

A revision of the genus *Deltocyathus* Milne Edwards & Haime, 1848 (Scleractinia, Caryophylliidae) from New Caledonia, with the description of a new species

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ABSTRACT

Based on part of the material collected during the HALIPRO 1, BATHUS 3, BATHUS 4, and NORFOLK 2 expeditions by the Muséum national d'Histoire naturelle, Paris off New Caledonia, 10 species of scleractinian corals belonging to the genus *Deltocyathus* were identified: *D. magnificus*, *D. rotulus*, *D. suluensis*, *D. vaughani*, *D. ornatus*, *D. heteroclitus*, *D. corrugatus*, *D. crassiseptum*, *D. cameratus* and *D. inusitatus* n. sp. These 10 species are fully described and illustrated, their distributional and bathymetric ranges are given. A brief history and an identification key for all species belonging to this genus are provided.

KEY WORDS

Scleractinia,
Caryophylliidae,
Deltocyathus,
New Calédonie,
new species.

RÉSUMÉ

Révision du genre Deltocyathus Milne Edwards & Haime, 1848 (Scleractinia, Caryophylliidae) de Nouvelle-Calédonie, avec la description d'une espèce nouvelle.

Une partie des échantillons collectés au cours des expéditions entreprises par le Muséum national d'Histoire naturelle, Paris en Nouvelle-Calédonie (i.e. HALIPRO 1, BATHUS 3, BATHUS 4, et NORFOLK 2) a permis l'identification de 10 espèces de coraux scléactiniaires appartenant au genre *Deltocyathus*: *D. magnificus*, *D. rotulus*, *D. suluensis*, *D. vaughani*, *D. ornatus*, *D. heteroclitus*, *D. corrugatus*, *D. crassiseptum*, *D. cameratus* and *D. inusitatus* n. sp. Ces 10 espèces sont ici entièrement caractérisées, leur distribution et leur bathymétrie sont données. Un bref historique de chaque espèce ainsi qu'une clé d'identification des espèces du genre sont proposés.

MOTS CLÉS

Scleractinia,
Caryophylliidae,
Deltocyathus,
Nouvelle-Calédonie,
espèce nouvelle.

INTRODUCTION

Within the most diverse family of azooxanthellate corals, the Caryophylliidae Dana, 1846, the genus *Deltocyathus* Milne Edwards & Haime, 1848, which is common worldwide and consists of 25 Recent valid species (Table 1), is characterized by having: a free, discoidal to patellate, solitary corallum in the adult state; well-developed costate septotheca; pali before all but last cycle of septa; P3 fusing P2 near the columella, forming chevrons (or deltas); paliform lobes sometime present before the last cycle; and a papillose columella.

With the first fossil record from the Paleocene (Goedert & Peckman 2005) and today predominantly collected below 150 m, the first description of a *Deltocyathus* species was made by Michelotti (1838) as *Turbinolia italica* Michelotti, 1838, being later transferred by Pourtalès (1880). The second and third descriptions were made by Pourtalès, who described *D. agassizii* Pourtalès, 1867, collected off Havana and *D. calcar* Pourtalès, 1874, collected at the Yucatan Straits, and off the west coast of Florida. In the same year, but collected during the *Challenger* expedition in 1874, was described one of the biggest species of this genus *D. magnificus* Moseley, 1876. Subsequently Lindström published *D. halianthus* (Lindström, 1877), dredged during the expedition of HMS *Eugenie* off Cap Frio, describing this species as *Leptocyathus halianthus* Lindström, 1877. At the end of the 19th century three more species were placed in this genus: *D. andamanicus* Alcock, 1898 and *D. rotulus* (Alcock, 1898), collected off Andaman Sea and off North Maldiva Atoll respectively, and *D. ornatus* Gardiner, 1899, collected off Baie du Santal, Lifu, near New Caledonia. As part of a series of studies of deep-sea corals collected in the India Ocean, Alfred Alcock described *D. suluensis* (Alcock, 1902) as *D. magnificus* var *suluensis*.

The next description of a species belonging to this genus, *D. vaughani* Yabe & Eguchi, 1932, was made from species collected in Japanese waters at Bosyu. Six years later, Gardiner & Waugh (1938), using the specimens collected by John Murray expedition described three new species pertaining to this genus, *D. murrayi* Gardiner & Waugh, 1938, *D. varians* Gardiner & Waugh, 1938, and *D. sarsi*

(Gardiner & Waugh, 1938), the last one described in the genus *Fungiacyathus* Sars, 1872, being transferred by Cairns (1998).

The last pulse of descriptions of new species of *Deltocyathus* started with the analyses of large collections from the western Atlantic Ocean deposited in museums, and especially revisions of all previous data, being described from Caribbean and adjacent waters: *D. eccentricus* Cairns, 1979, *D. moseley* Cairns, 1979 and *D. pourtalesi* Cairns, 1979. Subsequently, during the 1980's, studies from Pacific Ocean increased the number of species from this genus, being described *D. parvulus* Keller, 1982, *D. heteroclitus* Wells, 1984 and *D. taiwanicus* Hu, 1987, *D. parvulus* being one of the deepest records of a scleractinian coral, reaching 5080 m. Finally, at the end of the 20th century, five more species belonging to this genus were described, all from Pacific waters, starting with *D. philippinensis* Cairns & Zibrowius, 1997, *D. stella* Cairns & Zibrowius, 1997, *D. corrugatus* Cairns, 1999, *D. crassiseptum* Cairns, 1999 and *D. cameratus* Cairns, 1999 (all collected by the Campagnes MUSORSTOM, the first two from cruises off Philippines and Indonesian regions, and the last three from Vanuatu, and Wallis and Futuna Islands).

As a result of the analyses of part of the collection made by the MNHN, Paris from New Caledonia waters (Table 2), 10 species of *Deltocyathus* were identified. The present study reports all new records of this genus, providing the complete synonymies, type locality, type material, description, distribution, and illustrations for all species examined, including the description of one new species collected during NORFOLK 2 expedition. Also, an identification key for all species pertaining to *Deltocyathus* is proposed.

ABBREVIATIONS

Morphological

CD	calicular diameter;
GCD	greater calicular diameter;
HT	height of corallum;
LCD	lesser calicular diameter;
PD	pedicel diameter;
Sx	septa of cycle designated by numerical subscript;
Sx>Sy	septa of cycle x wider than those of cycle y;
Px	paliform lobes before the septal cycle designated by numerical subscript.

TABLE 1. — Species of *Deltocyathus* Milne Edwards & Haime, 1848 (chronological description ordered) with their respective junior synonyms, distribution, and depth range. 1, Western North Pacific; 2, Eastern North Pacific; 3, Western South Pacific; 4, Eastern South Pacific; 5, Western North Atlantic; 6, Eastern North Atlantic; 7, Western South Atlantic; 8, Eastern South Atlantic; 9, Indian Ocean.

<i>Deltocyathus</i> species	Junior synonyms	Distribution									Depth range (m)
		1	2	3	4	5	6	7	8	9	
<i>D. italicus</i> (Michelotti, 1838)	<i>D. conicus</i> Zibrowius, 1980					●	●	●	●		403-2634
<i>D. agassizii</i> Pourtalès, 1867						●					494-1115
<i>D. calcar</i> Pourtalès, 1874						●		●			81-675
<i>D. magnificus</i> Moseley, 1876	<i>Fungiacyathus</i> sp. <i>sensu</i> Veron 1986	●	●							●	88-1500
<i>D. halianthus</i> (Lindström, 1877)								●			46-130
<i>D. andamanicus</i> Alcock, 1898										●	187-397
<i>D. rotulus</i> (Alcock, 1898)	<i>D. fragilis</i> Alcock, 1902	●	●							●	210-1300
<i>D. ornatus</i> Gardiner, 1899						●					73-360
<i>D. suluensis</i> Alcock, 1902	<i>D. formosus</i> Cairns, 1995	●	●							●	142-1050
<i>D. vaughani</i> Yabe & Eguchi, 1932	<i>Levipalifer orientalis</i> Vaughan, 1900 not <i>D. orientalis</i> Duncan, 1876	●	●								88-1097
<i>D. murrayi</i> Gardiner & Waugh, 1938					●					●	1948-2312
<i>D. varians</i> Gardiner & Waugh, 1938									●		655-732
<i>D. sarsi</i> (Gardiner & Waugh, 1938)									●		44-80
<i>D. eccentricus</i> Cairns, 1979							●	●		●	183-1000
<i>D. moseleyi</i> Cairns, 1979							●	●			200-1372
<i>D. pourtalesi</i> Cairns, 1979							●				311-567
<i>D. parvulus</i> Keller, 1982		●	●	●							1940-5080
<i>D. heteroclitus</i> Wells, 1984			●								208-335
<i>D. taiwanicus</i> Hu, 1987				●							320-697
<i>D. philippinensis</i> Cairns & Zibrowius, 1997		●									342-522
<i>D. stella</i> Cairns & Zibrowius, 1997		●	●								206-597
<i>D. corrugatus</i> Cairns, 1999						●					280-390
<i>D. crassiseptum</i> Cairns, 1999						●					413-536
<i>D. cameratus</i> Cairns, 1999						●					305-1175
<i>D. inusitatus</i> n. sp.						●					410-777

Institutions

- BMNH The Natural History Museum, London;
- IM Indian Museum, Calcutta;
- MCZ Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts;
- MNHN Muséum national d'Histoire naturelle, Paris;
- MoNZ Museum of New Zealand Te Papa Tongarewa, Wellington;
- NZOI New Zealand Oceanographic Institute, Wellington;
- USNM United States National Museum (now National Museum of Natural History – NMNH), Washington, DC;
- ZMA Zoologisch Museum, Amsterdam.

MATERIAL AND METHODS

Each species is provided with a complete citation synonym, type locality, type material, new records, description or diagnosis, and distribution. All species with new records, when pertinent, were discussed

and illustrations are provided.

Measurements and counts follow Wells (1956), Zibrowius (1980) and Cairns (1979, 2000). The basic morphological terminology used is explained by Vaughan & Wells (1943), Wells (1956), Alloiteau (1952) and Cairns (1982), and in case of septal formula by Cairns (1989).

SYSTEMATICS

- Order SCLERACTINIA Bourne, 1900
- Suborder CARYOPHYLLIINA
Vaughan & Wells, 1943
- Family CARYOPHYLLIIDAE Dana, 1846

Genus *Deltocyathus*
Milne Edwards & Haime, 1848

DIAGNOSIS. — Corallum solitary, discoidal to patellate,

free in adult stage. Costae well developed, and pali present before all but last septal cycle, but paliform lobes may also be present before the fourth cycle. Inner edges of each pair of P3 fused to the P2 in each system, forming

characteristic chevrons. Columella papillose.

TYPE SPECIES. — *Turbinolia italica* Michelotti, 1838 (Tortona, Italy [Miocene]), by monotypy.

KEY TO THE RECENT SPECIES OF *DELTOCYATHUS* MILNE EDWARDS & HAIME, 1848

1. Costal spines present 2
— Costal spines absent 6
2. Six to eight costal spines; one granule per costal width 3
— Twelve costal spines; more than one granule per costal width 4
3. All costae equal; corallum shape as shallow bowl *D. heteroclitus*
— Costae unequal; corallum patellate *D. calcar*
4. S4-P3 junction below S3-P3 notch 5
— S4-P3 junction at S3-P3 notch *D. corrugatus*
5. P3>P1-2 *D. stella*
— All palar cycles equal in size *D. ornatus*
6. Adult corallum with 5 full cycles of septa (96) 7
— Adult corallum with 4 cycles of septa or an incomplete 5th cycle (44-80) 10
7. Corallum usually reproduce by fragmentation, showing a prominent scar *D. sarsi*
— Corallum not reproduce by fragmentation 8
8. Base flat to slightly concave *D. magnificus*
— Base usually convex 9
9. First cycle of septa wider than secondaries *D. suluensi*
— First and second septal cycles equal in width *D. rotulus*
10. Corallum attached *D. halianthus*
— Corallum free 11
11. All costae extend from calicular edge to centre 12
— C4 and/or C3 not reach the centre 13
12. C1-3>C4; base flat to hemispherical; S1 and S2 not thick *D. moseleyi*
— All costae equal and bisected by a row of granules; base flat to convex; S1 and S2 thick *D. crassisepalum*
13. Penultimate septal cycle wider than the last cycle 14
— Penultimate septal cycle equal or smaller than the last cycle 17
14. All costae equal in width 15
— Costae not equal in width 16
15. Five cycles of septa present; all systems dimorphic *D. inusitatus* n. sp.
— Four cycles of septa present; systems not dimorphic *D. cameratus*
16. Shape of base flat *D. pourtalesi*
— Shape of base conical (apical angle: 80° to 120°) *D. italicus*

- 17. Calicular margin jagged, S3 and adjacent S4 project as a triangular to rectangular lancets 18
- Calicular margin not jagged 20
- 18. S3 highly exsert *D. andamanicus*
- All septa equal exsert or little difference 19
- 19. Paliform lobes elongated; columella spongy with low twisted processes *D. murrayi*
- No well-defined pali; no true columella *D. varians*
- 20. Corallum strongly conical *D. parvulus*
- Corallum flat to slightly conical 21
- 21. P4 present *D. vaughani*
- P4 absent 22
- 22. S1, S2, and S3 sinuous 23
- First three septal cycles not sinuous 24
- 23. C3 and C4 do not reach centre of the base; S3>>S4 *D. eccentricus*
- Only C4 do not reach centre of base; S3>S4 *D. agassizii*
- 24. Septal formula: S1-2>S3>S4>S5; when S5 present the fourth cycle septa become dimorphic *D. taiwanicus*
- Septal formula: S1>S2>S3>S4; S4 not dimorphic *D. philippinensis*

Deltocyathus magnificus Moseley, 1876
(Fig. 1A)

Deltocyathus magnificus Moseley, 1876: 552, 553; 1881: 147, 148, pl. 4, fig. 10, pl. 13, figs 1, 2. — Gardiner 1899: 164. — Alcock 1902b: 20; 1902c: 49. — Faustino 1927: 76, pl. VI, figs 3-5. — Yabe & Eguchi 1932: 388; 1937: 128-130, 138-140, pl. 20, figs 13, 14; 1942: 126. — Eguchi 1938: 2, table 2, fig. 1a, b; 1965: 286, 2 figs. — Utinomi 1965: 254. — Eguchi & Miyawaki 1975: 57. — Keller 1982: 50. — Hu 1987: 39. — Grygier 1991: 43, fig. 21G. — Cairns & Parker 1992: 27, 28, pl. 7, figs j-l, pl. 8, fig. a. — Cairns & Keller 1993: 245. — Cairns 1994: 56, pl. 24, figs d, e, g, h; 1995: 74; 1998: 381, 382, fig. 4; 1999: 91, fig. 11i; 2004: 280. — Cairns & Zibrowius 1997: 126-127a. — Cairns *et al.* 1999: 21.

Bathyactis palifera – Hoffmeister 1933: 14, pl. 4, fig. 6.

Fungiacyathus paliferus – Wells 1958: 262. — Veron 1986: 598. — Cairns & Parker 1992: 6, 7.

Fungiacyathus sp. – Veron 1986: 598.

TYPE MATERIAL. — The single remaining syntype of *Deltocyathus magnificus* is deposited at the BMNH (uncataloged).

TYPE LOCALITY. — 5°49'S, 132°14'E (off Kei Islands, Banda Sea), 236 m.

NEW RECORDS. — HALIPRO 1, stn CP 877, 1 specimen (MNHN-Scl.2008-001); 1 specimen (USNM 1114164).

DISTRIBUTION. — New Caledonia waters (23°03.51'S, 166°59.20'E, 464-480 m). Previous records: east China sea, 88-422 m (Cairns 1994); western Pacific from Japan to southeastern Australia, 88-1500 m (Cairns & Zibrowius 1997); including Vanuatu region, 408-433 m (Cairns 1999); Sulu Archipelago, Moluccas, 118-1500 m; Philippines, Indonesia, 8-522 m (Cairns & Parker 1992); western Australia, 250 m (Cairns 2004).

DESCRIPTION

Corallum discoidal to hexagonal with a slightly concave base. Largest specimen examined (HALIPRO 1, stn CP 877) 25.5 mm in calicular diameter and 7 mm in height, with a depression of 6 mm in diameter in centre of base. Costae equal thin ridges, finely dentate, being separated by wide furrows and extending up to 1 mm beyond calicular margin. C3-5 not present at centre of base. All costae laterally spinose

TABLE 2. — List of the stations where specimens of *Deltocyathus* Milne Edwards & Haime, 1848 have been collected.

Expedition station	Latitude S	Longitude E	Depth (m)	Date
BATHUS 3				
CP 818	23°43.89'	168°16.32'	394	28.XI.1993
CP 842	23°05.00'	166°47.81'	830	1.XII.1993
CP 847	23°02.53'	166°58.18'	405-411	1.XII.1993
DW 786	23°54.46'	169°49.15'	699-715	25.XI.1993
BATHUS 4				
CP 885	22°05.03'	165°58.28'	250-300	1.VIII.1994
CP 889	21°00.83'	164°27.34'	416-433	2.VIII.1994
CP 950	20°31.93'	164°56.11'	705-750	10.VIII.1994
DW 883	22°03.43'	165°56.03'	450-600	1.VIII.1994
DW 887	21°06.67'	164°27.62'	320-344	2.VIII.1994
DW 894	20°15.77'	163°52.03'	245-268	3.VIII.1994
DW 898	20°16.63'	163°50.21'	500-600	3.VIII.1994
DW 902	19°00.84'	163°14.83'	341-351	4.VIII.1994
DW 903	18°59.93'	163°13.55'	386-400	4.VIII.1994
DW 914	18°48.79'	163°15.23'	600-616	5.VIII.1994
HALIPRO I				
CP 877	23°03.51'	166°59.20'	464-480	31.III.1994
NORFOLK 2				
DW 2024	23°28'	167°51'	370-371	21.X.2003
DW 2025	23°27'	167°51'	410-443	21.X.2003
DW 2034	23°41'	167°41'	485-505	22.X.2003
DW 2037	23°40'	167°41'	517-570	22.X.2003
DW 2041	23°41'	168°01'	400	23.X.2003
DW 2086	24°56'	168°22'	707-777	28.X.2003
DW 2087	24°56'	168°22'	518-586	28.X.2003
DW 2092	24°45'	168°07'	320-345	29.X.2003
DW 2097	24°44'	168°06'	580-583	29.X.2003
DW 2103	23°57'	167°44'	717-737	30.X.2003
DW 2104	23°58'	167°43'	700-752	30.X.2003
DW 2117	23°24'	168°00'	400	1.XI.2003

especially near calicular edge, where intercostal furrows are deeper. Corallum white.

Septa hexamerally arranged in 5 cycles ($S1 \geq S2 > S3 > S4 > S5$), but any specimen examined display a complete fifth cycle, denoting their juvenile stage. S1 only independent septa, 6 mm exsert, joining columella through a wide palus that sometimes are divided at the upper margin in 3 paliform lobes. S2 equal to slightly less wide than S1, also joining columella through a wide and tall pali. S3 $\frac{2}{3}$ width of S3, less exsert and bear a paliform lobe that fuses to P2 near columella. S4 half size of S3 and less exsert, joining P3 through a typical deltoyathid chevron arrangement. S5 less exsert but equal in width to S4, also bearing a paliform lobe that fuses P4.

Fossa very shallow, aligned with the 2 principal and opposite S1, containing a papillose columella variable in size, shape, and number of rods.

REMARKS

Among all species of the genus *Deltocyathus* that do not present coastal spines, only four can reach five cycles of septa in the adult stage: *D. sarsi*, *D. magnificus*, *D. suluensis*, and *D. rotulus*. Of these species, *D. sarsi* is known only from off Vanuatu islands (Gardiner & Waugh 1938), and at 80 m in western Australia (Cairns 2004). Among the other three species, all were collected off New Caledonia, and *D. magnificus* is easily distinguished by having a more robust corallum and a flat to concave base, and usually is whiter than *D. rotulus* and *D. suluensis* which normally present a reddish brown pigment in some parts of the coralla.

Deltocyathus rotulus (Alcock, 1898)

(Fig. 1B)

Trochocyathus rotulus Alcock, 1898: 16, pl. 2, figs 1, 1a.

Deltocyathus fragilis Alcock, 1902a: 99, 100; 1902c: 21, pl. 1, figs 15, 15a.

Deltocyathus rotulus. — Van der Horst 1931: 6. — Gardiner & Waugh 1938: 196. — Yabe & Eguchi 1937: 129. — Keller 1982: 50. — Cairns & Keller 1993: 245, pl. 5, fig. I. — Cairns 1994: 55, 56, pl. 24, figs j, k; 1999: 91, 92; 2004: 280. — Cairns & Zibrowius 1997: 125, 126, fig. 16a-c. — Cairns *et al.* 1999: 22.

TYPE MATERIAL. — The holotype of *Trochocyathus rotulus* is presumed to be deposited at the IM. Six syntypes of *Deltocyathus fragilis* are deposited at the ZMA (Coel. 1188).

TYPE LOCALITY. — North Maldive Atoll, 1408-1756 m (*Trochocyathus rotulus*). 7°24'S, 118°15.2'E (Flores Sea), 794 m (*Deltocyathus fragilis*).

NEW RECORDS. — BATHUS 3, stn CP 842, 2 specimens (MNHN-Sci.2008-0002); stn DW 786, 1 specimen (MNHN-Sci.2008-0003). — BATHUS 4, stn CP 950, 62 specimens (MNHN-Sci.2008-0004); 10 specimens (USNM 1114141).

DISTRIBUTION. — New Caledonia waters from 20°31'S to 23°54'S, 699-830 m. Elsewhere: Indian Ocean off Durban, off Mozambique, off Zanzibar (Cairns & Keller 1993),

510-1986 m, including Maldive islands (Alcock 1898; Gardiner & Waugh 1938), Gulf of Aden (Gardiner & Waugh 1938), off Sri Lanka (Van der Horst 1931), and off Tanzania (Gardiner & Waugh 1938); Pacific Ocean off southeastern Japan (Cairns 1994), 799-1187 m, off Philippines, Indonesia (Flores and Celebes Sea), Malaysia (Alcock 1902a, c; Cairns & Zibrowius 1997), 210-1719 m, Vanuatu and Wallis and Futuna region (Cairns 1999), 1050-1160 m, Australia region off Queensland (Cairns 2004), 143-1192 m.

DESCRIPTION

Corallum circular to slightly elliptical with lancedted calicular margin. Each apex correspond to those C4 flanked by C5. Base normally slightly conical and pointed in centre. However, largest specimen examined (BATHUS 3, stn CP 842), with 19 mm in calicular diameter and 4 mm in height, shows a flat base with upturned edges. Costae more prominent near calicular edge as low serrated ridges. C1-3 originates in centre of the base, C4 present only near calicular edge, and C5 slightly wider than C4. Corallum white to reddish-brown.

Septa hexamerally arranged in 5 cycles (S1-2>S3>S4>S5). S1-2 do not fuse to any adjacent septa, each bearing a palus about 1-2.5 mm wide. S3 less exert with irregularly shaped paliform lobe, sometimes P3 wider than P1-2, but some specimens present P3 very small. Adjacent to the P3, near columella, sometimes 2 or 3 small paliform teeth are present. S4 less wide and exert than S3 but bear a wide and tall palus, producing a prominent palar crown encircling columella. Each P4 fuses to the flanked P3 near columella. S5 fuses to the axial edge of adjacent P4 close to basal theca through a long and porous lamella.

Fossa extremely shallow containing a well-developed papillose columella composed of several interconnected rods.

REMARKS

Among the *Deltocyathus* species from New Caledonia with five septal cycles, *D. rotulus* is easily distinguished from *D. suluensis* by having a scalloped calicular edge, a pigmented columella and paliform lobes, and paliform lobes that reach the same high of the septa. For comparison with *D. magnificus* see previous remarks.

Deltocyathus suluensis Alcock, 1902 (Fig. 1C)

Deltocyathus italicus – Alcock 1902c: 19 (in part).

Deltocyathus magnificus var. *suluensis* Alcock, 1902c: 20, 21. — Faustino 1927: 76, 77. — Yabe & Eguchi 1937: 129. — Van Soest 1979: 111, pl. 2, figs 3, 4.

Deltocyathus formosus Cairns, 1995: 73, 74, pl. 19, figs f, g.

Deltocyathus suluensis. — Cairns & Zibrowius 1997: 125, fig. 16d. — Cairns 1998: 382; 1999a: 92; 2004: 281. — Cairns *et al.* 1999: 22.

TYPE MATERIAL. — The types of *D. suluensis* are presumed to be deposited at the IM. The holotype (CO266) of *D. formosus* and one paratype (CO228) are deposited at the MoNZ. Additional paratypes are deposited at NZOI (station numbers: stn K826 [1], K828 [2], and K870 [1]), and at the USNM (94171 [3], 94172 [1], and 94173 [6]).

TYPE LOCALITY. — 5°43'N, 119°40'E-6°11'N, 120°37'E (Sulu Archipelago), 450-522 m (*D. magnificus* var. *suluensis*). 29°13.96'S, 177°52.84'W (Kermadec Ridge), 530-567 m (*D. formosus*).

NEW RECORDS. — BATHUS 3, stn DW 786, 3 specimens (MNHN-ScI.2008-0005). — BATHUS 4, stn CP 889, 2 specimens (MNHN-ScI.2008-0006). — NORFOLK 2, stn DW 2097, 3 specimens (MNHN-ScI.2008-0007); stn DW 2104, 1 specimen (MNHN-ScI.2008-0008).

DISTRIBUTION. — New Caledonia waters from 21°00.83'S, 164°27.34'E to 24°44'S, 169°49.15'E, 416-752 m. Previous records: Indian Ocean off western Australia from Dampier Land to Port Hedland (Cairns 1998; 2004), 401-530 m; Pacific Ocean from Philippines and Indonesian region (Cairns & Zibrowius 1997), 204-540 m to southern Norfolk Ridges, New Zealand (Cairns 1995), 142-565 m, including Wallis and Futuna region and Vanuatu region (Cairns 1999), 400-650 m, and off Queensland, Australia (Cairns 2004), 246-1050 m.

DESCRIPTION

Corallum circular with base flat to slightly convex. Calicular margin serrate but not lancedted. Largest specimen examined (BATHUS 3, stn DW 786) 22 mm in calicular diameter and 7 mm in height. Costae present as round granular ridges separated by well-defined same width intercostal furrows. Only C1-2 originates at centre of base.

Septa hexamerally arranged in 5 complete cycles (S1≥S2>S3>S4>>S5). S1 only independent septa and

extend half distance to columella, being separated from their pali by a moderately wide notch. Higher septal cycles progressive less wide. S1-4 and P1-4 arranged in a typical *Deltocyathus* fashion, fusing through porous processes. S5 rudimentary.

Fossa shallow containing a well-developed papillose columella.

REMARKS

See Remarks of *D. magnificus* and *D. rotulus*.

Deltocyathus vaughani Yabe & Eguchi, 1932
(Fig. 1D)

Levipalifer orientalis Vaughan, 1900: 201, 202, pl. 16, figs 3-7 (junior secondary homonym of *D. orientalis* Duncan, 1876).

Deltocyathus vaughani Yabe & Eguchi, 1932: 388, 389; 1937: 130, 135-138, pl. 20, figs 11a-c, 12a-c; 1942: 113, 126. — Eguchi 1965: 287, 3 figs; 1968: C35. — Eguchi & Miyawaki 1975: 57. — Keller 1982: 51, figs 2, 3, 7a, b. — Zibrowius & Grygier 1985: 121, fig. 12. — Hu 1987: 39. — Cairns 1994: 54, 55, pl. 23, figs i, j, pl. 24, figs a-c, f; 1999: 93, 94. — Cairns & Zibrowius 1997: 72. — Cairns *et al.* 1999: 22. — Ogawa 2006: 109.

Deltocyathus (Levipalifer) vaughani – Wells 1956: F423-424, figs 325, 4a, b.

TYPE MATERIAL. — The holotype of *Levipalifer orientalis* is deposited at the USNM (19391).

TYPE LOCALITY. — Off Bosyu, Japan, depth unknown (*Levipalifer orientalis*).

NEW RECORDS. — BATHUS 4, stn DW 914, 1 specimen (USNM 1114140). — NORFOLK 2, stn DW 2037, 1 specimen (MNHN-Sci.2008-0009).

DISTRIBUTION. — New Caledonia waters from 18°48.79'S, 163°15.23'E to 23°40'S, 167°41'E, 517-616 m. Previous records: Japan, off Honshu and Kyushu (Yabe & Eguchi 1932; Cairns 1994), Sagami Sea (Ogawa 2006),

88-1097; Philippines and Indonesia regions (Cairns & Zibrowius 1997), 247-807 m; Vanuatu region (Cairns 1999), 585-919 m.

DESCRIPTION

Corallum circular with base flat to slightly convex bearing a small epicentre boss. Largest specimen examined (NORFOLK 2, stn DW 2037) 21 mm in calicular diameter and 9.1 mm in height. Costae rounded, granular and separated by intercostal furrows deeper at calicular edge. Near calicular margin, lateral faces of costae bears numerous pointed granules. All costae extend to base as a row of low and round granules, except from those of C3 and C4, which do not reach the centre of base. Corallum white.

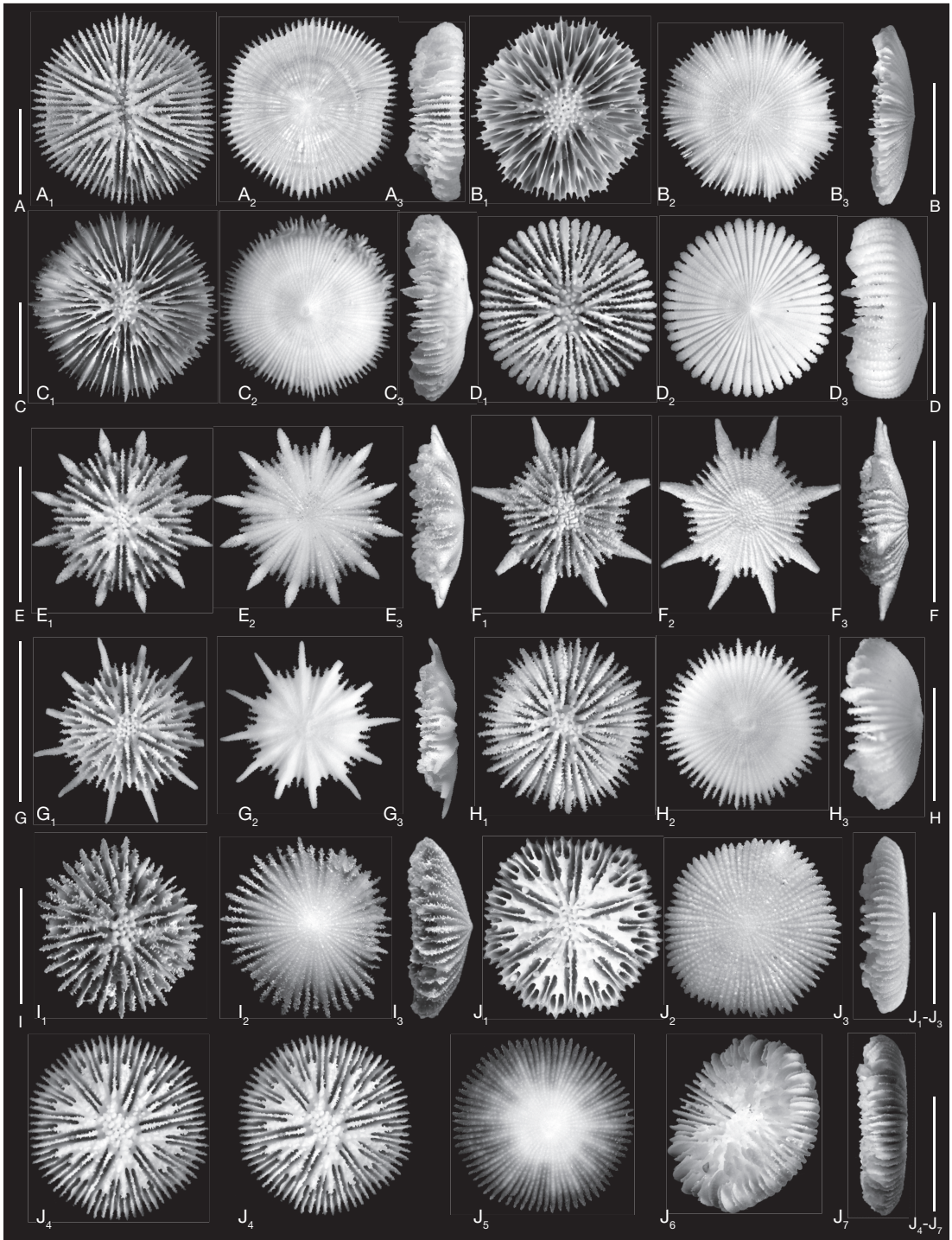
Septa hexamerally arranged in 4 complete cycles (S1>S2>S4>S3) for a total of 48 septa. S1 highly exsert and only independent septa, almost reaching columella and bearing a wide lamellar paliform lobe that fuses to the columella. S2 less exsert and wide than S1, each bearing a paliform lobe (P2) recessed from columella moreso than P1. S3 smallest septa, bearing a wide pali. S4 as exsert as S3, slightly wider and often bear a narrow paliform lobe, which fuses to enclosed P3. If P4 are absent, inner edge of S4 fuses to P3. All septal and palar faces show sparsely pointed granules.

Fossa shallow containing and elongate columella composed by small interconnected, sometimes granulated papillae.

REMARKS

Among the three New Caledonia *Deltocyathus* species that do not have spines at the calicular edge and have four septal cycles (*D. vaughani*, *D. cameratus*, *D. crassiseptum*), *D. vaughani* is distinguished by having: a more robust corallum, a non-jagged calicular edge, all septa reaching the same distance

Fig. 1. — **A**, *Deltocyathus magnificus* Moseley, 1876 (MNHN-Sci.2008-0001); **A**₁, calicular; **A**₂, basal; and **A**₃, lateral views; **B**, *D. rotulus* (Alcock, 1898) (MNHN-Sci.2008-0004); **B**₁, calicular; **B**₂, basal; and **B**₃, lateral views; **C**, *D. suluensis* Alcock, 1902 (MNHN-Sci.2008-0006); **C**₁, calicular; **C**₂, basal; and **C**₃, lateral views; **D**, *D. vaughani* Yabe & Eguchi, 1932 (MNHN-Sci.2008-0009); **D**₁, calicular; **D**₂, basal; and **D**₃, lateral views; **E**, *D. ornatus* Gardiner, 1899 (USNM 1114145); **E**₁, calicular; **E**₂, basal; and **E**₃, lateral views; **F**, *D. heteroclitus* Wells, 1984 (USNM 1114160); **F**₁, calicular; **F**₂, basal; and **F**₃, lateral views; **G**, *D. corrugatus* Cairns, 1999 (MNHN-Sci.2008-0023); **G**₁, calicular; **G**₂, basal; and **G**₃, lateral views; **H**, *D. crassiseptum* Cairns, 1999 (MNHN-Sci.2008-0026); **H**₁, calicular; **H**₂, basal; and **H**₃, lateral views; **I**, *D. cameratus* Cairns, 1999 (USNM 1114123); **I**₁, calicular; **I**₂, basal; and **I**₃, lateral views; **J**, *D. inusitatus* n. sp.; **J**₁-**J**₃, paratype USNM 1114137; **J**₁, calicular; **J**₂, basal; and **J**₃, lateral views; **J**₄-**J**₇, holotype MNHN-Sci.2008-0034; **J**₄, calicular stereo pair; **J**₅, basal; **J**₆, oblique; and **J**₇, lateral views. All lateral views are not presented in life position. Scale bars: 1 cm.



from calicular margin, dimorphic S4 (those S4 near flanking S1 are larger than S3 and those flanking S2 are equal in width to S3) and the presence of P4. According to Cairns (1994) the presence of P4 can be used to distinguish this species from all other *Deltocyathus* with four septal cycles.

Deltocyathus ornatus Gardiner, 1899
(Fig. 1E)

Deltocyathus ornatus Gardiner, 1899: 163, 164, pl. 20, fig. 25a, b. — Gardiner & Waugh 1938: 195. — Veron 1986: 606. — Cairns 1995: 72 (in part); 1999: 98, fig. 13h, i; 2004: 280. — Cairns *et al.* 1999: 22.

TYPE MATERIAL. — The holotype is deposited at the BMNH.

TYPE LOCALITY. — Baie du Santal, Lifu, Loyalty Islands, 73 m.

NEW RECORDS. — BATHUS 4, stn DW 887, 4 specimens (MNHN-ScI.2008-0010); stn DW 902 (MNHN-ScI.2008-0012); 1 specimen (USNM 1114163); stn DW 903, 1 specimen (MNHN-ScI.2008-0011). — NOR-FOLK 2, stn DW 2092, 4 specimens (USNM 1114145); stn DW 2117, 5 specimens (MNHN-ScI.2008-0013).

DISTRIBUTION. — New Caledonia waters from 18°59.93'S, 163°13.55'E to 24°45'S, 168°07'E, Loyalty islands (Gardiner 1899), 73-400 m. Previous records: Australia off Queensland (Cairns 1995), 315-360 m; Wallis and Futuna region, and Vanuatu region (Cairns 1999), 295-360 m.

DESCRIPTION

Corallum circular, lancetted and shaped as a shallow bowl with upturned edges. Base flat to slightly concave, sometimes with small scar at centre. C1-2 equal and always reach centre of base, being separated from adjacent costae by moderately deep intercostal furrows. C3 most developed costae projecting up to 1.5 mm beyond calicular edge as 12 granular spines. C4 do not reach centre of base, but fuses adjacent C3 beyond calicular margin producing 12 well-developed apices. Corallum white.

Septa hexamerally arranged in 4 cycles (S1>S2>S4>S3). S1 only independent septa, extending $\frac{3}{4}$ the distance to columella, being separated from their dimorphic paliform lobe (as in *D. crassiseptum*) by a deep notch. S2 slightly narrower than S1 and

bear a small palus. S3 are smallest septa ($\frac{1}{3}$ of S2) but bears largest paliform lobes which fuse P2 near columella. S4 fuses outer edge of flanked P3.

Fossa shallow containing an elliptical papillose columella aligned with the two principal S1. Columella consists of small, short, fused tuberculate papillae.

REMARKS

Among the five-spined species of *Deltocyathus*, three occur in New Caledonian waters: *D. ornatus*, *D. heteroclitus*, and *D. corrugatus*. *Deltocyathus ornatus* and *D. corrugatus* are easily separated from *D. heteroclitus* using the number of spines present: 12 versus 6-8 in *D. heteroclitus*, and the P1 dimorphism: dimorphic in *D. ornatus* and *D. corrugatus* and not dimorphic in *D. heteroclitus*. However, the differences between the other two species with 12 spines that occur in New Caledonia region are very subtle: *D. corrugatus* usually possesses a circular basal scar, C3 very prominent, and longer and slender costal spines (also see Cairns 1999).

Deltocyathus heteroclitus Wells, 1984
(Fig. 1F)

Deltocyathus heteroclitus Wells, 1984: 210, figs 3, 1-6. — Cairns & Zibrowius 1997: 124. — Cairns 1999: 69, 97, 98, fig. 13d-g, text-fig. A. — Cairns *et al.* 1999: 21.

TYPE MATERIAL. — The holotype and 5 paratypes are deposited at the USNM (71849, 71850, and 71851).

TYPE LOCALITY. — Navaka River, Espiritu Santo, Vanuatu (Late Pleistocene).

NEW RECORDS. — BATHUS 4, stn DW 887, 2 specimens (MNHN-ScI.2008-0015); stn DW 894, 2 specimens (MNHN-ScI.2008-0016); stn DW 898, 1 specimen (MNHN-ScI.2008-0017); 1 specimen (USNM 1114160).

DISTRIBUTION. — New Caledonia waters from 20°15.77'S, 163°50.21'E to 21°06.67'S, 164°27.62'E, 245-600 m. Previous records: Wallis and Futuna region, 349-355 m, and Vanuatu region (Cairns 1999), 208-210 m, including late Pleistocene of Espiritu Santo (Wells 1984).

DESCRIPTION

Corallum polygonal and lancetted in calicular margin, each lancet corresponding to each P3 and P4. Largest

specimen examined (BATHUS 4, stn DW 894) 11.9 mm in calicular diameter and 4.1 mm in height. Base conical with a pointed centre, but one specimen (BATHUS 4, stn DW 887) shows a large depression in the middle to the base. All costae well developed and equal sized, extending from calicular margin to centre of the base, being separated by shallow intercostal furrows. However, when flanked, C3 is broader and most prominent costae, extending up to 1 mm beyond the calicular edge forming robust costal spines, not reaching the centre of the base. All costae bear several granules near calicular edge, sometimes becoming a row near the middle of the base.

Septa hexamerally arranged in four cycles (S1>S2>S4>S3), however, no specimen examined have a complete fourth cycle, usually resulting in 39–42 septa. Number of spines (C3) dependent of number of flanked S3. S1 only independent septa extending $\frac{1}{2}$ to $\frac{3}{4}$ distance to columella, being separated from a lamellar palus by a slender notch. S2 slightly smaller than S1 but bear a wider palus. S3 dimorphic in size: those unflanked by S4 slightly smaller than S2, being fused by axial edges to adjacent P2; however, those S3 flanked by S4 are the smallest septa, but bear the widest and tallest paliform lobe, and sometimes 2 or 3 small paliform teeth near columella. P3 high granular, sinuous in upper edge, and are the most recessed pali from columella. S4 fuse to adjacent P3 through a solid lamella at the level of S3–P3 notch. All septal faces granulated and slightly sinuous in upper edge.

Fossa shallow containing an elliptical papillose columella composed by several granular elements.

REMARKS

See identification key and Remarks of *D. ornatus*.

Deltocyathus corrugatus Cairns, 1999 (Fig. 1G)

Deltocyathus corrugatus Cairns, 1999: 98.

TYPE MATERIAL. — The holotype is at the NZOI (H 689), and 10 paratypes are deposited at the USNM (94169 [5], and 94170 [5]).

TYPE LOCALITY. — 28°54'36"S, 167°44'12"E (Norfolk Islands), 390 m.

NEW RECORDS. — BATHUS 4, stn DW 898, 8 specimens (MNHN-Scl.2008-0019); stn CP 883, 2 specimens (MNHN-Scl.2008-0020); 1 specimen (USNM 1114161); stn DW 903, 2 specimens (MNHN-Scl.2008-0021); stn CP 885, 1 specimen (MNHN-Scl.2008-0022); stn CP 889, 3 specimens (MNHN-Scl.2008-0023); 3 specimens (USNM 1114162); stn CP 967, 3 specimens (MNHN-Scl.2008-0018).

DISTRIBUTION. — New Caledonia waters from 18°59.93'S, 163°13.55'E to 23°02.53'S, 166°58.18'E, including Loyalty Islands (Cairns 1995), 250–600 m. Previous records: from southern Great Barrier Reef, Australia (Wells 1984) to Norfolk Ridge, New Zealand (Cairns 1995), 73–390 m.

DESCRIPTION

Corallum circular. Calice lancetted, lancets correspond to each C3 flanked by C4. Largest specimen examined (BATHUS 3, stn CP 847) 15 mm in calicular diameter and 4.2 mm in height. Corallum usually white but sometimes slightly reddish-brown pigmented. Base flat to slightly convex, having a small scar of previous attachment (during early stages) in centre. All costae well developed. C1–2 more prominent near calicular edge, becoming a row of granules near centre of base. C3 thickest and tallest costae, extending up to 2 mm and normally upturned slightly beyond calicular edge as granulated costal spines. C4 and C3 form a broad three-step ridge. All costae granulated specially near calicular edge, and a small low granule ridge is present beside each C1–2.

Septa hexamerally arranged in 4 complete cycles (S1≥S2>S4>S3). S1 independent, extending half distance to columella and bearing a wide lamellar palus, which is often fused to columella. S2 equal to or slightly less wide than S1, also bearing a pali of same size of P1, forming a crown more recessed from columella than the crown formed by P1. S3 smallest septa, bearing the tallest pali which fuse to inner edge of near P2 by a porous lamella. S4 slightly wider than S3, and have a spinose margin. Each S4 fuses the adjacent P3 through a long porous lamella. All pali equal sized (P1 sometimes dimorphic) and septa and palar faces bear pointed granules.

Fossa shallow with an elliptical papillose columella.

REMARKS

See Remarks of *D. ornatus*.

Deltocyathus crassiseptum Cairns, 1999
(Fig. 1H)

Deltocyathus crassiseptum Cairns, 1999: 94, fig. 12c-f.

TYPE MATERIAL. — The holotype and 78 paratypes are deposited at the MNHN (uncatalogued), and 39 at the USNM (98681 [2], 98682 [9], 98683 [13], 98684 [8], 98685 [2], 98686 [5]).

TYPE LOCALITY. — 19°21'S, 169°25'E (Tanna), 433-450 m.

NEW RECORDS. — BATHUS 3, stn CP 818, 4 specimens (MNHN-Scl.2008-0024). — BATHUS 4, stn CP 889, 1 specimen (MNHN-Scl.2008-0026). — HALIPRO 1, stn CP 877, 1 specimen (MNHN-Scl.2008-0025). — NORFOLK 2, stn DW 2041, 2 specimens (MNHN-Scl.2008-0027); stn DW 2024, 6 specimens (MNHN-Scl.2008-0028); 6 specimens (USNM 1114122); stn DW 2025, 1 specimen (MNHN-Scl.2008-0029); stn DW 2097, 2 specimens (MNHN-Scl.2008-0030); stn DW 2117, 2 specimens (MNHN-Scl.2008-0031).

DISTRIBUTION. — New Caledonia waters from 21°00.83'S, 164°27.34'E to 24°44'S, 168°06'E, 370-583 m. Previous records: Wallis and Futuna region (Cairns 1999), 420-510 m; Vanuatu region (Cairns 1999), 413-536 m.

DESCRIPTION

Corallum circular to slightly elliptical shaped as a shallow bowl. Theca thick. Base flat to slightly convex, usually with a scar, and sometimes protuberant. Largest specimen examined (BATHUS 3, stn CP 877) 14.2 mm in calicular diameter and 4.6 mm in height. However, smaller coralla show a CD:HT ratio near 2. Costae unequal and more prominent at calicular edge where they are separated by intercostal grooves bisected by a row of low and rounded granules that sometimes resemble a small ridge in the valley formed by the adjacent costae. C1-2 broader than other costae. Corallum white to reddish-brown.

Septa hexamerally arranged in four cycles (48 septa) with septal formula: S1>S2>S3>S4. However, in larger coralla up to 3 pairs of S5 are present resulting in 56 septa. S1 thick and most exsert septa, extending half distance to columella and bear a dimorphic lamellar paliform lobe. Those paliform

lobes before the two principal S1 are narrower than the other four P1, but all reach the columella. S2 equal to slightly smaller and less exsert than S1, also bearing a paliform lobe that reaches columella by a small paliform teeth. S3 about ¾ width of S2, bearing a tall recessed pali that fuses P2 in a chevron arrangement typical of the genus. S4 smallest septa and in some coralla composed by a row of spines. All septal and palar faces very granular.

Fossa shallow to moderately deep, containing a papillose columella.

REMARKS

First time reported since the original description, the specimens of *D. crassiseptum* are distinguished from the New Caledonia congeners by having: a slightly thicker S1-2 in relation to the other septa, corallum shaped as a bowl, absence of costal spines, well-arranged crowns formed by the paliform lobes, and paliform lobes and columellar elements that terminate below the septa upper edges. Different pigmentation patterns can be found in New Caledonia specimens of *D. crassiseptum*: some have the entire calicular edge and septa reddish-brown, other specimens present only the S3 and paliform lobes pigmented, some are completely pigmented and some are entirely white.

Deltocyathus cameratus Cairns, 1999
(Fig. 1I)

Deltocyathus cameratus Cairns, 1999: 95, figs 12g-i, 13a; 2004: 280.

TYPE MATERIAL. — The holotype and 38 paratypes are deposited at the MNHN (uncatalogued), and 15 at the USNM (98687 [1], 98688 [4], 98689 [1], 98690 [1], 98691 [3], 98692 [1], 98693 [4]).

TYPE LOCALITY. — 18°52'S, 168°52'E (Erromango, Vanuatu), 720-830 m.

NEW RECORDS. — NORFOLK 2, stn DW 2086, 2 specimens (MNHN-Scl.2008-0032); stn DW 2103, 2 specimens (MNHN-Scl.2008-0033); 2 specimens (USNM 1114123).

DISTRIBUTION. — New Caledonia waters from 23°57'S, 167°44'E to 24°56'S, 168°22'E, 707-777 m. Previous records: known only in the Pacific Ocean from Wallis and

Futuna region, 305-1010 m, and Vanuatu region (Cairns 1999), 512-1175 m to Lord Howe Rise, including Elizabeth Reef and Britannia (Cairns 2004), 419-1078 m.

DESCRIPTION

Calice circular with lancetted margin. Lancets correspond to each C3 and C4 that project outward. All costae ridged and covered with low rounded granules. Intercostal grooves more prominent at calicular edge and coarsely pointed spines are present in this region. Between C3 and C4, intercostal grooves are slightly shallower than others, and just C1 and C2 originate at centre of base. C4 smaller than C3. Base slightly conical. Corallum white but reddish-brown in well-preserved coralla.

Septa hexamerally arranged in 4 complete cycles (S1>S2>S4>S3). S1 only independent septa and extend half distance to columella. Each S1 bears a lamellar paliform lobe, which encircles the columella forming the first palar crown. S2 less wide and exsert than S1, bearing a palus more recessed from columella than P1. S3 smallest septa, but posses the tallest palus which fuses S2 in a well-developed lamellar structure. P3 form outermost crown. S4 less exsert but slightly wider than S3. Each pair of S4 fuses the flanked S3 with a porous lamella that extend lower in theca almost to columella. All septa and palar faces coarsely granulated.

Fossa nonextant containing a well-developed papillose columella formed by 10-15 granular rods.

REMARKS

Among the other four non-spined species of *Deltocyathus* from New Caledonia with four septal cycles, *D. cameratus* is distinguished by the conical base with pointed centre, calicular margin lancetted, and the well-developed lamellar fusions of the S4 to P3 and S3 to P2.

Deltocyathus inusitatus n. sp. (Fig. 1J)

HOLOTYPE. — NORFOLK 2, stn DW 2097 (MNHN-ScI.2008-0034).

PARATYPES. — NORFOLK 2, stn DW 2025, 2 specimens (MNHN-ScI.2008-0035, MNHN-ScI.2008-0036); stn

DW 2034, 1 specimen (MNHN-ScI.2008-0037); 1 specimen (USNM 1114137); stn DW 2086, 1 specimen (MNHN-ScI.2008-0038); stn DW 2087, 1 specimen (MNHN-ScI.2008-0039); 1 specimen (USNM 1114138); stn DW 2097, 1 specimen (MNHN-ScI.2008-0040).

TYPE LOCALITY. — Bank Kaimon Maru (24°44'S, 168°06'E), 580-583 m.

ETYMOLOGY. — The species name *inusitatus* (from Latin *inusitatus*, meaning unusual, extraordinary, strange, rare) refers to the unusual septal arrangement presented in this species.

DISTRIBUTION. — New Caledonia region from 23°27'S, 167°51'E to 24°56'S, 168°22'E (Bank Brachiopode, Bank Stylaster, Bank Éponge, and Bank Kaimon Maru).

DESCRIPTION

Corallum free and patellate, with flat to very slightly convex base. Well-preserved coralla show a small and usually convex epicentre boss in base. Specimens range from 11 to 13.4 mm in GCD and 2.9 to 4 mm in HT. Holotype measures 13.3 × 13.2 mm in CD and 3.6 mm in HT. Well-preserved specimens have a circular calice, and worn specimens appear to have a polygonal margin. Calicular margin not lancetted or serrate, projection of all septa being equal. Costae granular being more conspicuous near calicular edge, where they are separated by shallow intercostal grooves. Granules small and low, becoming more slender and taller near calicular edge. All specimens analyzed show a reddish-brown to purple calicular edge, including all septal edges and approximately 3 mm of base edge in direction to centre.

Septa always hexamerally arranged in 5 incomplete cycles (S1≥S2>S3≥S5>S4), normally having 69 to 72 septa. All systems present two dimorphic half systems, one composed of 1 S1, 1 S2, 1 S3, 2 S4, and 4 S5, and the other composed of 1 S1, 1 S2, 1 S3 and 2 S4. All specimens contain 3 half-systems. S5 oriented to the right of half systems with less septa, and 3 to left. S1 about 1.8 mm exsert and only independent septa, extending half distance to columella. P1 well developed and separated from S1 by a wide notch which contains a slender paliform tooth. S2 similar in shape and exserteness, but sometimes slightly less wide than S1. Notch separating S2 from their paliform lobes less wide than those of S1, and sometimes bearing a small

paliform tooth. At the site that S3 join S2 there are usually 1 to 3 paliform teeth. S3 dimorphic in width, those in the half-system with no S5 equal to slightly less wide than the flanking S4 (specially S4 near S1), extending $\frac{1}{4}$ to $\frac{1}{5}$ distance to columella. P3 as wide as S3, being separated by a small notch. However, those S3 in the half-system with S5 are bigger than the flanking S4, extending about $\frac{1}{3}$ distance to columella. Before joining columella, all P3 usually bear 1 to 4 paliform teeth. Axial edges of each pair of S5 solidly fused as a thick lamella to outer edge of adjacent P4. Usually S5 beside a primary or secondary septa is wider than other S5. P4 of crowded half system join P3 at approximately $\frac{3}{5}$ distance from columella and in half systems without S5, P4 fuse P3 as thick lamella. P3 join P2 near columella and axial edges of P1 and P2 are fused to columella. All septa and palar faces bear sparse, pointed granules.

Fossa extremely shallow to nonextant, containing a well-developed papillose columella, consisting of 7 to 20 often fused granular rods.

REMARKS

Among the other 24 Recent species belonging to the genus *Deltocyathus*, *D. inusitatus* can most easily be distinguished by its unusually dimorphic septal cycles, one half system composed of 1 S1, 1 S2, 1 S3, 2 S4, and 4 S5, and the other composed of 1 S1, 1 S2, 1 S3 and 2 S4. All specimens consist of 3 half-systems with S5 oriented to the right of the half systems with less septa, and 3 to the left. Other distinctive characters are its flat base, all septa extending the same distance beyond the calicular margin, and usually a small paliform tooth present between S1 and P1.

Two coralla from NORFOLK 2 expedition, stn DW 2087 showed evidence of calicular regeneration.

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