap one another, one extending over the other in an asymmetric fashion (Figs 24A, B, and Versluys, 1906: fig. 113). Medial scales (Figs 24B, 25B) up to 1 mm in length, rectangular in shape, and rather slender. Adaxial buccal scales (Figs 24A, B, 25C) up to 1.5 mm in length and broad, encircling over half of operculum. Distal edges of all body-wall scales rounded, not spinose or lobate; outer surfaces relatively smooth, appearing glossy. Ratio of major body-wall scales approximately 1:0.45:0.75. Adaxial side of polyp bordered by one pair of small, elliptical (greater axis 0.28–0.38 mm) scales (Figs 25F, G), remaining adaxial side naked (Fig. 25F).

Operculum easily seen in lateral view, opercular scales showing great disparity in size, ranging from 0.51 to 1.40 mm in length (Fig. 25A). Abaxial opercular dimorphic, 1.18–1.28 in length, one with symmetrical shoulders on both sides (L:W 1.05–1.12, Fig. 25A, upper left) and the other underdeveloped on one side (Figs 24C, D, 25A, second from left), and thus having a higher L:W. Abaxial opercular highly creased on outer surface such that distal edge appears to be notched and

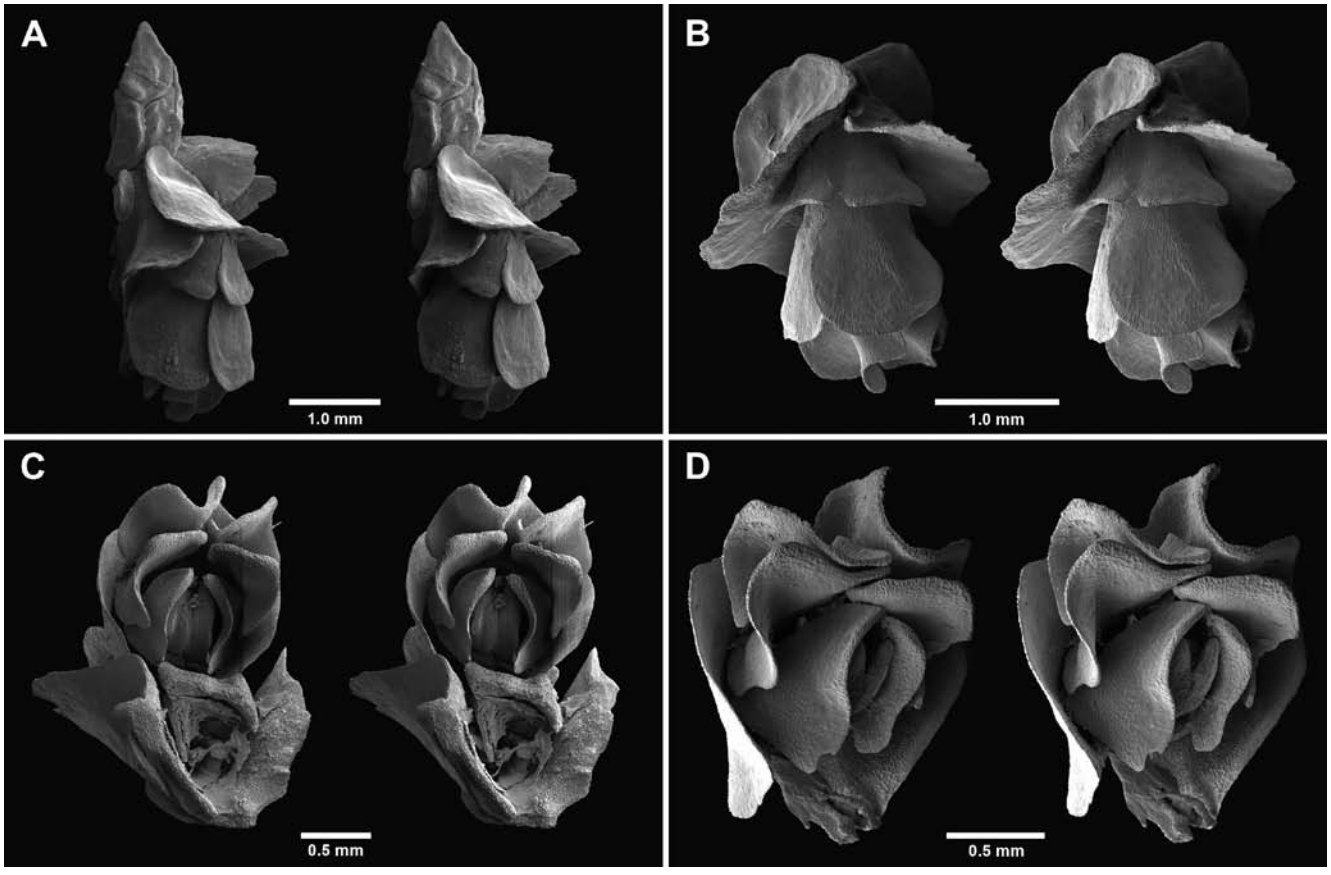

Figure 24. *Narella studeri* from K806: A, abaxial view of a polyp and several coenenchymal scales; B, abaxial view of a polyp showing concave basal scales; C, adaxial view of a polyp showing highly creased opercular scales; D, apical view of a polyp showing a pair of very small adaxial opercular scales. All views are in stereo.

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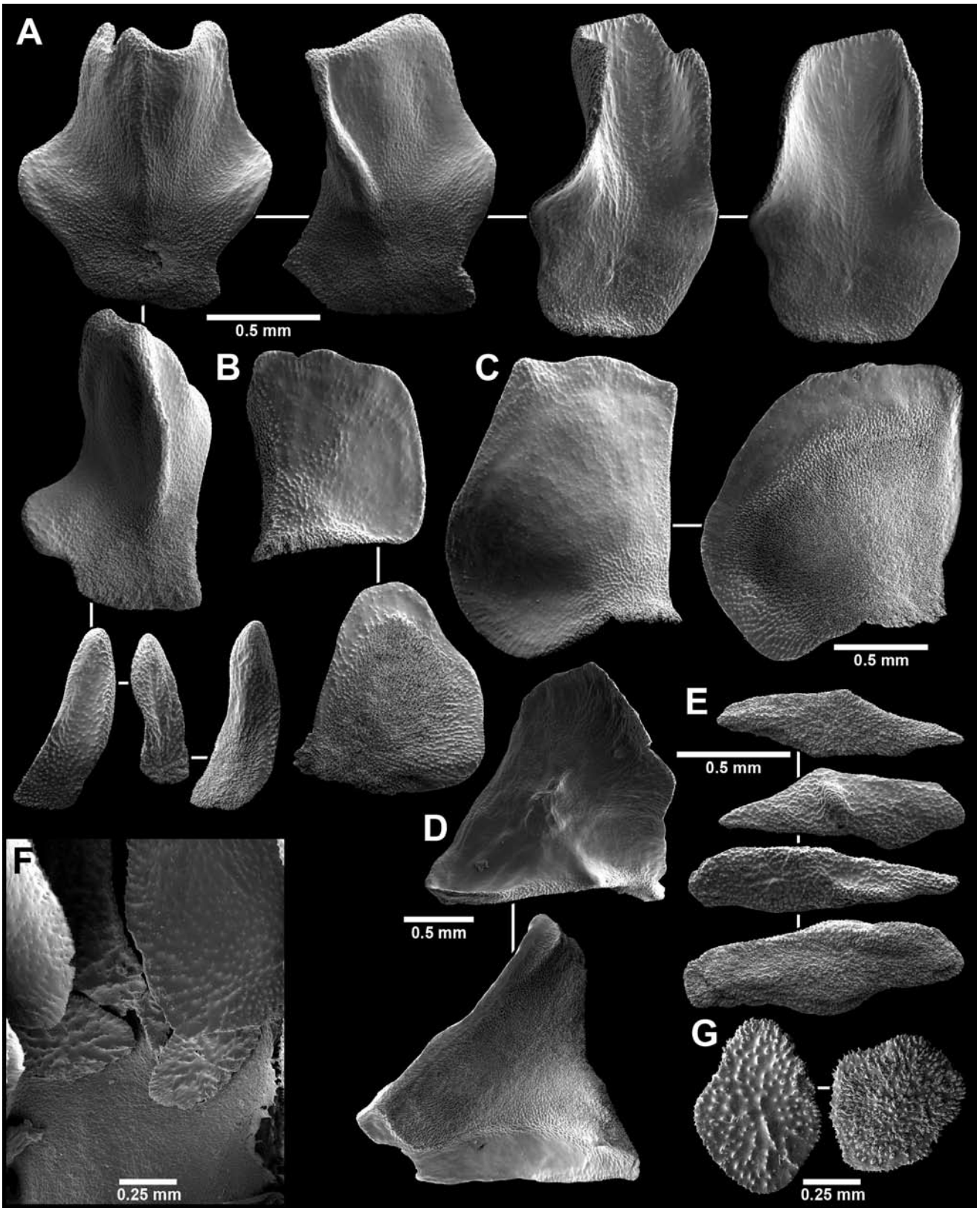

Figure 25. Sclerites of *Narella studeri* from K806: A, eight opercular scales showing disparity in size; B, two medial scales; C, two buccal scales; D, two massive basal scales; E, four coenenchymal scales; F, adaxial buccal scales *in situ*; G, adaxial body-wall scales. (Figs A and B share a common scale bar of 0.5 mm.)

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flanked by short projections (Fig. 25A), the inner surface consisting of a wide rounded ridge, but not keeled. Outer lateral operculars 1.3–1.5 mm in length, have an adaxial shoulder, and an L:W of 1.5–1.6. Inner lateral operculars asymmetric but without shoulders, up to 1.3 mm in length (L:W = 1.7–1.9). Adaxial operculars quite small (only 0.51–0.84 mm long, L:W = 2.7–3.8), with a flat outer surface, occupying only about 10% of surface area of a fully developed abaxial opercular scale (Figs 24D, 25A, lower three). Tentacular platelets not observed.

Coenenchymal scales elongate, fusiform (L:W = 3.1–5), up to 1.5 mm in length and 0.10–0.13 mm in thickness, arranged in an imbricate pattern; outer surface granular and occasionally ridged (Fig. 25E).

TYPES: The holotype of *Stachyodes regularis* Wright & Studer, 1889 is deposited at the Natural History Museum (1889.05.27.71). A fragment of the holotype was also deposited at the ZMA (van Soest 1979), but has recently been relocated to Naturalis Biodiversity Center, Leiden.

TYPE LOCALITY: *Challenger*–171: 28°33'S, 177°50'W (Kermadec Ridge north of Raoul Island), 1097 m.

REMARKS: One of the specimens reported herein (NIWA 11316) could be considered as topotypic, as it was collected about 3 km from the type locality at a slightly greater (68 m deeper) depth, and perhaps not so coincidentally 100 years and 8 days after the original collection, as it was taken on the *Challenger* Centenary Cruise of 1974. It was also collected at the same precise depth (1165 m) as the *Siboga* specimen from the Celebes.

Stachyodes regularis Wright & Studer, 1889 is a junior secondary homonym of *Primnoa (= Narella) regularis* Duchassaing & Michelotti, 1860, the type species of the genus. Versluys (1906) provided a replacement name, *N. studeri*, as well as reporting an additional specimen from the Celebes, the only specimen reported since the original description until now.

Although not examined, the records of *N. studeri* from off New South Wales (Thomson & Mackinnon 1911) at 59–143 m are questioned based on their shallow depths.

Narelloides n. gen.

DIAGNOSIS: Colonies uniplanar. Polyps arranged in whorls, facing upward. Polyp sclerites consist of a medial unpaired infrabasal scale, a pair of basals (each with a curved articulating ridge), Two to four pairs of medials, a pair of pointed abaxial marginals (buccals), one pair of inner lateral marginals, and one pair of adaxial marginals, most of the abaxial face being naked, thus six marginal scales. Body-wall scales with a smooth outer face and a digitate basal margin. Opercular scales prominently ridged. Coenenchymal scales elliptical and flat.

TYPE SPECIES: *Narelloides crinitus*, here designated.

ETYMOLOGY: Adding the suffix *-oides* to the stem *Narella*, meaning similar to *Narella*. According to the ICZN (1999: article 30.1.4.4), generic names ending in *-oides* are considered to be masculine.

DISCUSSION: Among the six genera having 3–6 pairs of abaxial body-wall scales, *Narelloides* most closely resembles *Narella*, but probably only because *Narella* encompasses so much variation for the characters being considered in Table 2; however, they are the only two taxa having at least some species with unpaired infrabasal scales. *Narelloides* differs from *Narella* in usually having three pairs of medial scales, and is unique among the five genera in having upward facing polyps, three (2–4) pairs of marginal scales, small digitate processes on the basal region of the body-wall scales, and a curved articulating ridge. Although *Narelloides* has the same number of marginal scales (6) as *Australogorgia* Cairns & Bayer, 2009, that genus differs in having dichotomous branching, downward facing polyps that are not arranged in whorls, and a lesser number of undifferentiated abaxial body-wall scales (Table 2).

The genus is monotypic.

DISTRIBUTION: Known only from off Three Kings Island, 157–224 m.

Narelloides crinitus n. sp. Figs 7, 8H, 26, 27

MATERIAL EXAMINED: Types.

DISTRIBUTION: Known only from off Three Kings Island (Fig. 7), 157–224 m.

DESCRIPTION: Colonies unbranched (flagelliform) and straight, the longest colony (NIWA 73280) being 1.1 m in length (now broken into three pieces). Holotype (Fig. 8H) only 25 cm in length, undoubtedly a fragment of a larger colony. No entire colony with holdfast known;

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Table 2. Distinguishing characters of the six primnoid genera having 3-6 pairs of abaxial body wall scales.

	Narella Gray, 1870	*Narelloides*, n. gen	*Paranarella* Cairns, 2007	*Metanarella*, n. gen.	*Australogorgia* Cairns & Bayer, 2009	*Candidella* Bayer, 1954
Colony branching	branched and unbranched	unbranched	long branches originating from a basal node	lyrate	dichotomous, equal	dichotomous, equal
Polyp orientation; number of polyps/whorl	down; 2–14	up; 7–9	unknown; 4–5	down; 7–8	down, irregularly arranged (not arranged in whorls)	perpendicular; 3– 7
Infrabasal scales	absent except for one species (unpaired)	single unpaired medial	none	1 pair, with elongate lateral process	none	none
Dorsolateral edge of basal scale	rounded and ridged	rounded	ridged	no basal scale	rounded	rounded
Medial scales	1 pair (rarely 2 pairs)	2–4 (usually 3) pairs	3 pairs	3 pairs	2 pairs, but body-wall scales undifferentiated	1–3 pairs, sometimes irregular in arrangement
Buccal (= marginal) scales	4 (2 ab and 2 small ad)	6 (2 ab, 2IL, 2 ad)	8 (full complement)	3 unpaired (1 medial and 2 IL)	6 (1 ab, 2IL, 2 ad)	4 (2 ab, 2 smaller ad)
Unique characters		curved articulating ridge; base of bw scales digitate		basal and adaxial scales lacking; marginals unpaired	body-wall scales undifferentiated, thus no basals recognised	basals concave; adaxial scales in rows completely covering face
Number of species; distribution	43; worldwide, 55–4594 m	1; Three Kings Ridge, New Zealand, 157–224 m	1; New England Seamounts, 3355 m	1; West Norfolk Ridge, 138–168 m	1; Tasmania, 987–1200 m	3; N. Atlantic, S. Pacific, Hawaii, 384–2165 m

axis stiff and straw yellow in colour. Polyps face upward, arranged in whorls of 7–9, polyps being fairly closely spaced: 3.5–4.5 polyps/cm. Whorl diameter 2.6–3.8 mm; horizontal length of polyps 1.9–2.4 mm.

Basal scales stand perpendicular to branch, up to 1 mm in height, their upper outer margins produced as a small lobe, their lower margin composed of numerous small, digitate processes (Figs 26D, 27E); dorsolateral edges curved; adaxially they are open. Inner face of basals tuberculate but distally also bearing an articulating ridge (Fig. 27E), similar to that of *Calyptrophora*, but curved. A single, wide (up to 0.90 mm), curved, medially placed infrabasal scale surrounds the lower region of the paired basal scales. Two to four (usually three) pairs of medial scales occur per polyp, the variation in number occurring even on polyps within the same whorl (Figs 26B, D, 27C). The medial scales adjacent to the basal scales (herein termed the primary medials) about 0.75 mm in length, have a straight distal edge, and are widest of the medial scales. The secondary, tertiary (if present), and quaternary (if present) pair of medials, each progressively farther from the basal scales, are equally long but less wide, and slightly pointed distally. The two abaxial marginals are similar to the medials but have a prominently, medially pointed distal margin (Figs 26B, D, 27B). All body-wall scales fairly smooth, having only sparse low granules; their lower margins bear digitate processes like the basal scales (Figs 27C, D). One pair of rectangular (greater diameter about 0.33 mm) inner lateral marginals (Fig. 26D) occurs directly adjacent to the inner lateral opercular scales, and another pair or two of equally sized adaxial marginals border the adaxial operculars (Fig. 27G), the remaining adaxial side of the polyp naked.

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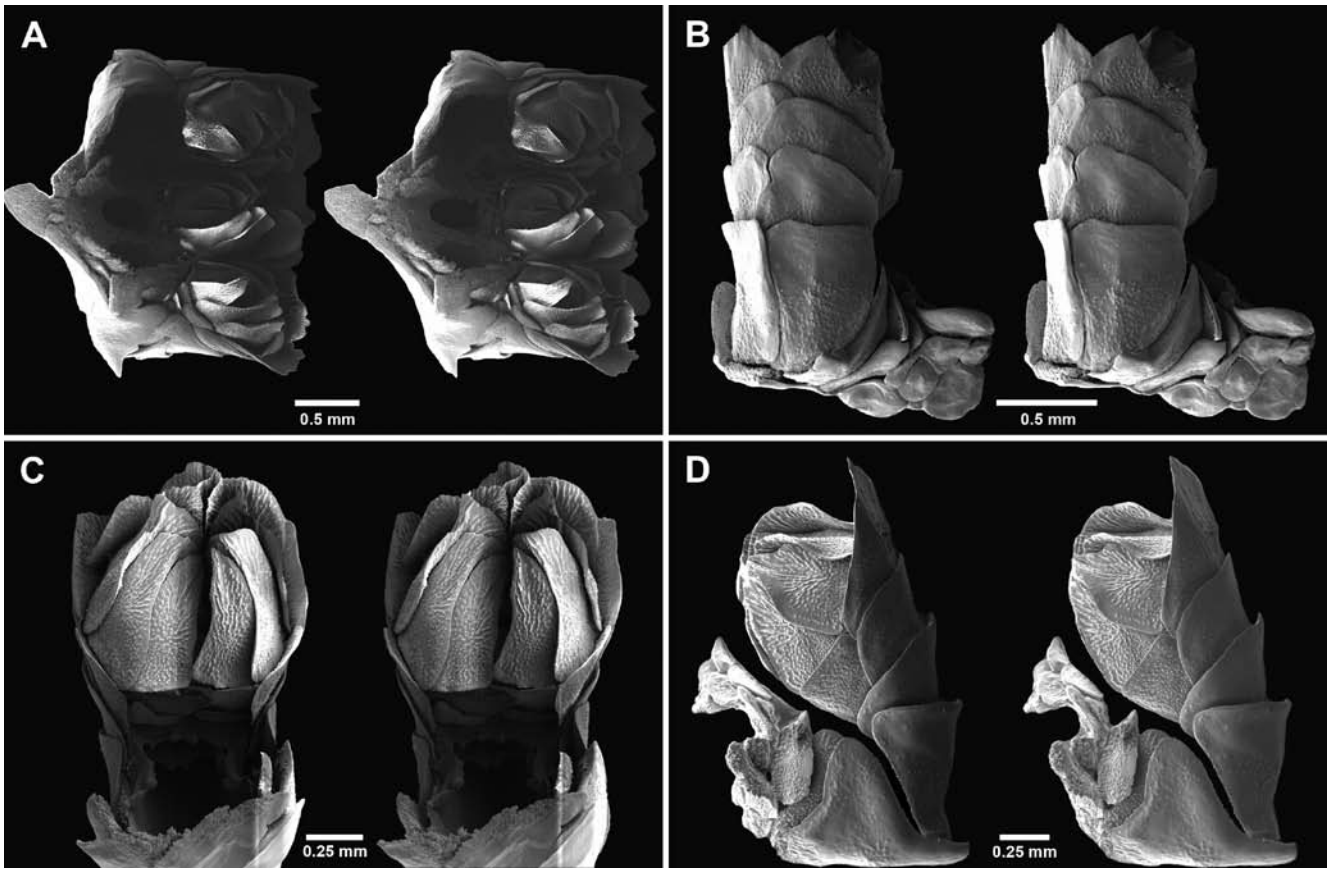

Figure 26. Holotype of *Narelloides crinitus*: A, partial whorl viewed from adaxial side; B, abaxial view of a polyp and several coenenchymal scales; C, adaxial view of a polyp and several pairs of adaxial body-wall scales; D, abaxial view of a polyp showing one inner lateral scale. All views are in stereo.

Thus each polyp has six marginal scales, the outer lateral scales missing.

Operculum easily seen in lateral view, opercular scales roughly of similar length (0.59–0.73 mm) but differing in width and symmetry according to position (Figs 26C, 27A) Abaxial opercular symmetrical and broad, having an L:W of 1.08–1.10; lateral opercular asymmetrical and often slightly longer than abaxials, having an L:W of 1.38–1.42; adaxial opercular shortest in the opercular crown and usually slightly asymmetrical, having an L:W of 1.60–1.69. Outer faces of opercular deeply creased; inner surface prominently keeled. Tentacular platelets not observed.

Coenenchymal scales (Figs 26B, 27F) oval to slightly elongate, up to 0.57 mm in greater diameter, having flat, fairly smooth outer surfaces.

TYPES: Holotype: E336, one branch, NIWA 81972, and one branch and SEM stubs 1650–1652, 1663–1664 (USNM 1180659). Paratypes: E336, four branches ranging from 8–22 cm in length, NIWA 76206, and one branch, USNM 1180660; E323, one branch , NIWA 71108; E842, one branch, NIWA 41552; TAN 0105/43, one colony, NIWA 73280.

TYPE LOCALITY: 34.00°S, 172.50°E (off Three Kings Island), 157 m.

ETYMOLOGY: Named *crinitus* (Latin for fringed, as with long hair), an allusion to the micro-digitiform fringe on the bases of the body-wall scales.

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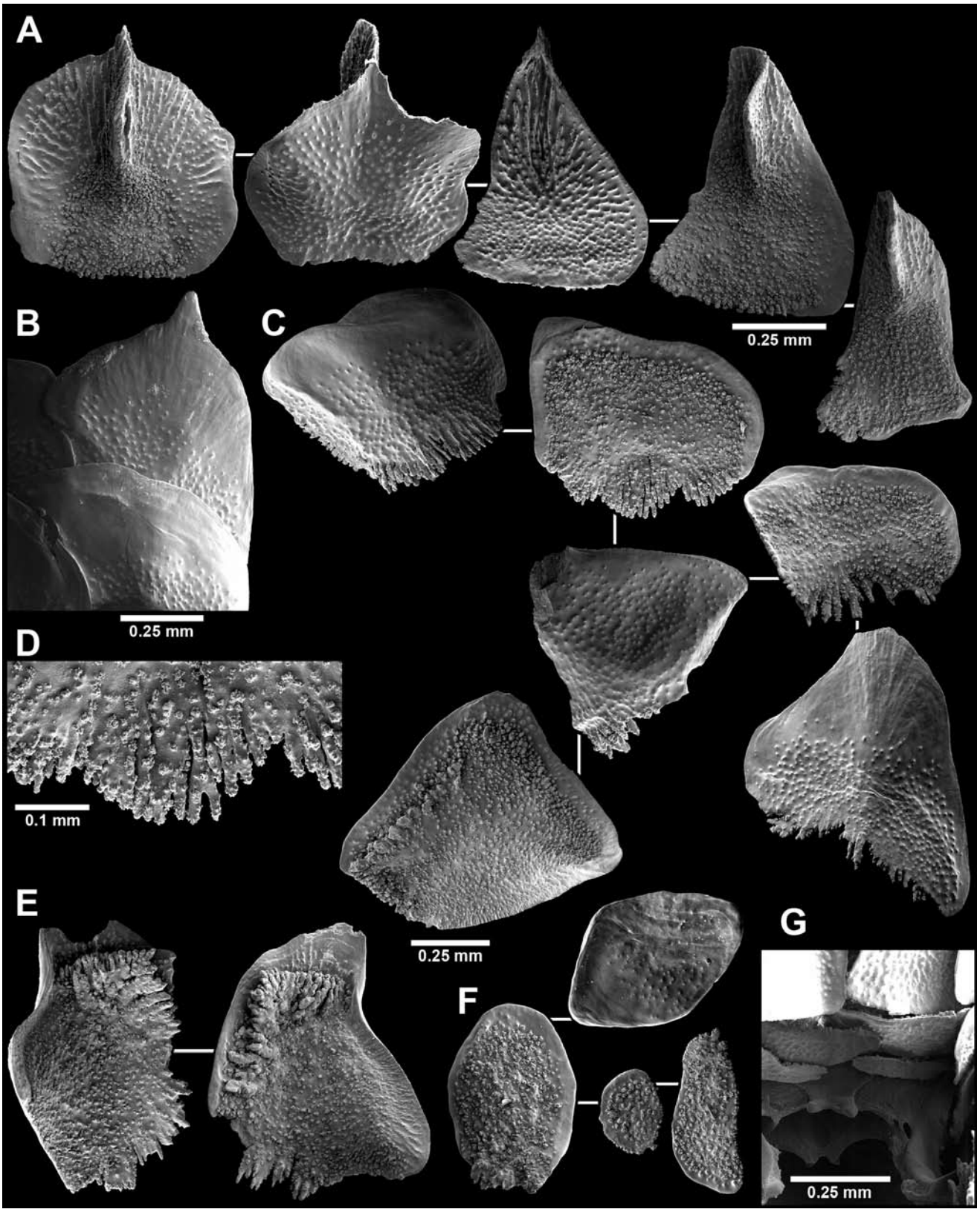

Figure 27. Sclerites from holotype of *Narelloides crinitus*: A, five opercular scales; B, distal pointed margin of a marginal scale; C, six medial body-wall scales, showing finely digitate bases; D, finely digitate base of a medial body-wall scale; E, inner faces of two basal scales showing articulating ridge and digitate bases; F, four coenenchymal scales; G, adaxial body-wall scales *in situ*. (Figs C, E, and F share a common scale bar of 0.25 mm.)

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Metanarella n. gen.

Diagnosis: Colonies uniplanar, with lyrate branching. Polyps arranged in whorls, facing downward. Polyp sclerites consist of one pair of infrabasals, three pairs of medials, and three unpaired marginal scales. Body-wall scales have a lobate distal edge and granular outer surface. Opercular scales with blunt keels, the adaxial operculars being quite small and partially hidden. Coenenchymal scales elongate and flat.

Type Species: *Metanarella nannolepis*, here designated.

Etymology: *Meta* (Greek for "among, near") + *narella* (Latin, probably for small nostrils), an allusion to the classification of this genus among those having *Narella*–like characteristics (See Table 2). Gender: feminine.

Discussion: Among the six genera having 3–6 pairs of abaxial body-wall scales (Table 2), *Metanarella* is similar to *Narelloides* and *Paranarella* in having three pairs of medial scales, but is also similar to *Narella* in having downward facing polyps. *Metanarella* is unique in having only three unpaired marginal scales, no adaxial or basal scales, and well-developed paired infrabasal scales.

The infrabasal scales are relatively large and could be interpreted as basal scales (Figs 28D, 29D), but because they are rather short for basals and because they have long dorsolateral extensions, they are considered herein to be infrabasals. The adjacent pair of scales, which would ordinarily be called the basals, are indistinguishable (except by size) from the more proximal medials, and thus they are considered also as the primary medial scales. This results in the unique situation of polyps having no basal scales, but an infrabasal and multiple medial scales. Also unique for this genus is the low number (3) of unpaired marginal scales, and complete lack of adaxial marginals.

The genus is monotypic.

Distribution: Known only from northern West Norfolk Ridge, 138–168 m.

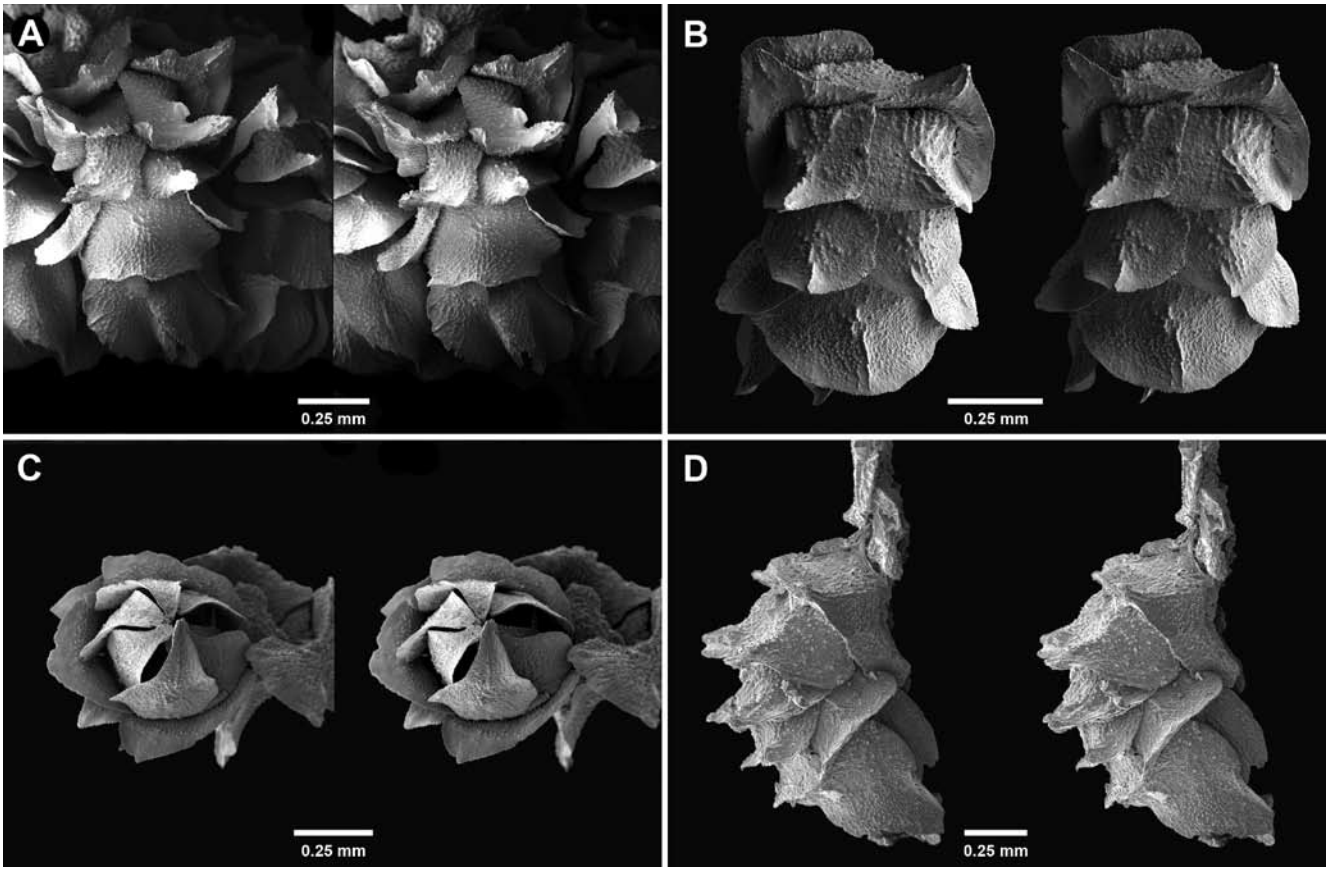

Figure 28. Holotype of *Metanarella nannolepis*: A-B, adaxial views of a polyp, both showing the medial unpaired abaxial marginal scale; C, apical view of a polyp showing the three marginal scales; D, lateral view of a polyp. All views are in stereo.

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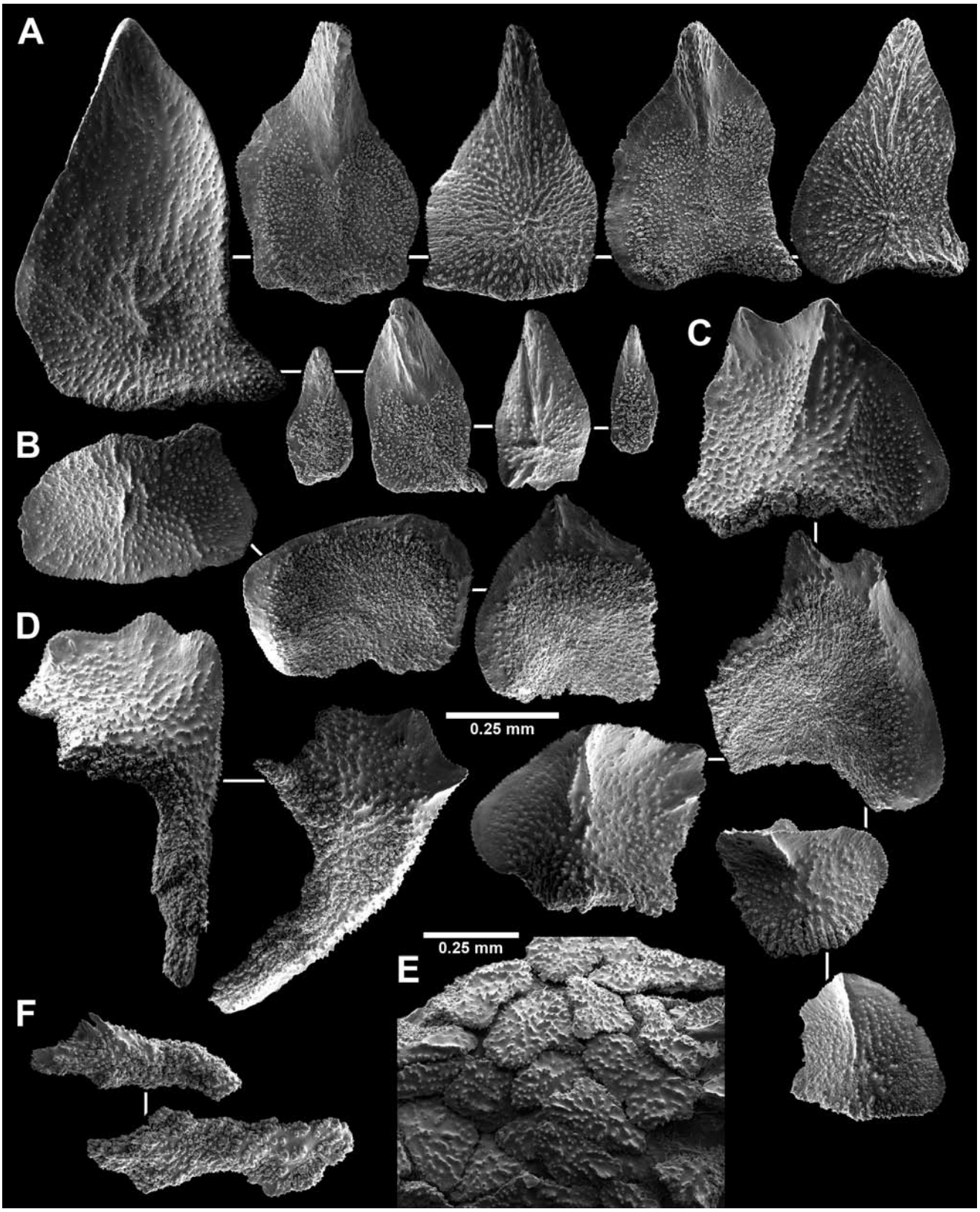

Figure 29. Sclerites from holotype of *Metanarella nannolepis*: A, nine opercular scales, showing great disparity in size; B, three marginal scales; C, five medial scales; D, two infrabasal scales; E, coenenchymal scale *in situ*: F, inner surface of two coenenchymal sclerites. (Figs A–D and F share a common scale bar of 0.25 mm.)

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Metanarella nannolepis n. sp. Figs 7, 9C, 28, 29

Material Examined: Types.

Distribution: Northern West Norfolk Ridge (Fig. 7), 138–168 m.

Description: Colonies uniplanar and lyrate, about half of the ascending branches unbranched (up to 11 cm in length), the other half bifurcating once or twice. Largest colony (the holotype, Fig. 9C) 14 cm tall and 11 cm broad, with a main stem 16 mm long and a basal branch diameter of 2.2 mm. Holdfast unknown; stem axis brown in colour. Polyps face downward, arranged in closely set (7 whorls/cm) whorls of 7–8. Whorl diameter 1.9–2.7 mm; horizontal length of polyps 1.2–1.6 mm.

Infrabasal scales paired and somewhat tall for this type of scale (Figs 28D, 29D), each about 0.30–0.37 mm in height, with an elongate, slender extension that borders lateral side of polyp; distal edge produced in two or three short broad lobes. Three pairs of medials cover the abaxial polyp surface, the primary pair being the broadest, the tertiary pair being quite narrow (Figs 28B, D, 29C); medial scales range from 0.29–0.52 mm in length. Dorsolateral edges of primary and sometimes secondary medials ridged; distal edges often bear one or two short, blunt lobes. Only three marginal scales occur in each polyp, one centrally placed abaxially, the other two flanking lateral side of the operculum (Fig. 28C); adaxial marginals and body-wall scales absent. marginals about 0.33 mm tall, quite broad (up to 0.57 mm), and gently curved to fit contour of operculum (Figs 28C, 29B); distal edges curved (without lobes or spines, Fig. 28B). Outer faces of all body-wall scales bear granules or short spines. Thus, altogether there are 19 scales in each polyp: two infrabasals, six medials, three marginals, and eight operculars.

Operculum easily seen in lateral view (Fig. 28D); in apical view it often appears that there are only six opercular scales since the adaxial scales are so small and partially hidden by their adjacent outer lateral operculars (Fig. 28C). Abaxial operculars symmetrical, about 0.62 mm in length, with an L:W of about 1.6. Lateral operculars asymmetrical, 0.56–0.90 mm in length, with an L:W of 1.48–1.80. Adaxial operculars quite small, only 0.29–0.43 mm in length and about 1/3 width of an abaxial, having an L:W of 1.95–2.60. Outer faces slightly creased and similar body-wall scale ornamentation; inner faces bearing a blunt keel. Tentacular platelets not observed.

Coenenchymal scales elongate (L:W 3–4) and irregular in shape, up to 0.65 mm in length; outer surface flat and granular; scales 50–65 μm in thickness (Figs 29E–F).

Types: Holotype: G1, NIWA 11076, and two branches and SEM stubs 1582–1584, 1656–1658 (USNM 1180661). Paratypes: G1, one colony, NIWA 76202; E865, several branches, NIWA 11219, and one colony, USNM 1180662.

Type Locality: 32°35′S, 167°23′E (northern West Norfolk Ridge) 138 m.

Etymology: *Nannos* (Greek for dwarf) + *lepis* (Greek for scale), meaning dwarf scale, treated as a noun in apposition, referring to the very small adaxial opercular scales.

Calyptrophora Gray, 1866

Calyptrophora Gray, 1866: 25, fig. 1. — Bayer 2001: 367–368. — Cairns & Bayer 2009: 44–45. — Cairns 2009: 420–426 (key to species).

Diagnosis (amended from Cairns & Bayer 2009): Colonies uniplanar to slightly bushy (lyrate, dichotomous, polychotomous, or biplanar branching) or unbranched (flagelliform). Polyps arranged in whorls, in most species with the polyps facing upward. Polyps consist of two annular sclerite rings, each composed of two inseparably fused scales; a pair or two of crescent-shaped infrabasals also present. Distal margins of body-wall scales usually spinose, toothed, or lobate, sometimes extending as a protective buccal cowl. Operculum composed of eight scales, invariably progressively decreasing in size from ab- to adaxial position; keels usually but not always present on inner distal side of operculars. Coenenchymal scales elongate and flat, sometimes quite thick, usually with a granular outer surface. Curved, flat tentacular platelets usually present.

Type Species: *Calyptrophora japonica* Gray, 1866, by monotypy.

Discussion: Twenty-one species are now recognised in the genus, making it the fifth most species-rich among the 43 primnoid genera (see Cairns & Bayer, 2009). The genus was reviewed by Cairns and Bayer (2009) and again by Cairns (2009), the latter containing a phylogenetic analysis of the species, as well as a list and key to all extant species. Bayer (2001) divided the genus into two species complexes: the *japonica*-complex, containing species having their polyps facing upward, and the *wyvillei*-complex, having polyps facing downward. However, the phylogenetic analysis of Cairns (2009) did not support these groupings. Characters used to distinguish among species include: direction that polyps face, branching pattern, spination of the distal edges of the buccal and basal scales, and micro-

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architecture (e.g. ridging and granulation) of the body-wall scales. Representatives of the types of all 21 species are deposited at the NMNH. Table 3 compares the species described herein.

DISTRIBUTION: Tropical and temperate latitudes of Atlantic, Pacific, and Indian Oceans, 227–3531 m.

Table 3. Distinguishing characters of the seven species of New Zealand *Calyptrophora*.

	C. cucullata	*C. inornata*	*C. cristata*	*C. niwa*	*C. clinata*	*C. diaphana*	*C. wyvillei*
Polyp orientation	up	up	up	up	down	down	down
Branching mode	lyrate, followed by dichotomous	lyrate, followed by dichotomous	lyrate biplanar (opposite bipectinate)	equal, dichotomous	unbranched	lyrate	lyrate (polychotomous)
Polyp length; whorl diameter (both in mm)	1.9–2.1; 3.8–4.1	1.6–1.9; 4.75–5.3	1.4–1.6; 2.5–3.0	2.0–2.2; 5.0–5.5	2.5–2.8; up to 9.6	2.5–2.8; 5.5–6.5	2.1–2.7; 4.0–4.5
Distal edge of basal scale	two flat, blunt spines, covered with serrate ridges	two short, flat teeth, spiny but not ridged	two short flattened spines and two low broad lobes	two tall, broad, forward-curved, serrate spines	two extremely long serrate spines, curved away from polyp	tall, thin translucent lobe (not spinose)	two large, flat teeth
Distal edge of buccal scale	eight triangular teeth, large translucent cowl	smooth and straight (no spines or teeth)	four short flattened spines	four to six round spines, with smooth tips	variable: straight, two rounded lobes, or two spines, producing a cowl	prominent translucent lobe forming a cowl (not spinose)	straight (not spinose), short cowl
Opercular keel	prominent	rounded, smooth keel	thick, spade-shaped keel	thick, rounded keel	absent	narrow	broad, rounded, smooth medial thickening
Tentacular platelets	common, up to 120 µm	common, up to 115 µm	not noted	common, up to 130 µm	common, up to 100 µm	not noted	uncommon, 100–120 µm
Coenenchymal scales	fusiform, of moderate thickness, granular and short ridges	elongate, extremely thick, granular	elongate, moderate thickness, granular	long, slender, thick	fusiform, granular	elongate, smooth	elongate, thin, granular
Other distinguishing characters			body-wall scales longitudinally ridged; dorsolateral region of body scales at right angle				
Distribution	North Island (and ridges to north), Lord Howe I, 619–1495 m	Ridges north of New Zealand, Chatham Rise, 885–954 m	Three Kings Ridge, 850 m	Chatham Rise, Kermadec Ridge, 1284–1411 m	Northwest Atlantic; North Island, New Zealand and ridges to north, 810–1842 m	off North Island, New Zealand, and Three Kings Ridge, 680–990 m	Celebes, Hawaiian Islands, Kermadec Islands, 784–1278 m

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Calyptrophora cucullata n. sp. Figs 3, 9H, 30, 31

MATERIAL EXAMINED: Types; TAN 0205/73, many branches, NIWA 14765; TAN 0413/26, two branches, NIWA 15616.

DISTRIBUTION: Kermadec, Colville, and Three Kings Ridges, Raukumara Plain, and off Lord Howe Island (Fig. 3), 619–1495 m.

DESCRIPTION: Colonies uniplanar, primarily lyrate in branching, some of the ascending branches being unbranched and up to 10 cm in length, others repeatedly dichotomously branched (Fig. 9H, and see Cairns 2009, fig. 8D). Type colony now fragmented into over 22 pieces (syntypes) and hundreds of individual polyps, the largest colony fragment 18 cm in length. Largest colony (NIWA 15616) 30 cm in height with a basal branch diameter of 3.6 mm, whereas another colony only 17 cm in length but with a basal main stem diameter of 5.2 mm (NIWA 14759). Main stem (that which attaches to substrate) gives rise to two lateral stems, from which numerous ascending branches diverge from its upper side, these branches parallel to one another and spaced at intervals of 10–15 mm (Fig. 9H). Polyps directed upward (distally) on all branches, occurring in whorls of 4–6 (Fig. 30A), the whorls tightly spaced (4 whorls/cm) such that intervening coenenchymal sclerites are obscured. Whorls diameter 3.8–4.1 mm; horizontal length of polyps 1.9–2.1 mm. Axis iridescent green; polyps an off-white.

Fused basal scales up to 2.1 mm in height, the distal 0.9–1.2 mm consisting of two broad, flat, usually blunt-tipped spines (Figs 30B, C, 31C, D, E). Inner surface of basal spines covered with 8–10 parallel, serrate ridges, half of which reach tip of spine (Figs 30B, 31D, E); outer surface of spine and basal scale covered with small rounded granules; articulating ridge pronounced (Fig. 31D). Fused buccal scales up to 1.6 mm in length and inclined toward branch making an approximately 60° angle with upright basal scale. Their delicate translucent distal margins extend far beyond (0.41 mm) operculum as a protective cowl (Figs 30A, B, D, 31B, F). Distal margin of cowl dentate, consisting of up to 8 equilaterally triangular teeth (Figs 30D, 31B, F); inner face of cowl bears small spines aligned in parallel rows;

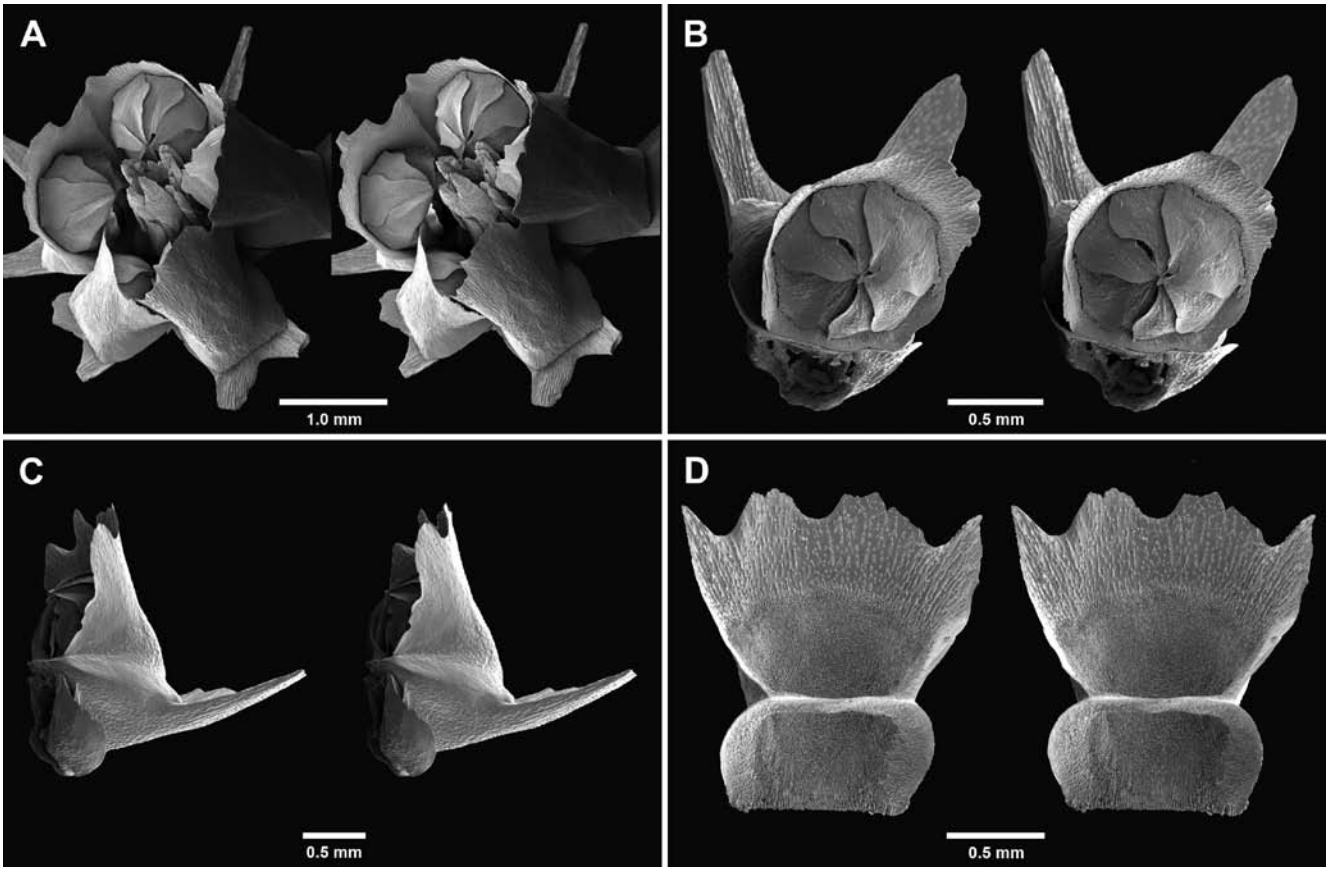

Figure 30. Holotype of *Calyptrophora cucullata*: A, apical view of a whorl of five polyps and several coenenchymal scales that surround the axis; B, apical view of a polyp showing the surrounding cowl and ridged inner face of basal spines; C, lateral view of a polyp also showing an infrabasal scale; D, inner surface of a fused buccal scale showing its dentate distal margin. All views are in stereo.

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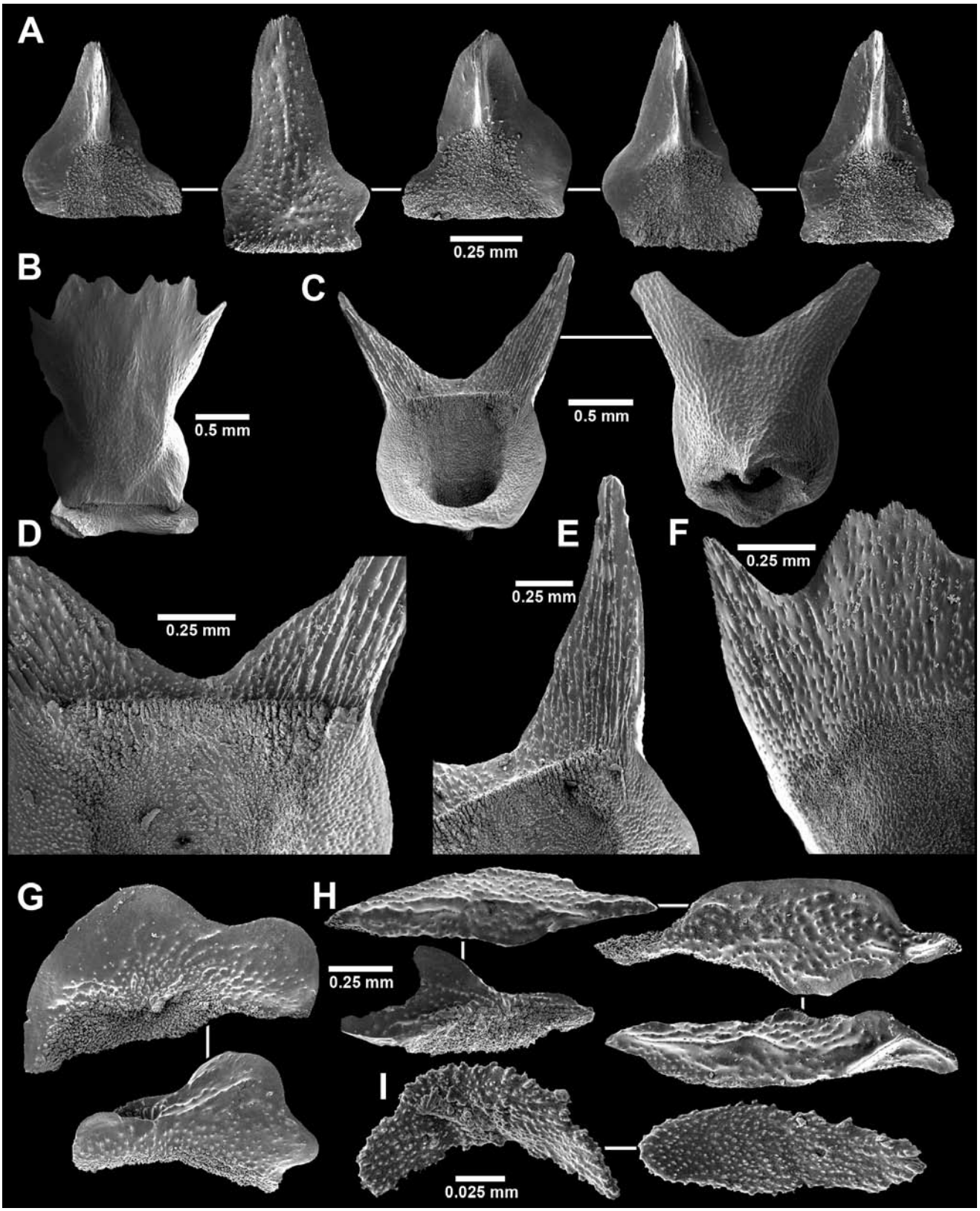

Figure 31. Sclerites from holotype of *Calyptrophora cucullata*: A, five opercular scales; B, adaxial view of a polyp (fused buccal scale); C, inner and outer surface of fused basal scale; D, articulating ridge of basal scale and two distal spines; E, articulating ridge of a basal scale and one distal spine; F, inner distal edge of a buccal spine; G, two infrabasal scales; H, four coenenchymal scales; I, two tentacular platelets. (Figs G and H share a common scale bar of 0.25 mm.)

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outer surface of cowl covered with small granules. Paired infrabasals crescent shaped and ridged, up to 1.0 mm in length and 0.51 mm in maximum height (Fig. 31G).

Operculum low in relief (Fig. 30B), almost flat, surrounded by the buccal cowl. Differential size of opercular scales not large from ab- to adaxial side of polyp (Fig. 31A), the abaxial operculars up to 0.71 mm in height (L:H = 1.5), the adaxials decreasing to about 0.45 mm in height (L:H = 1.15), and becoming slightly more equilateral in shape. All but abaxial operculars bear a protruding shoulder at their lower edge facing the adaxial side. Outer surface of operculars covered in small granules; lower inner side covered with tubercles, the distal half bearing a prominent medial keel. Tentacular platelets common: elongate, flat (thin), and curved about 45° along its longer axis, up to 120 μm in length and 37 μm in width (Fig. 31I).

Coenenchymal scales fusiform in shape, usually with two pointed tips, up to 1.1 mm in length and usually 0.18–0.28 mm in width. Outer surface covered with small granules and occasionally low, short ridges (Fig. 31H).

TYPES: Syntypes: TAN 0205/20, 22 branches from same colony, NIWA 14760, and numerous disarticulated polyps and SEM stubs 1547–1550 (USNM 1180235); TAN 0205/20, 20 branches, NIWA 11290 and 14759; Z9025, two colonies, NIWA 11150; NZOI Q57, branches with only two polyps, NIWA 14741.

TYPE LOCALITY: As for the species.

COMPARISONS: Only two other species (*C. antilla* Bayer, 2001 and *C. inornata,* n. sp.) have a lyrate branching mode followed by subsequent dichotomous branching of the branches. *Calyptrophora cucullata* is easily distinguished from *C. antilla* by having a well developed cowl, closely spaced whorls, flattened teeth on the margin of the buccal and basal scales (Figs 30D, 31D)(v. spines round in cross-section), more polyps per whorl, and more whorls per cm. It is distinguished from *C. inornata* by having prominent basal spines (also see Table 3).

ETYMOLOGY: From the Latin *cucullatus* (meaning hooded or cowled), in allusion to the prominent buccal scales.

REMARKS: Two specimens (NIWA 14765 and 15616) differ from the types in having shorter basal spines and a tendency to have exclusively lyrate branching, with no secondary branching of the branches. Otherwise they are similar and are interpreted as intraspecific variation, but not included in the type series.

Calyptrophora inornata n. sp. Figs 1, 9B, 32, 33

MATERIAL EXAMINED: Types.

DISTRIBUTION: Southern Norfolk Ridge, off Three Kings Island, Chatham Rise east of Chatham Island (Fig. 1), 885–954 m.

DESCRIPTION: Colonies uniplanar and branched in a lyrate fashion; however, branches from the two lateral stems also continue to branch dichotomously (Fig. 9B, and Cairns, 2009: fig. 8D). Holotype (Fig. 9B) only half of a colony 17 cm in length, having a basal main stem diameter of 1.5 x 2.9 mm; ascending branches occur every 10–12 mm along lateral stem. Longest colony (NIWA 42520) 31 cm in length and 7.1 mm in basal branch diameter, but largest colony, mostly denuded of polyps, 26 cm in length but with a massive basal main stem diameter of 24 mm. Axis bronze, larger-diameter branches being inflexible. Polyps directed upward, occurring in whorls of 6–9, the whorls fairly widely spaced resulting in about 4 whorls per cm. Whorl diameter 4.75–5.3 mm; horizontal length of polyps 1.6–1.9 mm.

Fused basal scales up to 1.4 mm in height, usually bent slightly toward branch, the distal 0.10–0.31 mm (5–23%, but usually 5–10% of scale) consisting of two short, flat buccal teeth, which are often eroded or broken (Figs 32A–C, 33D, E); outer surface of basal scales granular, inner face of buccal spines spinose (Fig. 33E). Fused buccal scales (Figs 32D, 33C) up to 1.33 mm and inclined toward branch, making an angle of 60–90° with basal scale. Distal margin of buccal scales straight, bearing no spines or lobes (Figs 32D, 33C); outer surface granular like that of basal scales, but strip directly adjacent to distal edge smooth. Both buccal and basal scales have rounded anterolateral edges. Infrabasals crescent-shaped, up to 1.1 mm in length and 0.43 mm in height (Figs 32D, 33F).

Operculum dome–shaped (Figs 32C, D), not protected by buccal scales. Opercular scales fairly flat (Fig. 33A), curved slightly along their longer axis to form curvature of dome, their outer surfaces covered with granules and small spines distally; outer tips of adaxial and outer lateral operculars also bear parallel ridges. Inner distal opercular surface bears a thick, rounded, smooth keel. Edges of operculars finely serrate (Fig. 33B), each serration about 3 μm in height. Abaxial operculars up to 0.90 mm in length (L:W = 1.7), the operculars becoming progressively smaller and more equilateral (i.e. lower L:W) toward adaxial side, where they are as short as 0.42 mm (L:W = 1.05–1.2). Tentacular platelets elongate, flat and curved in greater axis, up to 115 μm in length and 28–33 μm wide (Fig. 33H).

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Coenenchymal scales elongate (up to 1.3 mm in length) and extremely thick (up to 0.44 mm); outer surface granular, without ridging (Fig. 33G).

Types: Holotype: TRIP 1674/32, partial colony, several dry polyps, NIWA 11149, and four polyp whorls and SEM stubs 1565–1567, 1573–1576 (USNM 1180654). Paratypes: TRIP 1289 (Z9939), three large dry branches, NIWA 11303; TRIP 2232/2, one branch, NIWA 42568; TRIP 2551/140, one dry branch, NIWA 42520; TRIP 2744/75, two colonies, NIWA 65534; TRIP 2744/162, one branch, NIWA 65546; TRIP 2744/189, two branches, NIWA 70700; TRIP 2744/252, three branches, NIWA 65535; TRIP 2744/253, four branches, NIWA 65536; TRIP 2889/46, one colony, NIWA 66304; TRIP 3252/4, four branches, NIWA 69534.

Type Locality: 34.50°S, 168.3333°E (southern Norfolk Ridge), 874–1030 m.

Comparisons: *Calyptrophora inornata* belongs to the complex of species having upward-facing polyps and small to no basal spines (Group 2 of the *japonica*-complex sensu Bayer 2001). In fact, the polyps of *C. inornata* are remarkably similar to those of the western Atlantic *C. trilepis* (Pourtalès, 1868), but differs in having lyrate followed by dichotomous branching (not equal dichotomous branching, even though Bayer described *C. trilepis* as being lyrate), stiff branches (not flexible), 6–9 polyps per whorl (v. 2–4 polyps per whorl), larger polyps, and much thicker coenenchymal sclerites. Also, see Table 3 (p. 43) for additional comparisons

Remarks: A large colony 40 cm in height (TRIP 3235/14: NIWA 69574 and USNM 1180233) is identical to *C. inornata* except that its polyps face downward. In this genus the orientation of polyps has traditionally been considered to be conservative at the species level, and thus used to define and discriminate its species. It is thus disconcerting to find an otherwise identical specimen to *C. inornata* differing only in this character.

Etymology: From the Latin *inornatus* (meaning unadorned), an allusion to the simple look of the polyps caused by the lack of buccal and basal spines.

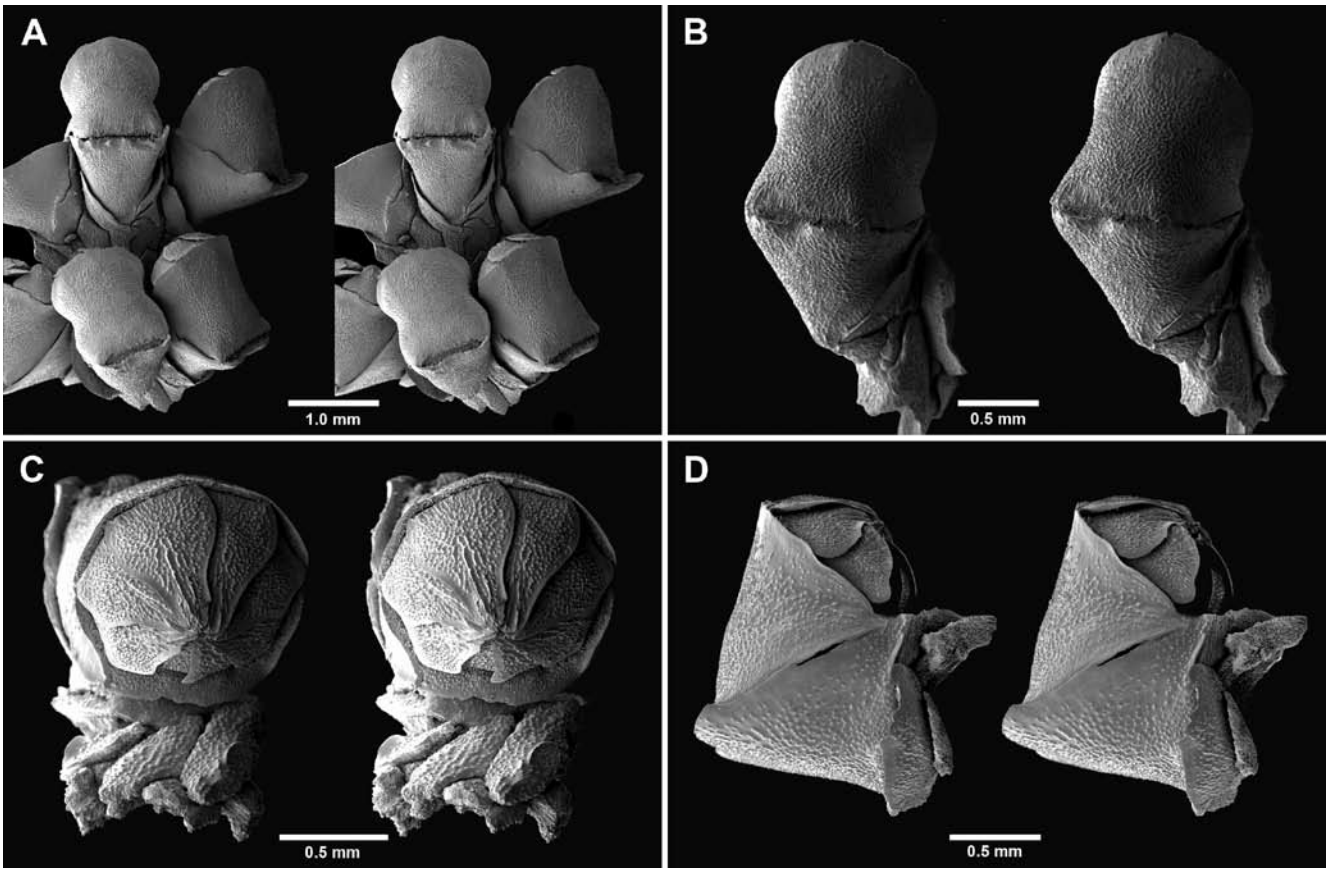

Figure 32. Holotype of *Calyptrophora inornata*: A, lateral view of two whorls of polyps; B, oblique abaxial view of a polyp showing its lack of marginal spination; C, apical view of a polyp and several thick coenenchymal scales; D, lateral view of a polyp showing one of its infrabasal scales. All views are in stereo.

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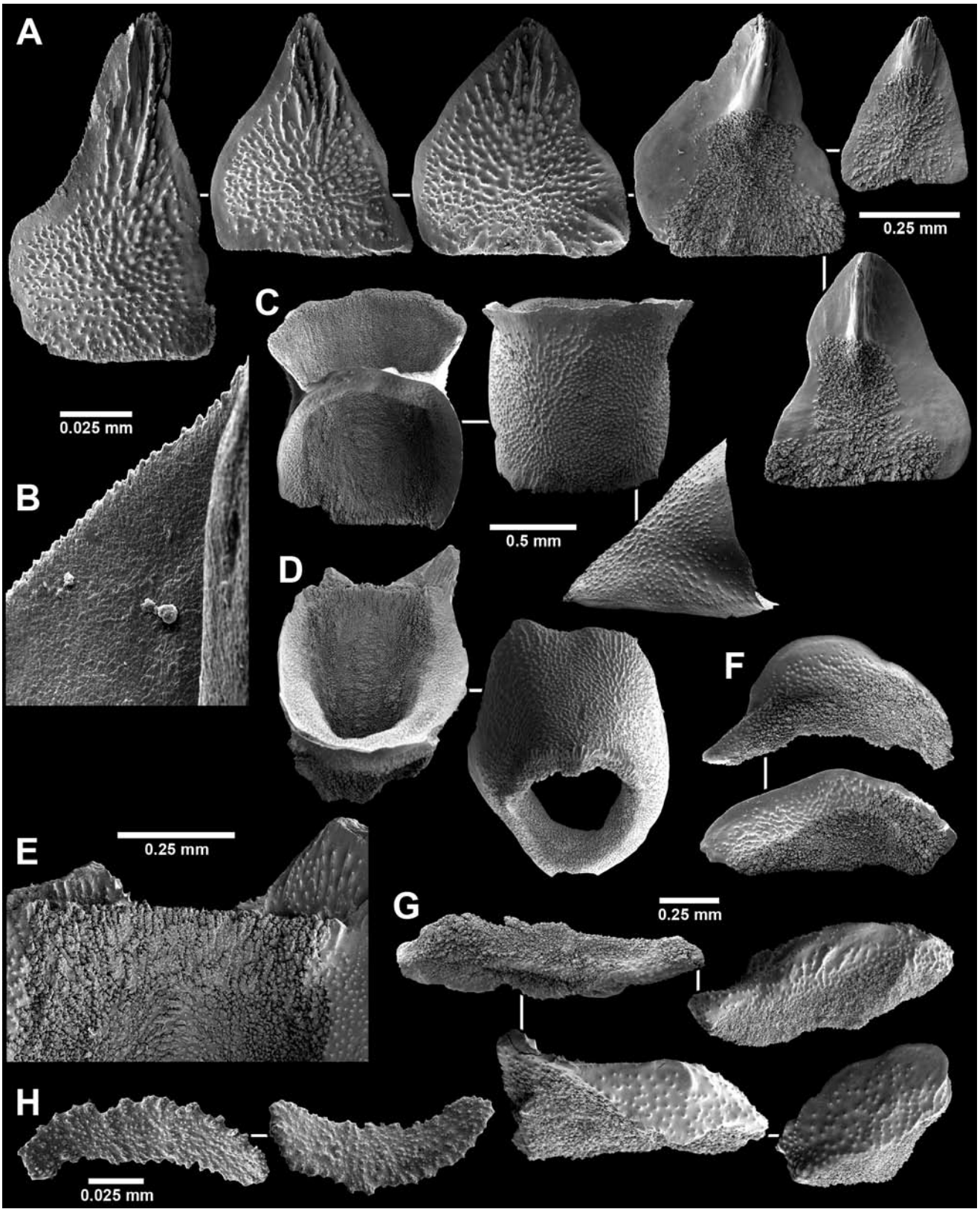

Figure 33. Sclerites from holotype of *Calyptrophora inornata:* A, six opercular scales; B, finely serrate edge of an opercular scale; C, three buccal scales; D, two basal scales; E, distal inner surface of a basal scale showing articulating ridge and distal spines; F, two infrabasal scales; G, four coenenchymal scales; H, two tentacular platelets. (Figs C and D share a common scale bar of 0.5 mm, and Figs F and G share a common scale bar of 0.25 mm.)

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Calyptrophora cristata n. sp. Figs 7, 9E, 34, 35

Material Examined: Holotype.

Distribution: Known only from type locality (Fig. 7).

Description: Colony lyrate biplanar, the two closely parallel planes of branching resulting from opposite bipectinate branching (Fig. 9E, and see Cairns, 2009: fig. 8E), the two lateral stems dividing from the main stem, each lateral stem producing a pair of ascending branches every 4–5 mm (opposite bipectinate). Holotype (Fig. 9E) 9 cm in length, representing only one side of a lyrate colony. Branches themselves unbranched and as long as 8 cm, growing parallel to one another; all branches fairly stiff. Axis brown-black in colour. Polyps directed upward, occurring in whorls of 4–6, the whorls fairly widely spaced (4/cm) such that coenenchymal scales are visible between whorls. Whorl diameter only 2.5–3.0 mm; horizontal length of polyps 1.4–1.6 mm.

Fused basal scales (Fig. 35D) up to 1.1 mm in height, usually bent up to 45° toward branch, the distal 0.1–0.2 mm (10–20% of height) consisting of two short, pointed, flattened spines, which bear several rows of aligned pointed granules on both their outer and inner faces (Fig. 35D, E). Adjacent to these spines toward the midline of the basal scale are a pair of broad, low (0.09–0.12 mm) lobes (Fig. 35E), which have granular surfaces. Outer surface of basal scales covered with low granules, as well as having prominent longitudinal ridges (Figs 34B, D, 35D) on the anterolateral right-angle edges that lead to the buccal spines. Fused buccal scales also up to 1.0 mm in length and inclined toward branch, making an approximately 90° angle with basal scale. Their distal margins bear four small (0.07–0.15 mm, or 7–16% of the total scale height), pointed, flattened spines (Figs 34A, C, D, 35B, C), which also bear rows of aligned pointed granules on both faces. Outer surface of buccal scales covered with granules and pointed spines. As well as having four longitudinal ridges that lead to the four distal spines, there are several additional ridges on the abaxial surface. Paired infrabasals crescent-shaped and robust, up to 1.0 mm in length and about 0.31 mm in height, although some up to 0.42 mm in height (Figs 34D, 35F).

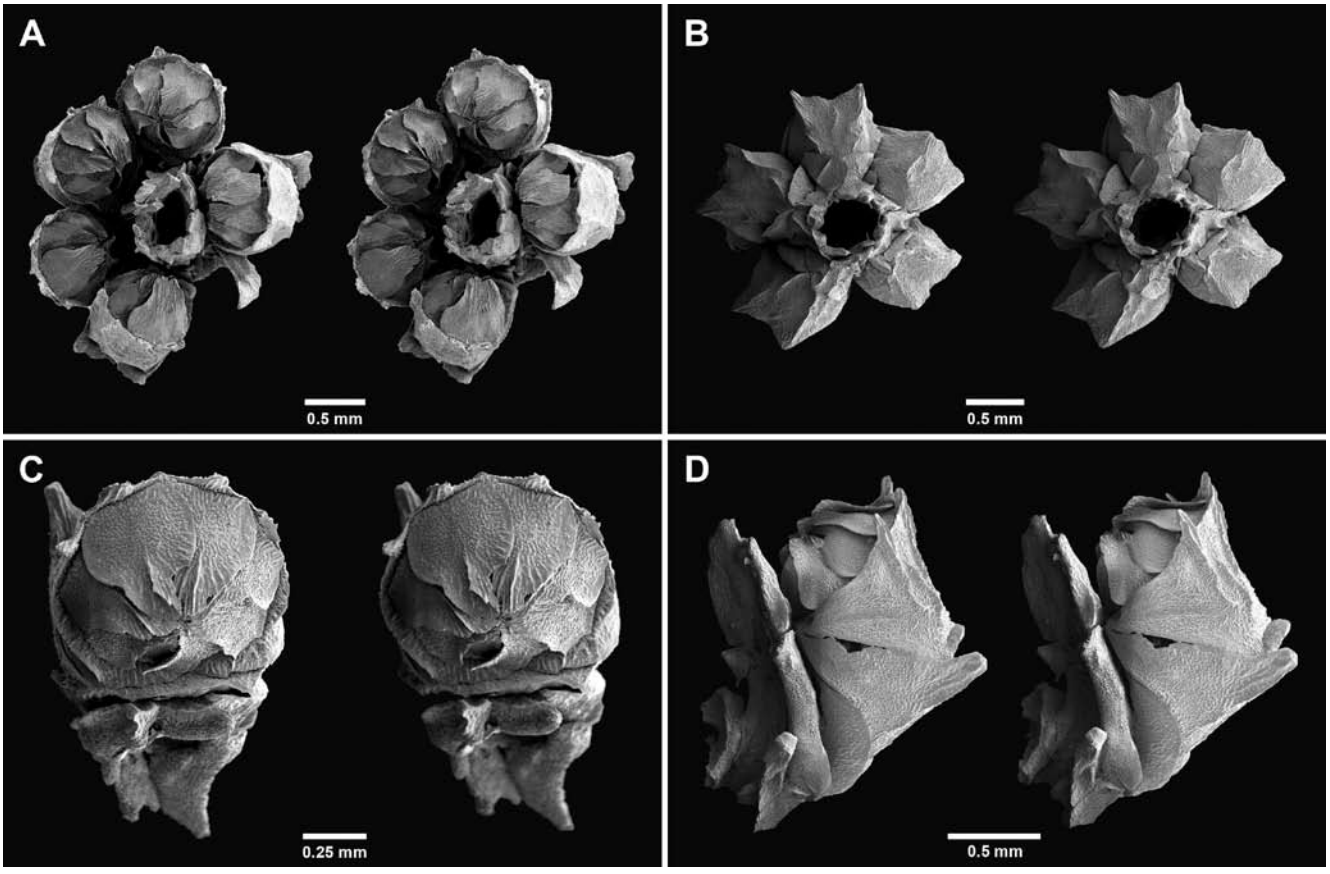

Figure 34. Holotype of *Calyptrophora cristata*: A, apical view of a whorl of five polyps and coenenchymal scales that surround the axis; B, basal view of a whorl of five polyps showing the ridged infrabasal scales and some coenenchymal scales; C, apical view of a polyp a several coenenchymal scales; D, lateral view of a polyp showing the buccal and basal spines. All views are in stereo.

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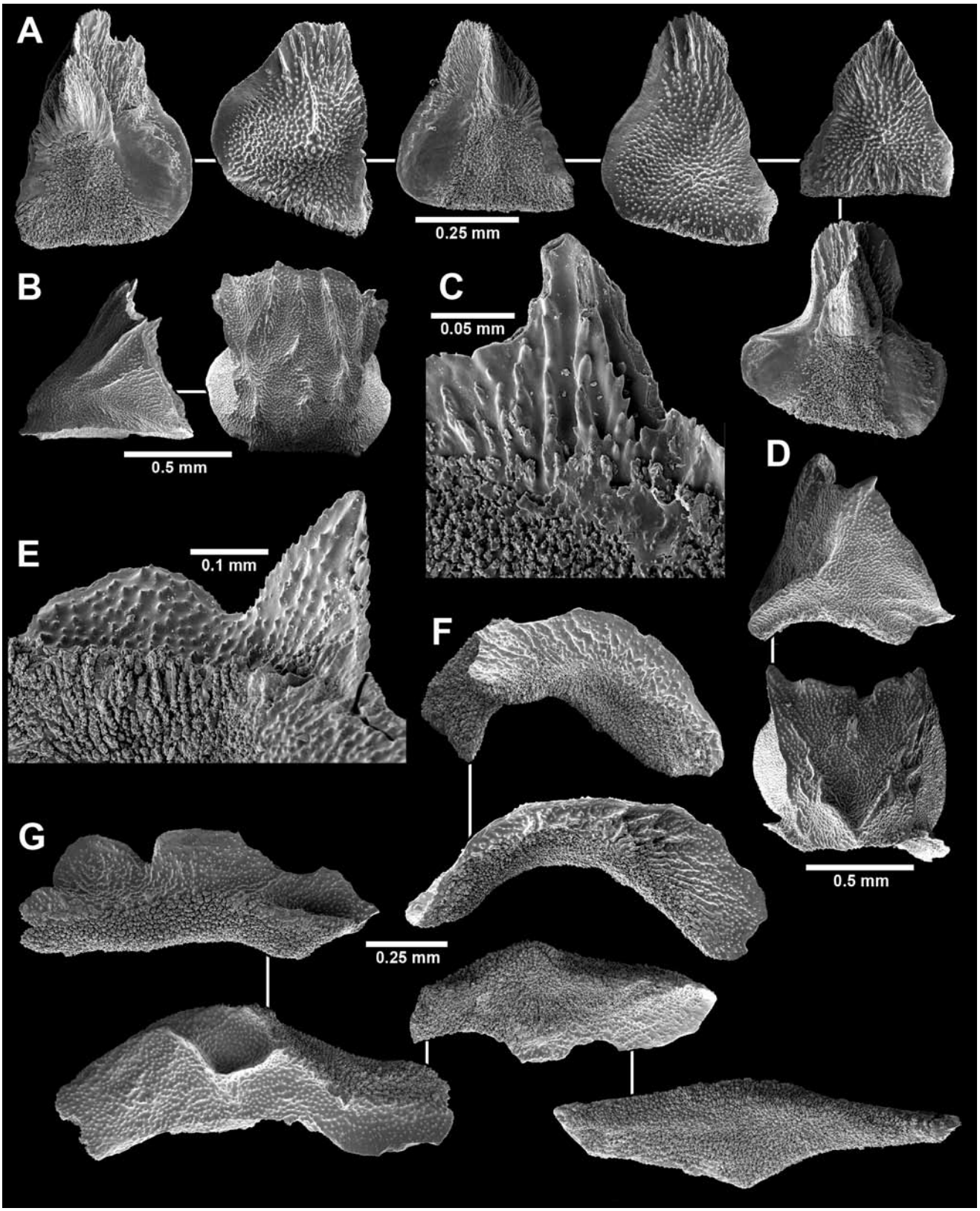

Figure 35. Sclerites from holotype of *Calyptrophora cristata:* A, six opercular scales; B, two buccal scales showing ornamentation on outer surface; C, inner distal face of buccal scale spine; D, two basal scales; E, inner distal face of basal scale spines; F, two infrabasal scales; G, four coenenchymal scales. (Figs F and G share a common scale bar of 0.25 mm.)

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Operculum conical, protected by the four short buccal spines (Figs 34C, D). Opercular scales relatively flat (Fig. 35A), their outer surface covered with low rounded granules, and in the case of the abaxial and outer laterals, bearing parallel ridges on their distal edges. Distal inner opercular face bears a prominent, thick, spade-shaped keel (Fig. 35A, lower right). Abaxial and outer lateral operculars up to 0.55 mm in length with an L:W ratio ranging from 1.1–1.3, the opercular scales becoming progressively smaller and more equilateral in shape toward adaxial side, where they are as short as 0.41 mm with an L:W of 1.0–1.2. Tentacular platelets not noted.

Coenenchymal scales elongate and often irregular in shape, up to 1.2 mm in length and 0.32 mm in width; scales moderately thick (0.1–0.15 mm), and often ridged on outer surface, these thin longitudinal ridges being up to 0.18 mm in height (Fig. 35G).

TYPES: Holotype: Station Z2098, one partial colony and dried polyps, NIWA 11157, and four branches and SEM stubs 1561–1564 (USNM 1180231).

TYPE LOCALITY: 28.6583°S, 173.0167°E (Betty Guyot, east slope of Three Kings Rise), 850 m.

COMPARISONS: *Calyptrophora cristata* is very similar to *C. japonica* (see Cairns & Bayer 2009, fig. 15i–j), these being the only species in the genus to have opposite bipectinate branching. The spination of the basal and buccal scales and polyp size are also similar. However, C. *cristata* differs in having ridges on its basal and buccal scales, an extra pair of lobes on the basal scales, shorter basal spines, ridged coenenchymal scales, and slightly fewer whorls per cm (six v. four) resulting in correspondingly smaller polyps (1.2–1.7 mm in length). The small size of its basal spines ally it to *C. trilepis* and *C. angularis*, but its colony shape, as well as other characters, differentiate from those species. Also see Table 3 (p. 43) for more comparisons.

ETYMOLOGY: From the Latin *cristatus* (meaning crested or ridged), alluding to the fine ridges and crests occurring on the buccal and basal body-wall scales, respectively.

Calyptrophora niwa n. sp. Figs 5, 9G, 36, 37

MATERIAL EXAMINED: Types.

DISTRIBUTION: Northwestern Chatham Rise, southern Kermadec Ridge (Fig. 5), 1284–1411 m.

DESCRIPTION: Holotype uniplanar, equally and dichotomously branched (Fig. 9G, and see Cairns 2009, fig. 8B) beginning only 6 mm above attached base. Colony 19 cm tall, with a basal main stem diameter of 3.1 mm; branches fairly flexible. Polyps directed upward on all branches, including main stem, occurring in whorls of 4–6, the polyps laterally closely spaced within a whorl but whorls slightly separated such that coenenchyme can be seen between them; approximately four whorls per cm branch length. Whorl diameter 5.0–5.5 mm, including basal spines; horizontal length of polyps 2.0–2.2 mm. Axis bronze; polyps and coenenchyme white.

Fused basal scales up to 2.2 mm in height and stand perpendicular to branch, the distal 0.7–1.0 mm (or 45–50%) consisting of two broad, pointed, slightly forward-curved spines (Figs 36A, E, 37C, D). Base of basal spines flattened but thick, covered with 10–12 ridges of irregularly aligned spines (Fig. 37E); distal part (terminal 0.45 mm) round in cross-section and smooth. Outer surface of basal scales granular; articulating ridge well–developed (Fig. 37E). Fused buccal scales up to 1.7 mm in length and inclined toward branch, making an approximately 45° angle with basal scale (Figs 36A, B, E, 37B); rarely two buccals present in same polyp. Distal margin of buccal scales bear four or six spines (Fig. 37B), which seem to be paired across the midline, some paired spines much smaller than others, the longest up to 0.6 mm (up to $^1/_5$ to $^1/_3$ total length of scale). Buccal spines round in cross-section, with a smooth distal tip, outer surface of buccals granular like that of basals. Paired infrabasals crescent-shaped and robust (Figs 36E, 37F), up to 1 mm in length and 0.45 mm in height near polyp midline; often two pairs of infrabasals are present (Fig. 36E).

Operculum dome-shaped (Figs 36C–E), protected only marginally by buccal scales (Figs 36C, D). Opercular scales relatively flat (Fig. 37A), with only a slight longitudinal crease on their outer side, and a thick, rounded, blunt keel on the inner surface; outer side covered with low granules and short rows of spines near apex. Abaxial operculars up to 0.75 mm in length with an L:W ratio ranging from 1.5–1.7, the opercular scales becoming progressively smaller and more equilateral in shape toward adaxial side, where they are as short as 0.45 mm with an L:W of 1.1–1.3. Tentacular platelets large, up to 130 µm in length and 36–50 µm in width, typical in shape for the genus: elongate, flat, and curved along their longer axis (Fig. 37H).

Coenenchymal scales quite long and slender, up to 1.4 mm in length and 0.23–0.37 mm in width, fitting together in a mosaic-like pattern. Coenenchymals of moderate thickness (0.1–0.15 mm), with blunt tips, and covered with small granules on outer surface (Fig. 37G).

TYPES: Holotype: Station TAN 0705/211, one colony in alcohol and some dry polyps, NIWA 28792, and dis-

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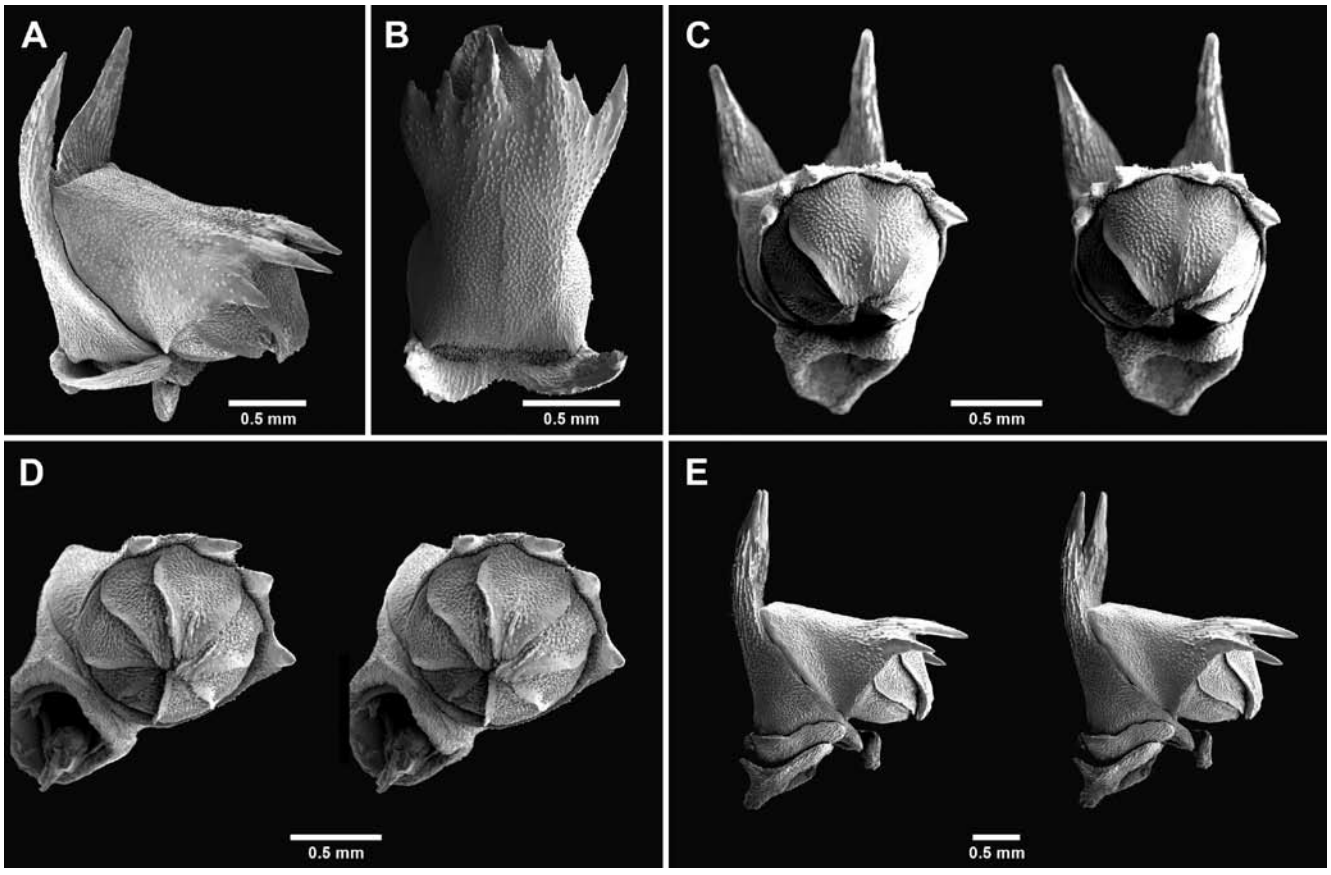

Figure 36. Holotype of *Calyptrophora niwa*: A, lateral view of a polyp; B, abaxial view of a polyp; C, apical view of a polyp showing spinose basal and buccal scales; D, oblique apical view of a polyp; E, lateral view of a polyp showing infrabasal scales. All views are in stereo.

articulated polyps and SEM stubs 1557–1560 (USNM 1180229). Paratypes: TAN 1007/52, two colonies, NIWA 64456; TAN 1007/53, one colony, NIWA 64492.

TYPE LOCALITY: 42.6547°S, 177.2132°W (the northern slope of Chatham Rise), 1377–1402 m.

COMPARISONS: Four other species of *Calyptrophora* have upward-facing polyps and equal dichotomous branching, all of which are fairly similar: *C. trilepis* (Pourtalès, 1868), *C. microdentata* Pasternak, 1985, *C. gerdae* Bayer, 2001, and *C. clarki* Bayer, 1951. *C. niwa* is easily distinguished from *C. trilepis* by having buccal and basal marginal spines. *Calyptrophora microdentata* differs in having unridged basal spines, more slender buccal spines, and smaller polyps. *Calyptrophora gerdae* also has smaller polyps and a buccal edge consisting of thin lobate teeth that form a cowl around the operculum. *Calyptrophora clarki* is the closest to *C. niwa*, but differs in having long and slender buccal spines that are ridged to their tips, and rarely occurring as more than 2 per polyp. *C. niwa* also has more slender basal spines and smaller polyps. Also see Table 3 (p. 43).

ETYMOLOGY: Named for the acronym of the National Institute of Water & Atmospheric Research (NIWA), Kilbirnie, Wellington, the organisation that collected all the specimens included in this report.

Calyptrophora clinata Cairns, 2007

Figs 3, 9D, 38, 39

Calyptrophora clinata Cairns, 2007: 254–257, figs. 1C, 8–10.— Cairns & Bayer 2009: 31 (listed).

MATERIAL EXAMINED: KAH 0204/32, nine branches and hundreds of disarticulated polyps (dry), NIWA 11136, 11286, 11287, and SEM stubs 1551–1556 (USNM 1179343); KAH 0204/40, three branches, NIWA 11163; TAN 0413/45, one alcohol branch and two dry branches, NIWA 15614, 15615, respectively; TAN 0205/47, three branches, NIWA 14764; TAN 9912/DR3, six branches, NIWA 27981; TRIP 2472/42, one colony, NIWA 77557; types of *C. clinata*.

DISTRIBUTION: Corner Rise Seamounts, North Atlantic (1315–1842 m); southern Colville Ridge, northern Three Kings Ridge, off North Cape (Cavalla Seamount), North Island, New Zealand, West Norfolk Ridge (Fig. 3), 810–820 m.

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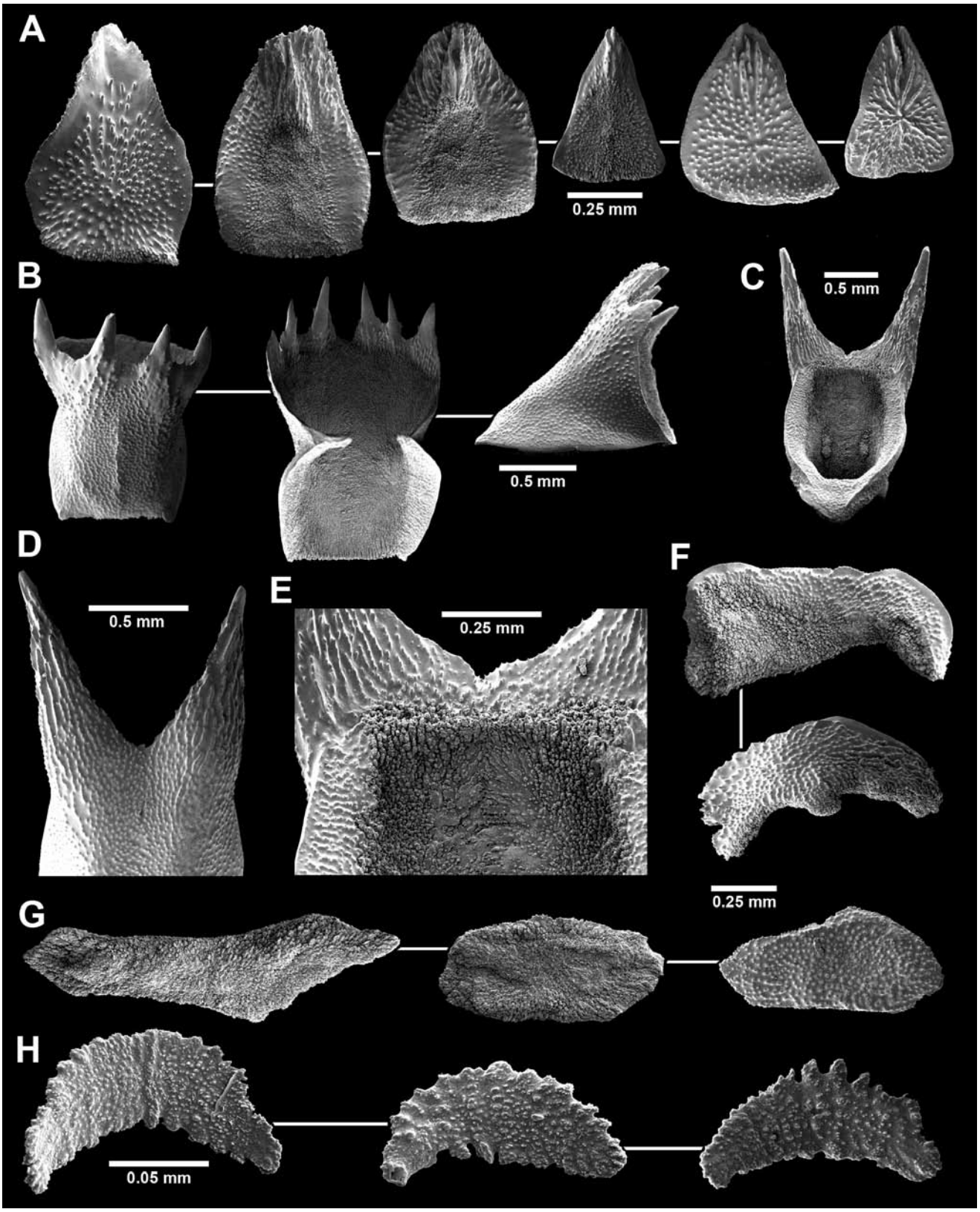

Figure 37. Sclerites from holotype of *Calyptrophora niwa:* A, six opercular scales; B, ab-, adaxial, and side views of three buccal scales; C, inner surface of a basal scale; D, outer surface of basal scale spine; E, articulating ridge of a basal scale; F, two infrabasal scales; G, three coenenchymal scales; H, three tentacular platelets. (Figs F and G share a common scale bar of 0.25 mm.)

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DESCRIPTION: Colonies unbranched (flagelliform). Largest branch fragment 23 cm (NIWA 11136, Fig. 9D), with a basal axis diameter of 2.6 mm, but largest colony (also from type locality) 22 cm long with a basal axis diameter of 4.0 mm; no colonies have an intact base. Polyps directed downward (toward the base), occurring in whorls of 7–12, the polyps within a whorl tightly packed, but with some space between adjacent whorls (about 4.5 whorls/cm) affording some view of underlying coenosteal sclerites. Whorl diameter, including the elongate basal spines, up to 9.6 mm; horizontal length of polyps 2.5–2.8 mm. Axis bronze or straw yellow in colour.

Fused basal scales up to 4.8 mm in height, the distal 2.7–3.1 mm (or 60–65%) constituting the elongate basal spines (Figs 38A–C, 39C–E); basal scales not perpendicular to branch, rather tilt slightly downward. Elongate basal spines gently curved upward, away from polyp body (Figs 38A, C). Lower portion of basal spines flat (Fig. 39E), becoming round in cross-section distally; both inner and outer surfaces of spines bear prominent serrate ridges (Figs 39E, F), 10–12 parallel ridges occurring on the lower, inner face adjacent to articulating ridge, the latter being well developed (Fig. 39E). Outer surface of basal scales, exclusive of spines, granular. Fused buccal scales (Figs 38B, C, 39B, D) up to 1.8 mm in length and strongly inclined (Fig. 38C) toward branch, making an approximately 30° angle with the perpendicular basal scale, directed straight down and almost touching branch surface. Their distal edges are delicate, forming a translucent cowl around operculum. Distal margin of cowl quite variable in shape, sometimes bearing a flat, upturned medial tooth (Fig. 38B), sometimes two or more rounded lobes, sometimes two short spines (Fig. 39D), and occasionally straight (Fig. 39B), all these morphologies present within the same whorl of polyps. Occasionally a second buccal scale underlies the primary (Fig. 39D). Outer surface of buccals granular, inner surface of cowl covered with rows of low spines. Paired infrabasals crescent-shaped, up to 2.2 mm in length and 0.75 mm in height, often remaining on branches that otherwise have lost their polyps (Fig. 39G).

Operculum conical, surrounded by a buccal cowl, but usually visible from lateral view. Opercular scales triangular, to rectangular, to almost circular (Fig. 39A), depending on position in polyp. Abaxial operculars up to 0.8 mm in length, the operculars decreasing in size

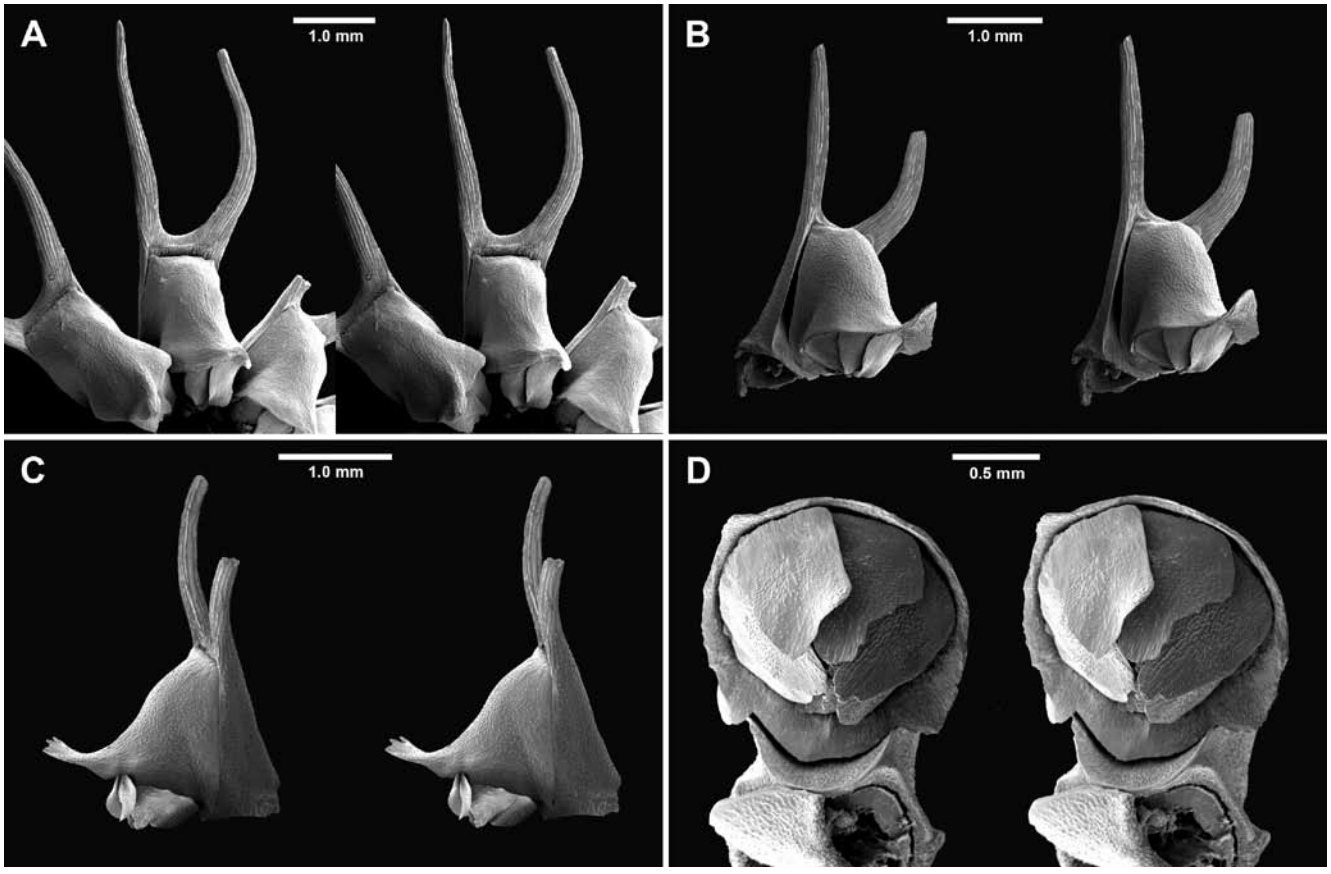

Figure 38. *Calyptrophora clinata* from KAH 0204/32: A, a partial whorl of polyps showing the ridged buccal spines; B, abaxial view of a polyp; C, lateral view of a polyp showing recurved buccal spines; D, apical view of a polyp showing only six opercular scales. All views are in stereo.

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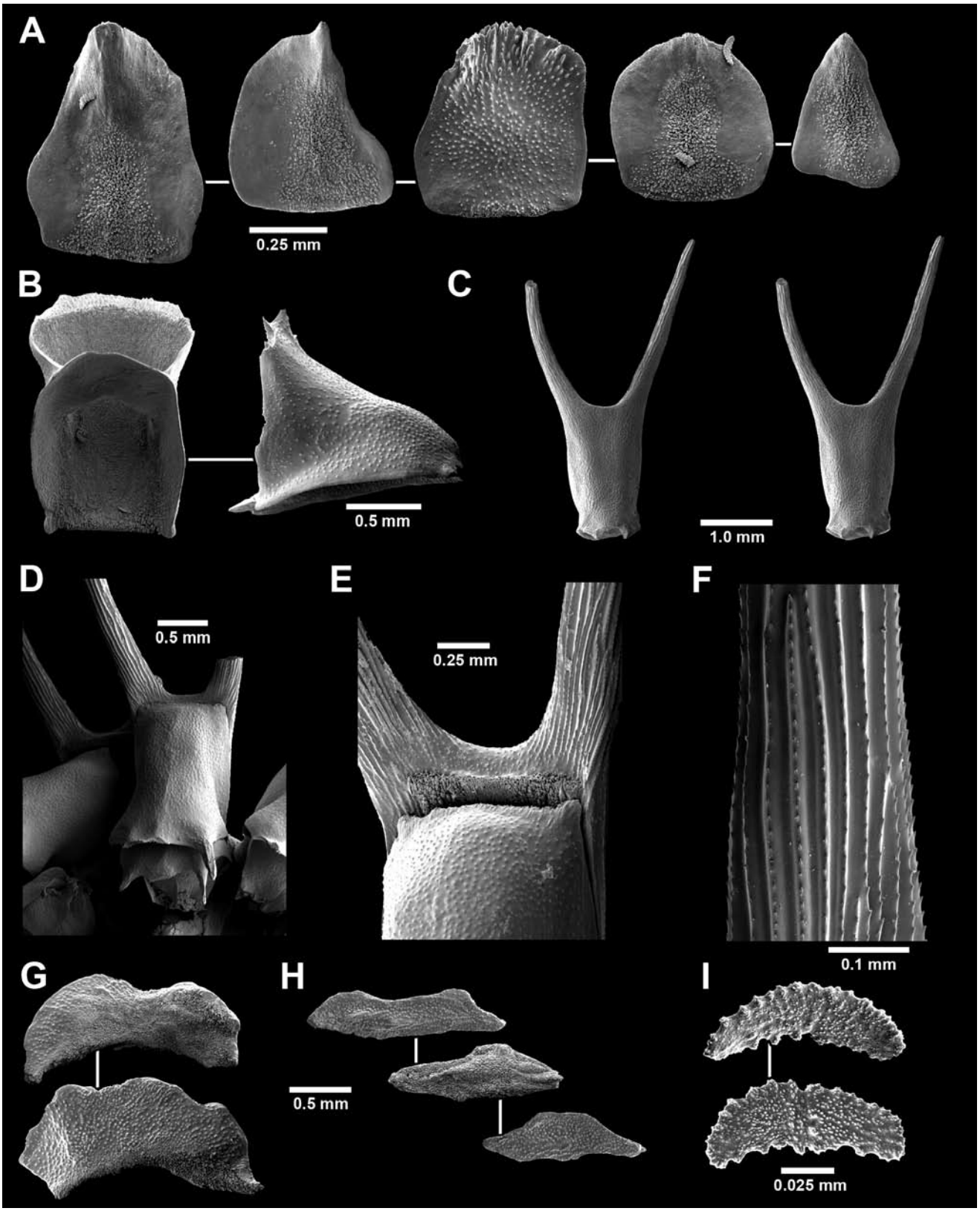

Figure 39. Sclerites of *Calyptrophora clinata* from KAH 0204/32: A, five opercular scales; B, adaxial and lateral views of buccal scales; C, outer view a basal scale, in stereo; D, abaxial view of a polyp showing spines of basal scale and a double set of buccal scales; E, intact polyp showing articulating ridge and inner ridging of a basal scale spine; F, serrate ridges of a basal scale spine; G, two infrabasal scales; H, three coenenchymal scales; I, two curved tentacular platelets. (Figs G and H share a common scale bar of 0.5 mm.)

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toward adaxial side where they are about 0.45 mm in length; L:W ratios vary from 1.03 to 1.36. Outer surface of operculars granular, like other scales; inner surface tuberculate basally, but otherwise smooth; each opercular has a longitudinal concavity on its outer surface that corresponds to a broad convexity on the inner side, but there are no opercular keels. Tentacular platelets common: elongate, flat (thin), and curved about 45° along its longer axis, up to 100 µm in length and 28–36 µm in width (Fig. 39I).

Coenenchymal scales fusiform in shape, usually with two pointed tips, up to 1.6 mm in length and 0.25–0.32 mm in width; outer surface granular, inner surface tuberculate (Fig. 39H).

TYPES: The holotype is deposited at the NMNH (USNM 1096714).

TYPE LOCALITY: 34°39.82′N, 49°49.01′W (Verrill Peak of Caloosahatchee Seamount of Corner Rise Seamounts, North Atlantic), 1316 m.

COMPARISONS: Only four species of *Calyptrophora* have downward-facing polyps, *C. clinata* being the only one having an unbranched colony. Also, see Table 3.

REMARKS: Although occurring virtually on the opposite sides of the globe, with no known intermediate populations, the New Zealand specimens of *C. clinata* are morphologically identical to the typical North Atlantic Corner Rise Seamounts populations, including aspects of branching, polyp orientation, morphology of the body-wall scales, relative sizes of the opercular scales, lack of opercular keel, coenenchymal sclerite shape, and anchoring infrabasal scales. The New Zealand specimens do have larger polyps, almost twice the size of those from the North Atlantic, and consequently longer buccal scales and spines, as well as a larger whorl diameter, but other than size-related differences they appear to be the same species. Watling *et al.* (2008) have reported several morphologically similar pairs of sibling species in other deep-water coral genera, one of the pair occurring on the North Atlantic New England Seamounts, the other in the central or southwest Pacific. They suggest the explanation for this relationship is the movement of North Atlantic Deep Water through the previously open Central American Seaway as late as 11 Mya. Some species of deep-water Scleractinia also have such a disjunct distribution, such as: *Vaughanella concinna* Gravier, 1915, *Stephanocyathus coronatus* (Pourtalès, 1867), *Gardineria paradoxa* (Pourtalès, 1868), *Coenosmilia arbuscula* Pourtalès, 1874, *Tethocyathus cylindraceus* (Pourtalès, 1868) and *Dasmosmilia lymani* (Pourtalès, 1981) (see Cairns 1995, 1999 and Cairns & Zibrowius 1997).

Calyptrophora diaphana n. sp. Figs 3, 9A, 40, 41

MATERIAL EXAMINED: Types.

DISTRIBUTION: Off Coromandel Peninsula and seamount east of Three Kings Ridge (Fig. 3), 680–990 m.

DESCRIPTION: Colony uniplanar and lyrate in branching, the ascending branches parallel to one another, unbranched, and up to 16 cm in length; branches occur every 9–10 mm from lateral stems. Holotype (Fig. 9A) represents only one half of a colony, measuring 24 cm in length, with a basal main stem diameter of 3.5 mm; paratype from NIWA 11306 55 cm in length; branches fairly stiff. Axis straw yellow in colour. Polyps directly downward, occurring in whorls of four or five on distal branches (Figs 40A, 41A), up to six or seven on larger-diameter branches, the whorls fairly well spaced (3–3.5 whorls per cm) such that coenenchymals can be seen between whorls. Whorl diameter 5.5–6.5 mm; horizontal length of polyps 2.5–2.8 mm.

Fused basal scales (Figs 40C, E, 41D) up to 2.4 mm in height, oriented perpendicular to branches, the distal 0.75–1.0 mm (35–45%) consisting of a thin, translucent lobe, which has a straight (not spinose) distal margin, occasionally having a shallow medial notch. Outer surface of basal scales covered with low granules, inner surface of lobe bears low aligned granules; anterolateral margin of scale rounded; articulating ridge well defined (Fig. 41E). Fused buccal scales (Figs 40C, E, 41C) up to 2.3 mm in height, making an approximately 90° angle with its basal scale. Distal margin of buccal scales (Figs 40E, 41C) project up to 0.75 mm (33% of length of buccal scale) as a thin, translucent, slightly flared cowl (Fig. 40D), the cowl having a straight (non-spinose) distal edge. Like the basal scale, outer surface covered with very low granules, almost smooth in texture. Paired infrabasals crescent–shaped (Figs 40E, 41G), up to 2.2 mm in length and 0.55 mm tall, a second pair of infrabasals occurring in some polyps.

Operculum conical and low, completely surrounded by the extensive buccal cowl. Opercular scales (Fig. 41B) slightly concave above, corresponding to a narrow longitudinal keel on inner surface. Single abaxial opercular scale almost rectangular (Figs 40D, 41B, upper left), its widest point being midway to the tip, up to 1.2 mm in length (L:W = 1.2). Single adaxial opercular, aligned opposite the abaxial on the polyp midline, triangular (Figs 40B, 41B, lower right), and about 0.7 mm in height (L:W = 1.1). Three pairs of lateral scales somewhat asymmetrical in shape, ranging from 0.85–1.15 mm in length. Outer face of operculars almost smooth, bearing only small granules. Tentacular platelets not noted.

Coenenchymal scales elongate, up to 1.6 mm in length, with blunt tips and smooth outer surfaces (Fig. 41F).

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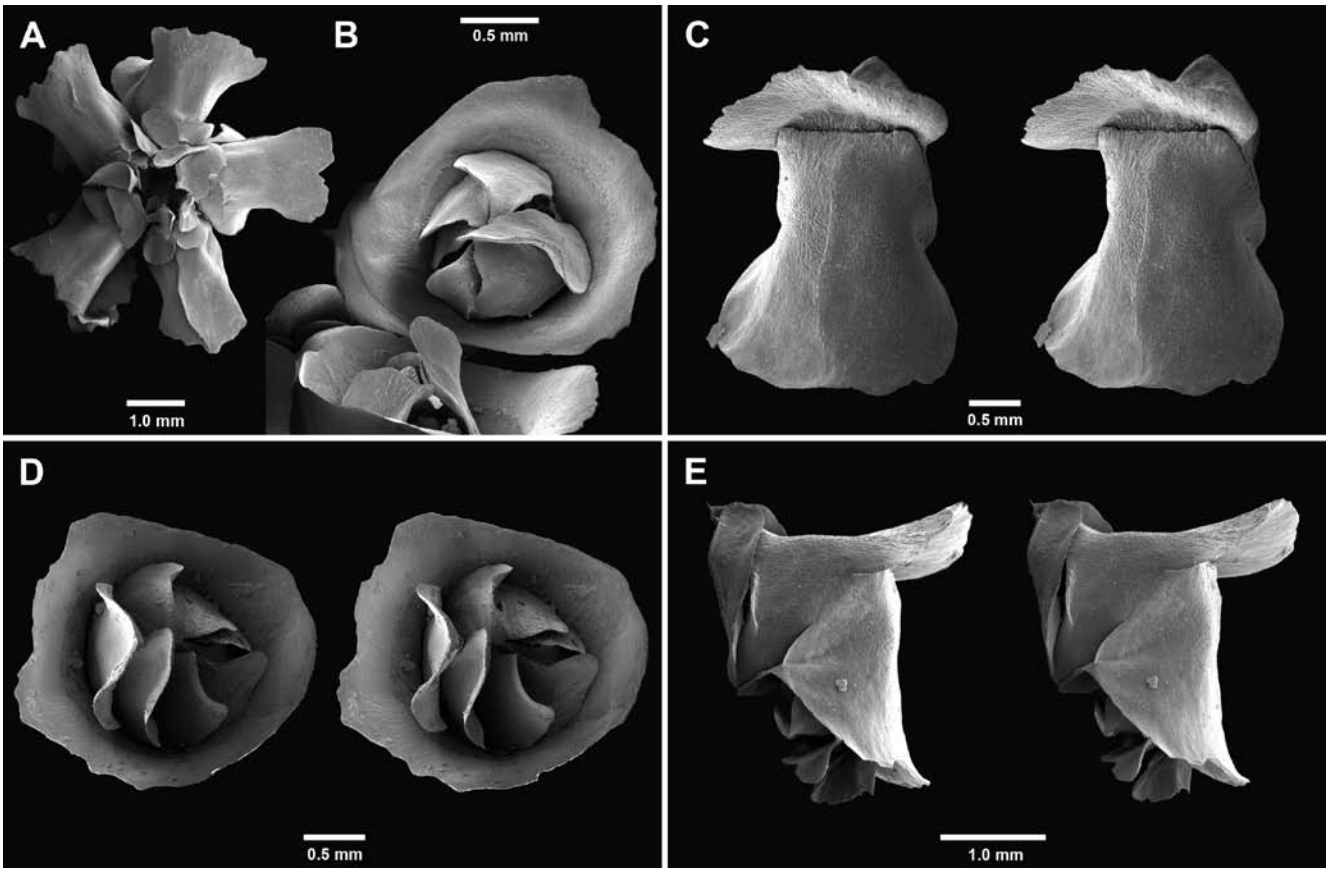

Figure 40. Holotype of *Calyptrophora diaphana*: A, basal view of a whorl of five polyps showing large infrabasal scales; B and D, apical views of a polyps showing the prominent buccal cowl; C, abaxial view of a polyp; E, lateral view of a polyp showing infrabasal scale. Figures C-E are stereo views.

TYPES: Holotype: KAH 9907/53, one colony and some dry polyps, NIWA 11307, and one branch and SEM stubs 1568–1572, 1577 (USNM 1180656). Paratype: one colony from same station as holotype, NIWA 11306; Z9025, one branch, NIWA 77556.

TYPE LOCALITY: 36.5045°S, 176.5075°E (continental slope off Coromandel Peninsula, North Island, New Zealand), 990 m.

COMPARISONS: Only three other species of *Calyptrophora* have downward-facing polyps (*C. wyvillei, C. agassizii*, and *C. clinata*); *C. diaphana* differs from those three in having a lyrate colony and non-spinose buccal scales (also see Table 3, p 43).

ETYMOLOGY: From the Neo-Latin *diaphanus* (meaning transparent, translucent, or diaphanous), an allusion to the thin body-wall scales, and the translucent buccal cowl.

Calyptrophora wyvillei Wright & Studer, 1889
Figs 4, 9I, 42, 43

Calyptrophora wyvillei Wright & Studer, 1889: 52, pl. 19, figs. 2, 2a, pl. 20, fig. 5.—Cairns 2009: 429–432, figs. 1D, 11–12 (complete synonymy).
Calyptrophora versluysi Nutting, 1908: 579, pl. 43, fig. 8.

MATERIAL EXAMINED: Station TAN 0205/32, branches, NIWA 14761, and SEM stubs 1578–1581, 1589–1590, 1625–1626 (USNM 1179345); K806, one colony, NIWA 76207); reference material from Hawaiian Islands (see Cairns 2009).

DISTRIBUTION: Kermadec Islands (Fig. 4), Celebes Sea, Hawaiian Islands, 784–1278 m.

DESCRIPTION: Colony essentially uniplanar and lyrate in branching; however, at first branching node from the main stem and at the next 2–4 branching nodes of the lateral stems on either side of the lyre, 3–4 ascending branches diverge both in the plane of the lyre and out of the plane, conferring a slightly bushy aspect to the colony (Fig. 9I). Branching nodes occur every 2 cm; branches often subsequently divide dichotomously;

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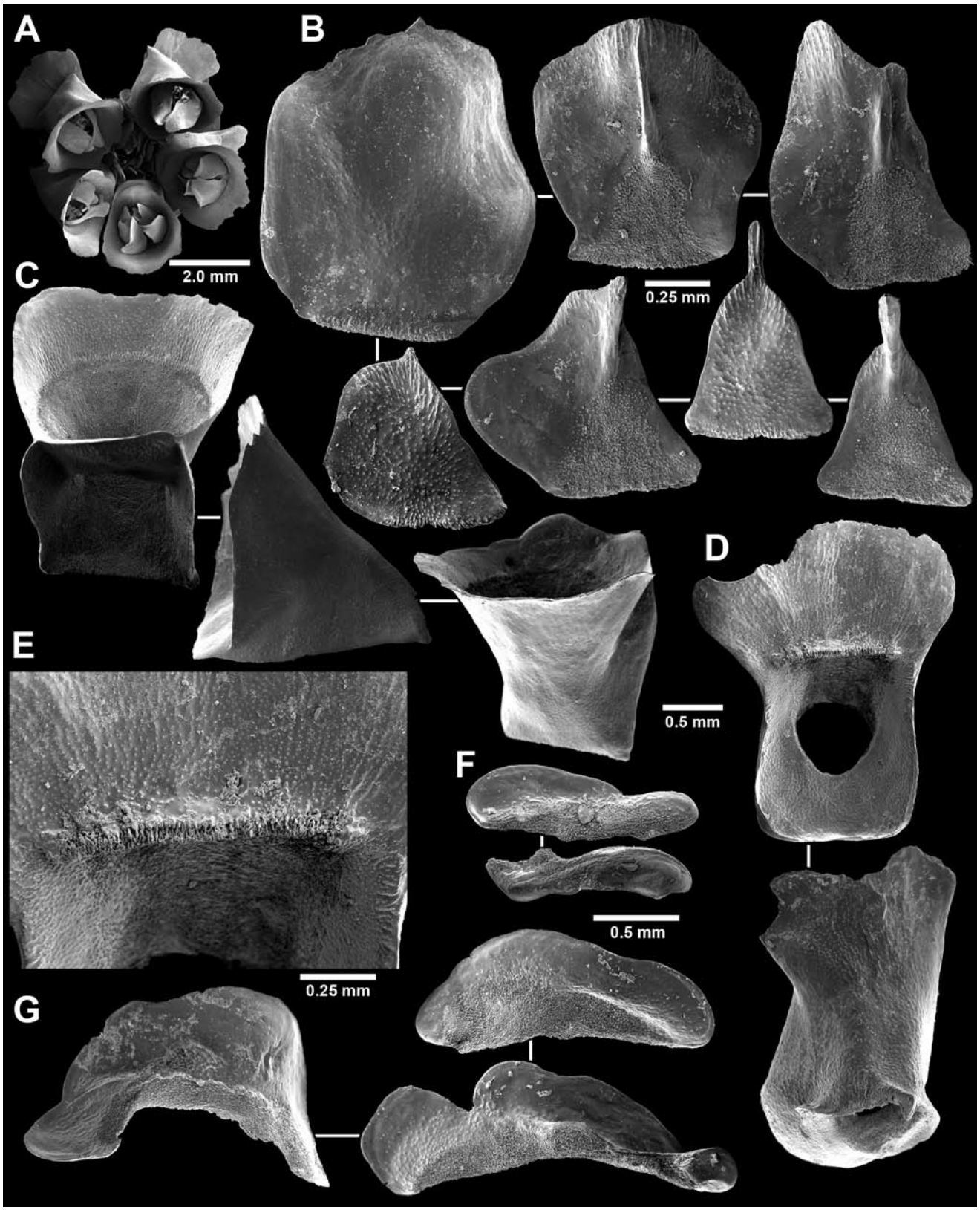

Figure 41. Polyp whorl and sclerites from holotype of *Calyptrophora diaphana*: A, upper view of a polyp whorl; B, seven opercular scales; C, adaxial, lateral, and abaxial views of buccal scales; D, inner and outer views of basal scales; E, articulating ridge of a basal scale; F, two coenenchymal scales; G, three infrabasal scales. (Figs C and D, and F and G share common scale bars of 0.5 mm.)

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branches quite stiff. Most intact colony (K806, Fig. 9I) 11 cm in height and 3.4 mm in basal branch diameter. Axis bronze in colour. Polyps directed downward, occurring in whorls of 4–5, and fairly closely spaced (3.5–4.0 whorls per cm). Whorl diameter 4.0–4.5 mm; horizontal length of polyps 2.1–2.7 mm.

Fused basal spines (Fig. 43D) up to 1.9 mm in height, the distal 0.6–0.95 mm (up to 50% of height) consisting of two flat, usually triangular-shaped teeth (Figs 42A, 43D); articulating ridge well-defined (Fig. 43C). Inner face of basal teeth not ridged, but do bear small aligned granules, and outer surface of scale also bears low granules. Fused buccal scales (Figs 42A, 43B) 1.6–1.85 mm in length, oriented parallel to branches, making an approximately 90° angle with the perpendicular basal scale. Distal margin of buccal scales usually straight (Fig. 43B) and delicate, rarely undulating or bearing low teeth (Fig. 42A); buccals slightly constricted medially. Outer surface of buccals granulated like basals. Paired infrabasals crescent-shaped and robust (Fig. 43E), up to 1.5 mm in length and up to 0.55 mm in height. A second, or lower pair of infrabasals (Fig. 42C) is usually present which serves as an "anchor scale" helping attach the polyp to the coenenchymal scales. These lower infrabasals often remain attached to the stem after the polyp has become unattached.

Operculum conical and easily seen in lateral view (Fig. 42C), the distal edge of buccals affording little cover (0.15 mm skirt) to opercular scales. Abaxial opercular scales elongate and tongue-shaped (up to 1.25 mm in length and L:W = 1.9–2.1), lateral operculars somewhat asymmetrical and sometimes misshapen (up to 1.8 mm in length), adaxial operculars triangular (only up to 0.6 mm in length with an L:W = 1.4–1.8) (Figs 42D, 43A). Outer surface of most operculars highly concave and granular; inner surface bears a broad, rounded distal medial thickening, but not qualifying for the term of a keel. Tentacular platelets not abundant, but when found are curved and measure between 100–120 μm in length (Fig. 43G).

Coenenchymal scales elongate (up to 1.5 mm), flat, and thin; slightly granular on top (no ridges) (Fig. 43F).

TYPES: The holotype is lost (see Cairns 2009).

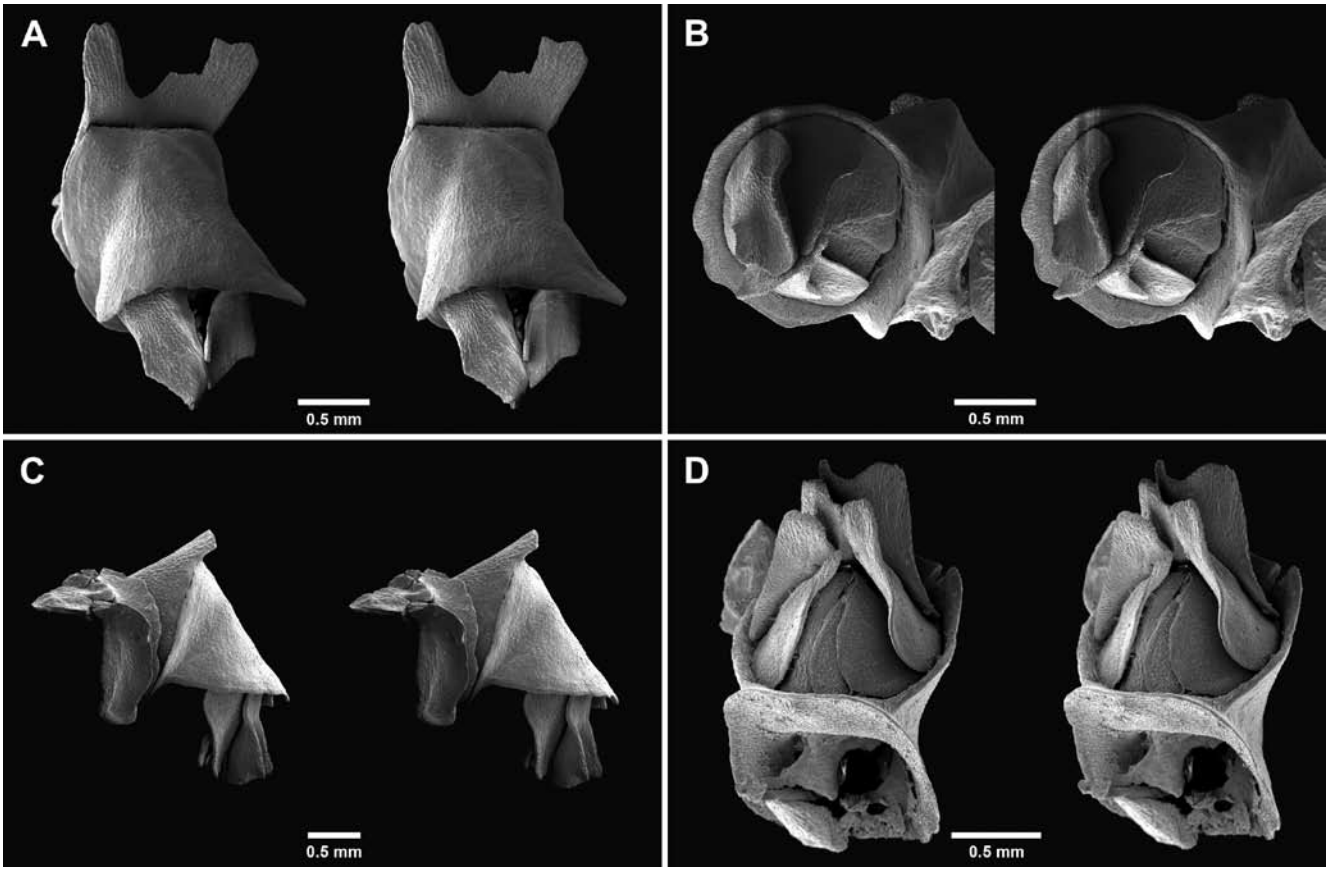

Figure 42. *Calyptrophora wyvillei* from TAN 0205/32; A, abaxial view of a polyp; B, apical view of a polyps; C, lateral view of a polyp showing two infrabasal scales; D, adaxial view of a polyp showing all eight opercular scales. All views are in stereo.

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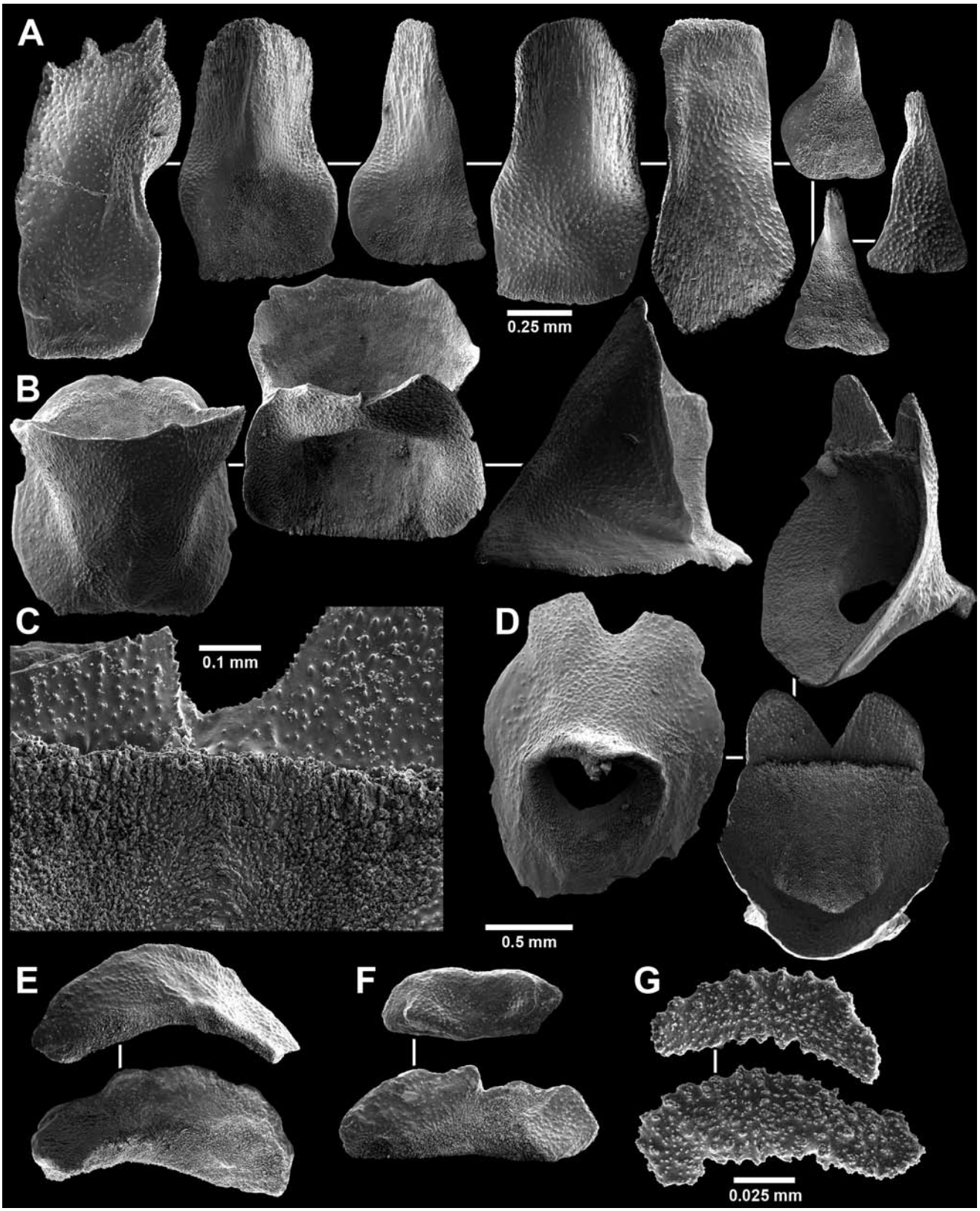

Figure 43. Sclerites of *Calyptrophora wyvillei* from TAN 0205/32; A, eight opercular scales; B, ab-, adaxial, and lateral views of buccal scales; C, articulating ridge and spines of a basal scale; D, three basal scales; E, two infrabasal scales; F, two coenenchymal scales; G, two curved tentacular platelets. (Figs B, D, E, and F share a common scale bar of 0.5 mm.)

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TYPE LOCALITY: *Challenger*-171: 28°33′S, 177°50′W (north of Raoul Island, Kermadec Ridge), 1097 m.

COMPARISONS: *Calyptrophora wyvillei* is one of four species having downward-facing polyps, and the only species in the genus to have lyrate, polychotomous branching (see Cairns, 2009, key to species; and Table 3, p. 43).

REMARKS: One of the specimens reported (K806) was collected less than 2 km from the type locality of *Challenger* station 171 on the *Challenger* Centenary Cruise, the other specimen from more southward on the Kermadec Ridge. The Kermadec specimens differ only slightly from those reported by Cairns (2009) from Hawaii by having a pronounced buccal cowl, shorter basal spines, and more whorls per cm. The Hawaiian population is described and illustrated by Cairns (2009), including a complete synonymy.

Helicoprimnoa n. gen.

DIAGNOSIS: Colonies consist of a monopodial main stem that spirals upward, from which undivided branches diverging in linear fashion from one side of the main stem (a modified lyrate form of branching). Polyps arranged in clusters, always on one side of the branches and on the main stem. Polyps covered with eight longitudinal rows of body-wall scales, the marginals not qualitatively different from others, the inner lateral and adaxial rows being short, producing a small naked region on adaxial side. Opercular scales with multi-ridged keels. Coenenchymal scales elongate, covered with rounded ridges.

TYPE SPECIES: *Helicoprimnoa fasciola*, here designated.

ETYMOLOGY: A combination of *helix* (Latin for coil or spiral) and *primnoa* (a common primnoid suffix), in allusion to the coiling nature of the colony. Gender: feminine.

DISCUSSION: The polyps of *Helicoprimnoa* are quite similar to those of *Plumarella*, but *Helicoprimnoa* differs from that genus and all other primnoid genera in three characters: its branching is monopodial and spiral (identical to that of *Iridogorgia,* see Watling 2007), its polyps are arranged in clusters (not whorls, pairs, or independently), and its coenenchymal scales have a unique ornamentation on their outer faces.

The genus is monotypic.

DISTRIBUTION: Known only from West Norfolk Ridge, 138 m.

Helicoprimnoa fasciola n. sp. Figs 3, 9F, 44, 45

MATERIAL EXAMINED: Types.

DISTRIBUTION: Known only from the type locality (Fig. 3).

DESCRIPTION: Colonies flagelliform, the main stem spiralling (coiled) upward in a clockwise fashion when viewed from above in the holotype (Fig. 9F) but in a counterclockwise fashion in the larger paratype. Holotype colony fragment about 7 cm in height, but 19 cm in linear dimension when measured along the axis, consisting of 1.5 revolutions and 36 branches; the circle around which the main stem spirals is about 2.5 cm in diameter. Attachment not present in any colonies; axis yellow, up to 0.7 mm in diameter; colony fragile and quite flexible. Undivided branches occur along one side of entire main stem in a regular fashion every 3–4 mm, diverging at a slightly upward tilt. Branches up to 7 cm in length, bearing clusters of 2–5 polyps, 4–5 clusters occurring every cm (Figs 44A, C). Polyp clusters occur on only one side of branches (not as whorls), each polyp 1.2–1.4 mm in length. Polyp clusters also often occur where the branches diverge from the main stem and one or two clusters may also occur on the main stem between successive branches.

Each polyp covered with eight longitudinal rows of body-wall scales (Figs 44B, C, 45C), marginal scales being distinctive only in that all scales become gradually progressively less wide toward base of polyp. All body-wall scales (Figs 44B, 45C) roughly rectangular, flat and thin, with a straight distal margin, and an L:W of 0.75–0.85. There are 8 or 9 pairs of abaxial body-wall scales (Fig. 44B), the abaxial marginals 0.26–0.30 mm in width. There is an equal number of slightly smaller (0.17–0.23 wide) outer lateral body-wall scales (Fig. 44C), only 6 or 7 pairs of inner lateral (Fig. 44D), and the same number of adaxial body-wall scales (Fig. 44D), these scales not continuing to the polyp base, resulting in a naked region on lower adaxial polyp face. Marginal inner lateral and adaxial scales both about 0.15–0.17 mm in width, the adaxial scales becoming much smaller and elliptical in shape (0.08 mm in diameter) toward naked region of polyp face (Fig. 44D). Body-wall scales covered with short spines radiating from a central point.

Operculum easily seen in lateral view as the marginal scales do not fold over the opercular scales (Figs 44D, E). Opercular scales symmetrical in shape, regardless of type, and fairly similar in size, ranging from up to 0.38 mm in length in the abaxial position to 0.28 mm in length in the adaxial position (Fig. 45A); L:W ranges only from 1.8–2.2. Opercular scales strongly curved to form a hemispherical operculum (Fig. 44E),

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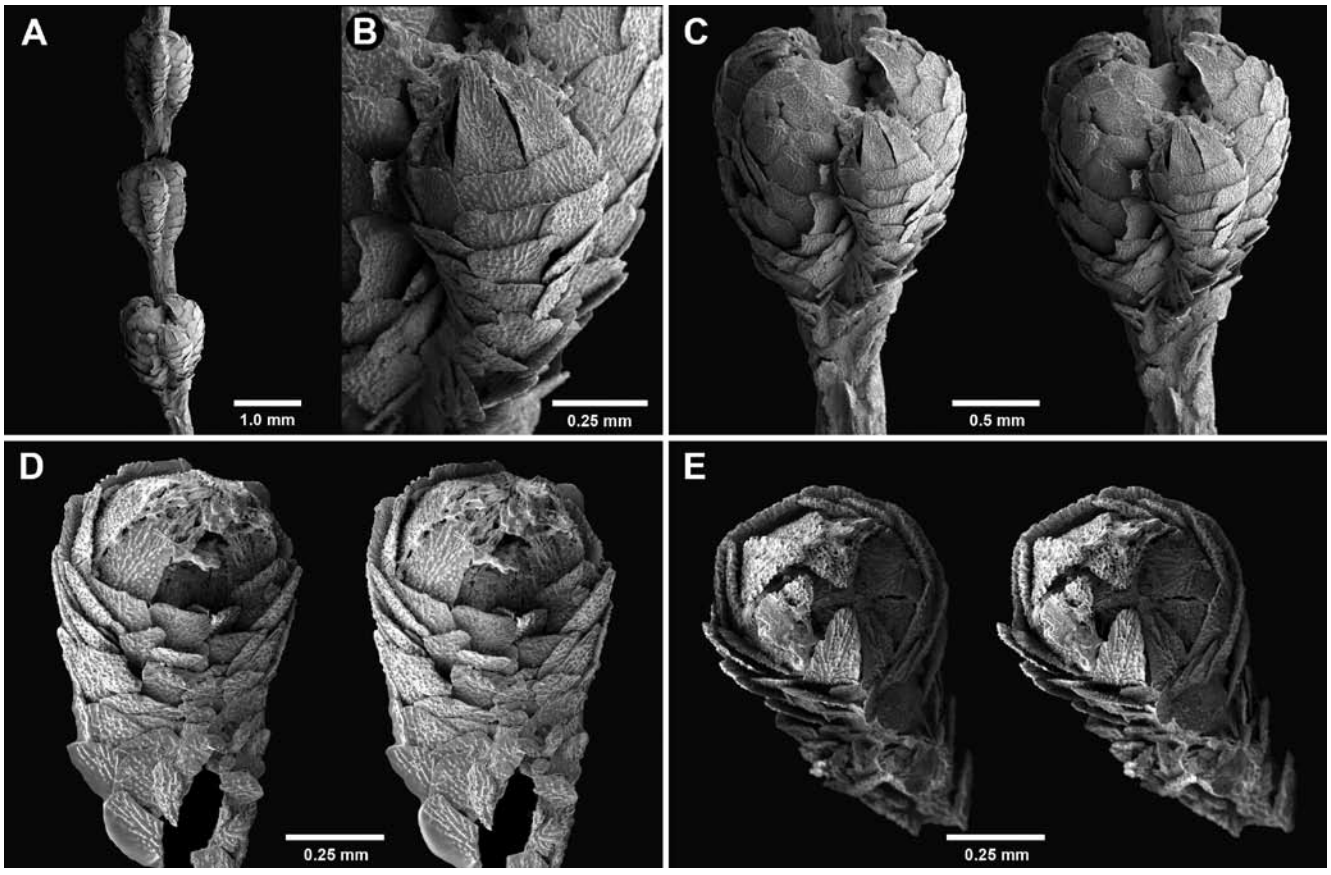

Figure 44. Holotype of *Helicoprimnoa fasciola*: A, branch segment consisting of three polyp clusters; B, lateral view of a polyp in a cluster; C, cluster of four polyps, one enlarged with an egg; D, adaxial view of a polyp; E, apical view of a polyp. Figures C–E are stereo views.

each bearing a wide, serrate, multi-ridged keel on its inner face; its outer face is covered with short spines like those of body-wall scales (Fig. 45B). Tentacular platelets not observed.

Coenenchymal scales elongate (L:W = 5–7.5) and pointed, up to 0.62 mm in length (Fig. 45E). Outer face of coenenchymals covered with five or six longitudinal rounded ridges, seemingly composed of the linear fusion of multiple rounded granules (Figs 45F, G).

TYPES: Holotype: G1, a colony fragment and 11 separate branches, NIWA 27979, and several short branch fragments and SEM stubs 1585–1588, 1590 (USNM 1180657). Paratypes: two smaller colonies from the same station, NIWA 76209.

TYPE LOCALITY: 32.5833°S, 167.3833°E (northern West Norfolk Ridge), 138 m.

ETYMOLOGY: Named *fasciola* (Latin for a small fascicle, bundle or cluster), a noun in apposition, alluding to the small clusters (not whorls) of polyps that occur on the branches.

REMARKS: Polyps containing one egg apiece are common, these polyps being about twice the width of normal polyps.

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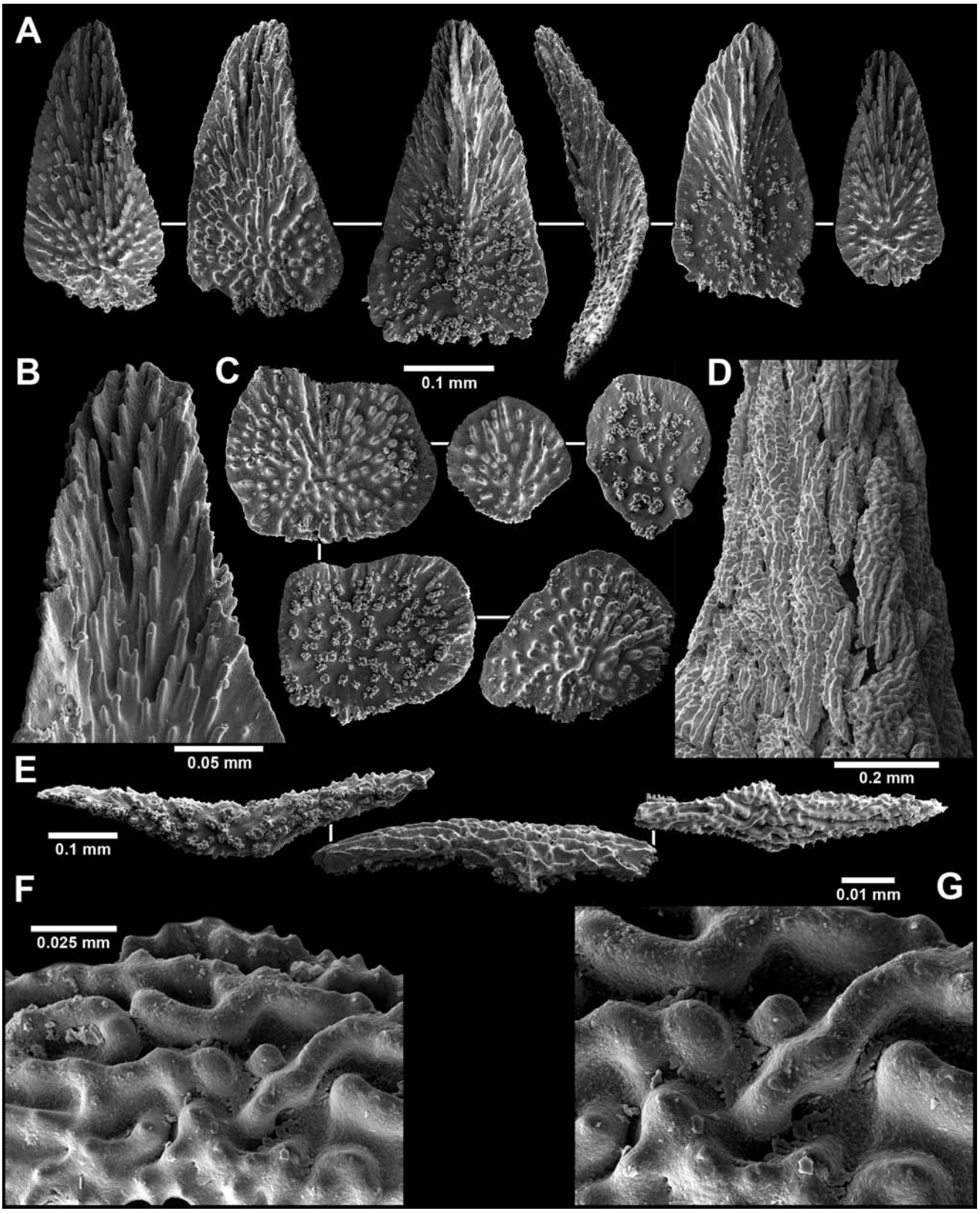

Figure 45. Sclerites from holotype of *Helicoprimnoa fasciola*: A, six opercular scales; B, outer spinose opercular tip; C, five body-wall scales; D, coenenchymal scales *in situ*; E, three coenenchymal scales; F–G, surface texture of coenenchymal scales showing coarse ridging and granulation. (Figs A and C share a common scale bar of 0.10 mm.)

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APPENDIX 1
List of stations

	°S Latitude	° Longitude	Depth range (m)	Date
Albatross 5543	8.7875N	123.58E	296	20/08/1909
Albatross 5664	4.722S	118.8883E	732	28/12/1909
Challenger 171	28.55	177.833W	1097	17/07/1874
E323	34.0	172.250E	165	11/04/1965
E336	34.0	172.50E	157	12/04/1965
E842	33.90	172.2833E	224	10/03/1968
E845	34.1250	172.0167E	277	16/03/1968
E856	32.1833	168.3000E	1169	18/03/1968
E860	32.3500	167.6833E	1246	18/03/1968
E865	32.6833	167.60E	168	19/03/1968
G1	32.5833	167.3833E	138	14/09/1966
K806	28.5117	177.8217W	1165	23/07/1974
K831	29.8617	178.1817W	965	27/07/1974
K842	30.1700	178.5983W	325	29/07/1974
K868	31.3583	178.8567W	335	01/08/1974
K872	31.340	178.8200W	280	02/08/1974
KAH 0006/45	37.5040	172.1187E	960	23/04/2000
KAH 0204/29	34.1631	173.9624E	782–790	17/04/2002
KAH 0204/30	34.1465	173.9632E	800–825	17/04/2002
KAH 0204/32	34.1620	173.9618E	780–810	17/04/2002
KAH 0204/38	34.1587	173.9630E	800	18/04/2002
KAH 0204/40	34.1641	173.9640E	805–820	18/04/2002
KAH 0204/44	34.2656	174.1032E	840–850	18/04/2002
KAH 0204/47	34.0425	174.8170E	792–880	19/04/2002
KAH 9907/51	36.5063	176.5163E	920	05/06/1999
KAH 9907/53	36.5045	176.5075E	990	05/06/1999
Q57	31.6000	158.9833E	874	27/05/1978
S568	30.1667	171.3367E	650–900	13/08/1983
S573	30.4950	172.7050E	975	15/08/1983
T226	28.5500	177.8333W	800	22/03/1982
T235	30.3217	178.3500W	510	23/03/1982
TAN 0104/153	42.7325	179.8985W	990–1076	18/04/2001
TAN 0104/336	42.7678	179.9218W	890–955	20/04/2001
TAN 0104/391	42.7893	179.9957E	1044	21/04/2001

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	°S Latitude	° Longitude	Depth range (m)	Date
TAN 0105/43	33.9875	171.7508E	170–174	28/03/2011
TAN 0107/219	35.7317	178.5223E	1200	23/05/2001
TAN 0205/20	33.7364	179.8313E	490–619	14/04/2002
TAN 0205/32	33.1708	179.970W	643–999	16/04/2002
TAN 0205/47	31.1367	179.0123W	776–841	19/04/2002
TAN 0205/51	31.1434	179.0059W	768–1144	20/04/2002
TAN 0205/73	30.0	178.0E	872–1086	23/04/2002
TAN 0205/88	34.0271	179.5577E	?	25/04/2002
TAN 0408/23	42.8292	177.4218E	824–826	13/07/2004
TAN 0413/21	36.8283	177.4480E	1118–1400	08/11/2004
TAN 0413/26	36.9450	177.3895E	1495–1608	09/11/2004
TAN 0413/39	36.9565	177.3430E	1073–1099	09/11/2004
TAN 0413/45	37.2078	177.2442E	720–900	10/11/2004
TAN 0413/129	37.3402	177.1115E	275	?
TAN 0413/160	37.4577	176.9013E	278–312	15/11/2004
TAN 0413/170	37.4615	176.9135E	247–294	16/11/2004
TAN 0604/111	42.7975	179.9877E	970–1040	07/06/2006
TAN 0705/211	42.6547	177.2131W	1377–1402	20/04/2007
TAN 0905/70	42.7365	179.6905W	840–1037	22/06/2009
TAN 0905/121	44.0278	174.591W	801–823	28/06/2009
TAN 1007/19	34.5793	177.6820E	1392–1670	?
TAN 1007/52	35.3477	178.5493E	1180–1284	01/06/2010
TAN 1007/53	35.3472	178.5333E	1411–1428	02/06/2010
TAN 1007/111	35.3548	178.54E	1230–1380	07/06/2010
TAN 9912/DR3	28.1455	175.4480E	138	14/09/1966
TRIP 1099/12	32.1817	179.0700W	128	05/04/1998
TRIP 1099/15	32.195	179.0917W	122–307	10/09/1998
TRIP 1152/06	37.4833	167.7172E	883	10/09/1998
TRIP 1289/?	34.7833	171.6667E	885	02/11/1999
TRIP 1674/32	34.50	168.7333E	874–1030	21/07/2002
TRIP 2232/2	33.6967	167.8283E	646–909	06/03/2006
TRIP 2472/42	34.3148	168.4748E	820–1071	03/08/2007
TRIP 2419/23	34.8150	169.8533E	820–1114	05/05/2007
TRIP 2551/140	43.9567	174.5607W	663–930	26/12/2007
TRIP 2889/46	33.5467	167.7450E	691–920	03/07/2009
TRIP 2889/48	33.55	167.7433E	790–927	03/07/2009
TRIP 2744/75	43.18	173.8384W		
TRIP 2744/162	43.9567	174.5683W	609–916	12/01/2009
TRIP 2744/189	43.9367	174.5483W		
TRIP 2744/252	43.9967	174.5917W	810–1000	23/10/2009
TRIP 2744/253	43.9950	174.580W	659–1020	23/10/2009
TRIP 2918/17	33.6717	167.110E	633–836	29/07/2009
TRIP 3178/12	37.3	168E	914–943	?
TRIP 3235/14	42.9667	178.4583E	447	01/12/2010
TRIP 3252/4	34.033	168.1417E	954	?

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	°S Latitude	° Longitude	Depth range (m)	Date
U210	33.4650	155.9450E	342	07/10/1982
X152	36.1623	176.8063E	945	28/11/1989
X494	43.8390	174.3023W	885	06/07/1994
X495	44.0	174.0065W	1436	07/07/1994
X628	35.3765	178.4452E	2400–2407	09/02/1996
Z2098	28.6583	173.0167E	850	04/09/1967
Z9025	31.9803	174.2645E	677–1680	?

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TAXONOMIC INDEX

Principal taxonomic account is in bold font; species illustrations in bold italic.

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