

A Solitary Deep-Water Corals of the Scleractinian of the Vietnamese Shelf

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Abstract For the first time described solitary corals collected of the shelf Vietnam. In general were identified 27 species, 16 genera attributed to the eight families. Two species were not previously known to science. At all stations were met representatives of genera *Flabellum*. Most massive settlements have formed two types *Dendrophyllia* sp. (33 spec. in samples) and *Truncatoflabellum crassum* (28 spec. in samples). Most taxonomically rich coral genera were *Flabellum*, *Truncatoflabellum*, and *Caryophyllia*. The high density of corals noted at stations with depths 90-230 m, the greatest variety-at a depth of 285-390 m. Deep water corals in Vietnam are integral with the coral fauna of the Indo-Polynesian Province. These data complement the general characteristics of the knowledge of the composition, morphology and chorology world fauna single coral.

Keywords: corals, deep-water, chorology, shelf, Vietnam

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1. Introduction

The spread of solitary ahermatypic corals in the oceans-a common phenomenon. We can not say that their study neglected by researchers. Data on the diversity of deep-water corals in various parts of the Pacific and their dissemination were in different years (Vaughan, 1941; Durham, 1947; Durham & Barnard, 1952; Cairns, 1991, 1994). They have met with deep dredging of the coast of Alaska, the Kuril Islands, the Commander, the Aleutian and the Galapagos Islands (Vaughan, 1941; Keller, 1978; Cairns, 1991; Latypov, 2004). Representatives of Caryophyllidae (more than 30 species) are found at depths of up 52 to 1680 m throughout Indo-Westpacific and in the temperate waters of the North Pacific. The most complete information about

the distribution of ahermatypic scleractinian (over 100 species) in the temperate waters of the Northern Pacific contained in the Cairns (Cairns, 1994). There are many species of these audit corals. In 80-ies of the last century were conducted and audit ahermatypic description deep corals in the Mediterranean and North Atlantic (Zibrowius, 1980). This paper describes in detail the more than 90 species, one-tenth of which first described to science. In the work on the audit of the ahermatypic corals of the Philippine Sea and adjacent waters, 58 species described in detail including an extensive synonymy and discussion about the variability of each of them (Cairns, 1989). Some information about the solitary corals of the Kuril Islands, the Japanese sea and reefs of Vietnam were in the works of the author (Latypov, 1995; Latypov, 2002, 2004).

Table 1. Location of stations

# station	North latitude	East longitude	Depth, m	The number of corals	The number of species
1	15° 31'	109° 07'	90	37	6
2	7° 16'	109° 23'	350-390	25	9
3	8° 13'	110° 35'	350	11	1
4	8° 02'	110° 30'	285-350	11	8
5	7° 58'	110° 36'	250	6	2
6	8° 41'	111° 42'	110-230	34	2
7	8° 41'	111° 42'	113-300	4	2
8	7° 15'	109° 22'	192-210	2	1
9	8° 41'	111° 42'	360-440	6	3
10	8° 40'	111° 42'	139-210	3	1
11	8° 41'	111° 42' 5''	329-428	5	4
12	9° 21'	111° 43'	376-379	5	2
13	9° 21'	111° 43' 7''	346-375	2	1

So far, there is no information about the single deep scleractinian the western part of the South China Sea and, in particular, the shelf of Vietnam. During a voyage in May-June 2007, studies have been conducted on the shelf

of Vietnam on scientific vessel FEBRAS "Academician Oparin" from the northern part of the Tonkin Gulf to reefs of the Spratly archipelago. When deep-water dredging is the collection of solitary corals, which is devoted to the

description of this article, which, I hope, will complement the overall performance new knowledge of composition, biology and horology world fauna solitary corals.

2. Material and Methods

Corals collected during the voyage 34 scientific vessel “Akademik Oparin” along the coast and shelf of Vietnam in 2007 at 13 stations in the South China Sea from 15° 31' to 7° 15' North latitude trawl of Zigby with square capture 120 x 70 cm at depths of 90 to 400 m. Living corals were recorded in 10 % solution of household bleach is “Whiteness” and oxalic acid to remove soft tissue and clay

fractions of cups corallites. One hundred fifty-seven instances collected corals. List of stations and their location shown in Table 1. The collection kept in the Museum A.V. Zhirmunsky Institute of Marine Biology, Vladivostok, Russia: No. 18620-No. 18650.

3. Systematic Account

In total, 27 were identified species, which considered sixteen genera eight families (Table 2). Two species not previously known to science, and one species, presumably *Dendrophyllia* sp, still not identified.

Table 2. Distribution of corals

Species	1	2	3	4	5	6	7	8	9	10	11	12	13
<i>Anthemiphyllia dentata</i>	+	-	-	+	-	+	-	-	-	-	+	-	-
<i>Asterosmilia marchadi</i>	-	+	+	-	-	-	-	-	-	-	-	-	-
<i>Balanophyllia serrata</i>	+	-	-	-	-	-	+	-	-	-	-	-	-
<i>Caryophyllia (Acanthocyathus) spiniger</i>	-	-	-	+	-	-	-	-	-	-	-	-	-
<i>C. (A.) spinicarens</i>	-	-	-	+	-	-	-	-	-	-	-	-	-
<i>C. (C.) quadragenaria</i>	-	+	-	-	-	-	+	-	-	-	-	-	-
<i>Crispatotrochus rubescens</i>	-	-	-	-	-	-	-	-	-	-	+	-	-
<i>Deltocyathus andamanicus</i>	+	-	-	+	+	-	-	+	-	-	-	-	-
<i>D.suluensis</i>	-	+	-	-	-	-	-	-	-	-	-	-	-
<i>D. radiatus</i>	+	+	-	+	-	-	-	-	-	-	-	-	-
<i>Flabellum (F.) politum</i>	-	+	-	+	-	+	-	-	-	-	-	-	-
<i>F. (U.) deludens</i>	-	-	-	+	-	-	-	-	+	-	-	-	-
<i>F. (U.) japonicum</i>	-	+	-	+	-	-	-	-	+	+	-	-	-
<i>Flabellum septodentatus</i>	-	-	-	-	-	-	-	-	-	-	-	-	+
<i>Fugiacyathus stephanus</i>	-	-	-	-	-	-	-	-	+	-	-	+	-
<i>Gardineria hawaiiensis</i>	-	-	-	-	-	-	-	-	+	-	-	-	-
<i>Javania insignis</i>	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Peponocyathus australiensis</i>	-	-	+	-	+	-	-	-	-	-	-	-	-
<i>Rhizosmilia elata</i>	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rhizotrochus typus</i>	-	+	-	-	-	-	-	-	-	-	-	-	-
<i>Stephanophyllia neglecta</i>	-	+	-	+	-	-	-	-	-	-	-	-	-
<i>Trochocyathus</i> sp	-	-	-	-	-	-	-	-	-	-	+	-	-
<i>T. vasiformis</i>	-	-	-	-	-	-	-	-	-	-	+	-	-
<i>Truncanflabellum aculeatum</i>	+	-	-	-	-	-	-	-	-	-	-	-	-
<i>Trucatoflabellum dens</i>	-	+	-	-	-	-	-	-	-	-	-	-	-
<i>T. crassum</i>	-	+	-	-	-	+	-	-	-	-	-	-	-
<i>T. vanuatu</i>	-	+	-	-	-	-	-	-	-	-	-	-	-

Note: Numbers stations marked by numerals

Order SCLERACTINIA.

Family ANTHEMIPHYLLIIDAE.

Genera *Anthemiphyllia* Pourtalès, 1878.

Anthemiphyllia dentata (Alcock, 1902).

Figure 1 A-Figure 1 C

Discotrochus dentatus.—Alcock, 1902a: 104.

Anthemiphyllia dentata.—Yabe and Eguchi, 1942: 128-129. —Cairns, 1994: 44 (cum syn).

Material examined.—10 specimens, station: 2-7° 16'N, 109° 23'E; 4 8° 02'N, 110° 30'E, 11-8° 41'N, 111° 42' 5'E, South China Sea, depth 329-428 m.

Description.—Button-like corallum 15-20 mm in diameter and 3-4 mm in height, freely lying on the bottom. Calice is shallow. Theca is marble-white greatly ribbed. Costal ribs are sharp cyclic.

Costae finely granular, 5 or 6 small (0.05 mm in diameter) rounded granules occurring across the width of a costae near corallum edge. Corallum white or reddish brown.

Septa arranged in four-five cycles: $S_2 > S_3 > S_4 > S_5$. Thick septa of the first cycle fuse with columella. Their axial ends are highly denticulated with 7-9 rectangular denticles. Septa of the second and third cycles connected by axial ends near columella. Septa of the fourth and fifth cycles are 3-7 mm in length and get filamentous thin

towards the calice bottom. Total number of septa is 86-92. Columella papillose and is solid up to fused, sometimes hill-shape projecting. Living corals have light-orange color.

Distribution.—Vietnam, Australia, Philippines, Japan, Maldives, 75-560 m.

Family CARYOPHYLLIIDAE.

Genera *Asterosmilia* Duncan, 1867.

Asterosmilia marchadi (Chevalier, 1966).

Figure 1 D-Figure 1 E

Dasmosmilia marchadi.—Chevalier, 1916: 944-949.

Asterosmilia marchadi.—Cairns, 1979: 140-142, Cairns & Zibrowius, 1997: 131-132 (cum syn).

Material examined.—1 specimen, station 2-7° 16'S, 109° 23'E, South China Sea, depth 350-390 m.

Description.—Trochoid corallum 8 mm in diameter and 18 mm in height with shapeless pedicel. Calice is elliptical deep with denticulated rim. Theca is brown with distinct ribbing.

Septa arranged in four complete cycles. Septa of the first cycle, slightly projecting upwards over the other septa and the calice rim, fuse with columella. Septa of the second and third cycles fuse by their axial ends near the columella and merge with it. Very short septa of the fourth

cycle formed along the calice wall, their axial ends are free. Lateral septal surfaces intensely covered by denticles, arranged in rows parallel to the upper septal edge. Total

number of septa is 62. Very small loose columella can be found in the calice bottom.

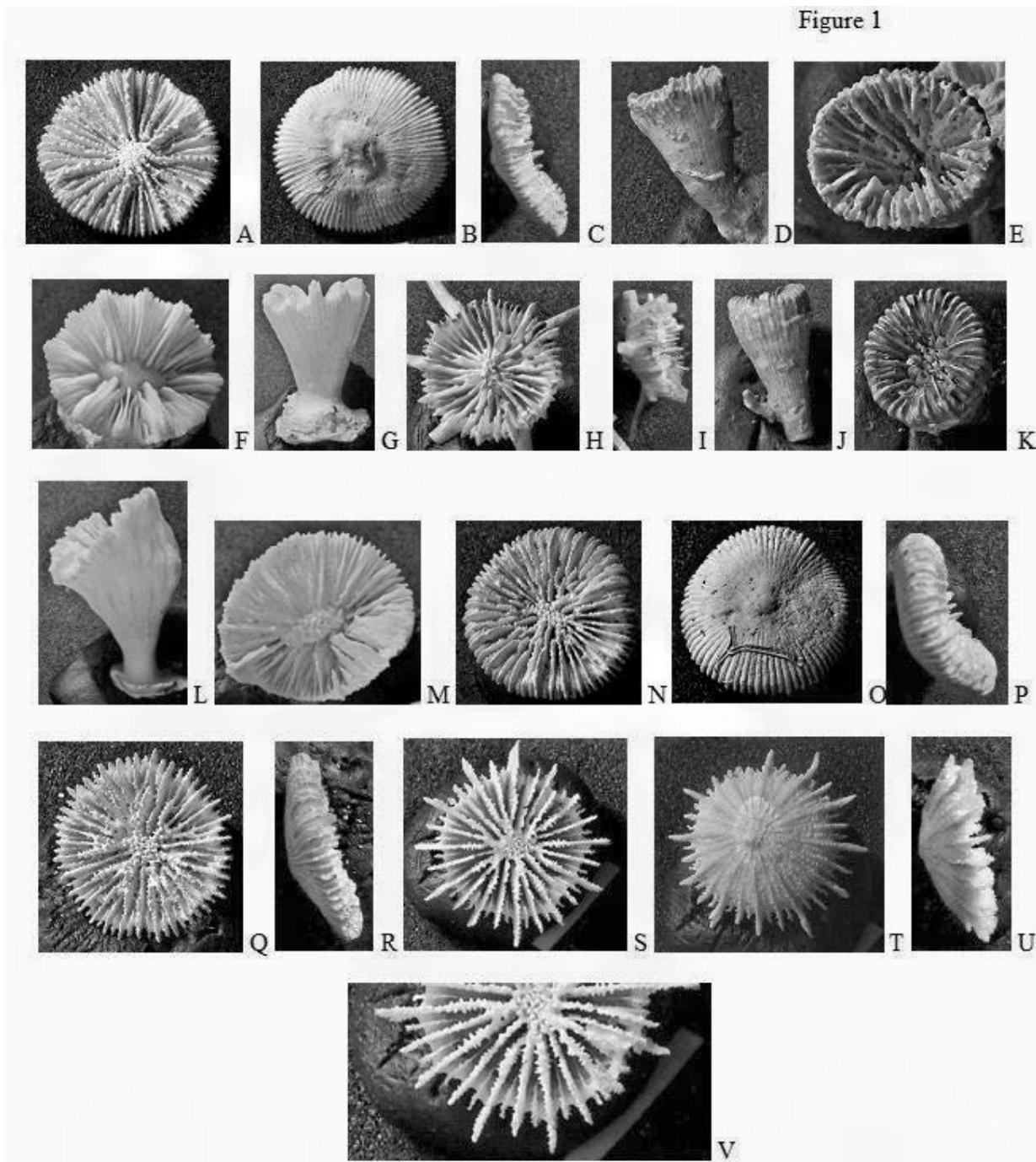


Figure 1. Form calices and septal apparatus of corallite

A-C-*Anthemiphyllia dentata*, x 1.5, spec. 18633; D-E-*Asterosmilia marchadi*, x 1.5 and x 3, spec. 18649; F-G-*Balanophyllia serrata*, x 1.2, spec. 18646; H-I-*Caryophyllia (A.) spiniger*, x 1.5, spec. 18624; J-K-*Caryophyllia (C.) quadragenaria*, x 1.2 and x 2, spec. 18623; L-M-*Crispatotrochus rubescens*, spec. 18648; N-P-*Deltocyathus suluensis*, x 2, spec. 18627; Q-R-*Deltocyathus andamanicus*, x 3, spec. 18620; S-V-*Deltocyathus radiatus*, x 2, spec. 18628

Remark.—Vietnamese specimen differs from the Atlantic ones by the absence of columella.

Distribution.—Vietnam, Caribbean, Malaysia, Portugal, the Philippines, North Atlantic 229-256 m.

Genera *Caryophyllia* Lamarck, 1801.

Caryophyllia (Acanthocyathus) spinicarens (Moseley, 1881).

Figure 3 M-Figure 3 N

Acanthocyathus spinicarens.—Moseley, 1881: 143-144

Caryophyllia (Premocyathus) spinicarens.—Cairns & Keller, 1993: 237.

Caryophyllia (A.) spinicarens.—Cairns & Zibrowius, 1997: 100-101.

Material examined.—2 specimens, station 4-8° 02' N, 110° 30' E, South China Sea, depth 285-350 m.

Description.—Trochoid, slightly curved corals, 25 mm in diameter and 20 mm in height, attached to substrate by thin cylindrical pedicel. Calice is ellipsoidal deep. Theca

lilac brown ribbed. Costal ribs big, very distinctly pronounced.

Septa arranged of four complete cycles and partially of the fifth cycle: $S_2 > S_3 > S_4 > S_5$. Septa of first cycle project upwards, they distinctly reinforced in comparison with other septa. They reach columella in calice depth. Septa of second and third cycles merge with columella. Their longitudinal ends form pali. Septa of fourth and fifth cycles, less than one third in diameter, adjoin lateral surfaces of septa of first cycles. Longitudinal edges of all septa weakly saw-shape denticulated, their lateral surfaces wavy bent and covered by small ripples. Total number of septa are 56-60. Columella solid, occupies up to a fourth of calice base area. Living corals have bright orange or green-yellow color.

Distribution.—Vietnam, Indonesia, Philippines, 223-477 m. ***Caryophyllia (Acanthocyathus) spiniger*** (Saville Kent, 1871).

Figure 1 H-Figure 1 I

Acanthocyathus spiniger.—Saville Kent, 1871: 275-276.

Caryophyllia (A.) spiniger.—Cairns, 1994: 49-50 (cum sin) —Cairns & Zibrowius, 1997: 99-100.

Material examined.—1 specimen, station 4-8° 02' N, 110° 30' E, South China Sea, depth 285-350 m.

Description.—Ceratoid coral, having 15 mm in diameter and 6 mm in height, attached to substrate by six 8-12 mm roots. Calice is shallow. Theca is dull white. Costal ribs distinctly pronounced in the upper corallite part.

Five complete cycles of septa are developed: $S_1 > S_2 > S_3 > S_4 > S_5$. Septa of the first cycle project upwards in comparison with the other septa and merge with columella. Septa of the second cycle also merge with columella and with longitudinal ends of septa of the third and fourth cycles. Septa of the fifth cycle are thin from 1/5 to 1/3 of the corallite diameter, their longitudinal ends are free. Longitudinal ends of septa are denticulated with rare big denticles. Total number of septa is 60. Columella is loose and small, projects upwards above longitudinal ends of septa. Color of living corals is yellow-orange.

Remark.—Our corals differ from the described earlier specimens of *C. spiniger* (Kent, 1871; Cairns, 1994) by distinct merger of longitudinal ends of septa of the second-fourth cycles.

Distribution.—Vietnam, Philippines, Japan, Australia, 152-350 m.

Caryophyllia (Caryophyllia) quadragenaria Alcock, 1902.

Figure 1 J-Figure 1 K

Caryophyllia quadragenaria.—Alcock, 1902: 10.

Caryophyllia (C.) quadragenaria.—Cairns, 1994: 46-47. (cum syn).

Material examined.—2 specimens, station 2-7° 16' N, 109° 23' E; 7-8° 41' N, 111° 42' E, South China Sea, depth 113-350 m.

Description.—Weakly conical or subcylindrical coral up to 20 mm in height and 10 mm in diameter, attached to substrate by thin pointed pedicel. Calice is not deep. Theca is brown with weak ribbing. Costal ribs weakly pronounced in upper corallite part.

Septa of sphenoid reinforced arranged in four complete cycles. Septa of the first cycle reach columella. Septa of the third and fourth cycles, of not more than a third of the coral diameter length, have free longitudinal ends. Total

number of septa is 50. Columella is loose, occupies up to a third of coral calice area. Living corals are orange-brown.

Distribution.—Vietnam, East China and South China seas, the Hawaiian Islands, New Zealand, Makassar Strait, Taiwan, Philippines, Japan, southwest of the Indian Ocean, 54-350 m.

Genera *Crispatotrochus* Tenison-Woods, 1878.

Crispatotrochus rubescens (Moseley, 1881).

Figure 1 L-Figure 1 M

Cyathoceras rubescens.—Moseley, 1881: 157.

Crispatotrochu srubescens.—Cairns, 1991: 15, —Cairns, 1994: 51 (cum syn).

Material examined.—1 specimen, station 11-8° 41' N, 111° 42' 5'' E, South China Sea, depth 329-428 m.

Description.—Trochoid, highly expanding upwards corallum 20 mm in diameter and 35 mm in height with a thin cylindrical pedicel 10 x 15 mm in diameter. Calice is weakly elliptical deep with thin denticulated rim. Theca is white porcelain-like with distinct cyclic ribbing. Corallum is white or reddish brown.

Septa arranged in four-five cycles: $S_1 > S_2 > S_3 > S_4 > S_5$. Septa of the first cycle, projecting upwards over the other septa and calice rim, vertically fall down, reach columella and do not fuse with it. Their axial ends are wavy sinuous. Septa of the second cycle are a third or a quarter shorter. Septa of the third cycle are 3-4 mm long. Septa of the fourth cycle, not longer than 2 mm, are formed along the calice rim. Septa of the fifth cycle are solitary rudimentary. Lateral surfaces of septa are densely covered by very fine denticles, arranged in fan-like rows. Total number of septa is 82. Fascicular columella is loose of sinuous papillae. Living corals are orange.

Remark.—Vietnamese specimen differs from the described earlier *C. rubescens* (Cairns, 1991, 1994) by the corallite shape, as well as septa of complete fourth cycles, which axial ends do not fuse with each other and columella.

Distribution.—Vietnam, Hawaiian Islands, Banda Sea, Christmas Island, Japan, the Philippines, 110-634 m.

Genera *Deltocyathus* Milne-Edwards and Haime, 1848.

Deltocyathus andamanicus Alcock, 1898.

Figure 1 Q-Figure 1 R

Deltocyathus andamanicus.—Alcock, 1896: 16-17, Vaughan, 1907: 71-72, Cairns & Zibrowius, 1997: 124-125.

Material examined.—10 specimens, stations: 4-8° 02' N, 110° 30' E; 5-7° 58' N, 110° 36' E; 8-7° 15' N 109° 22' E, South China Sea, depth 197-350 m.

Description.—Button-like corals, 7-11 mm in diameter and up to 2.5 mm in height, lying freely on bottom. Calices small. Theca white porcelain-like. Costal ribs thin, sharply delineated by cycles.

Septa arranged of complete four and incomplete five cycles: $S_2 > S_3 > S_4 > S_5$. First and second cycle septa reach columella. First two cycles septa adjoin lateral surfaces of following cycles by their longitudinal ends. Longitudinal surfaces of all septa are greatly denticulated. Total number of septa is 58-64. Columella is loose, composed of granular pillars and formed basally from longitudinal ends of septa. Living corals is orange-yellow.

Distribution.—Vietnam, Andaman Islands, the Northern Maldives, South-West Atlantic, 46-397 m.

Deltocyathus suluensis Alcock, 1902.

Figure 1 N-Figure 1 P

Deltocyathus italicus.—Alcock 1902: 19 (in part).

Deltocyathus suluensis.—Cairns & Zibrowius 1997: 125, —Kitahara & Cairns, 2009: 239-240 (cum syn).

Material examined.—3 specimens, station 2-7° 16' S, 109° 23' E, South China Sea, depth 350-390 m.

Description.—Button-like corals, 11-17 mm in diameter and 3-4 mm in height, freely lying on the bottom. Calice is shallow. Theca is dull-white, fine-ribbed. Costal ribs are well pronounced. Granular ridges separated by well-defined same width intercostal furrows.

Septa hexamerally arranged in four-five cycles: (S1 ≥ S2 > S3 > S4 > S5). Septa of the first and second cycles, projecting upwards, reach columella. Septa of the second and third cycles merge with columella by their longitudinal ends. Septa of the fourth and fifth cycles adjoin lateral surface of septa of the higher cycles. Longitudinal and lateral septal surfaces are denticulated and carinated. Fossa shallow containing a well-developed papillose columella. Total number of septa is 64-74. Living corals have reddish-orange color.

Distribution.—Vietnam, the Western Pacific, Indonesia, Philippine, New Zealand, Indian Ocean, 142-1050 m.

Genera *Trochocyathus* Milne Edwards and Haime, 1848.

Trochocyathus vasiformis Bourne, 1903.

Figure 3 A-Figure 3 B

Material examined.—1 specimen, station 11-8° 41' N, 111° 42' 5'' E, South China Sea, depth 329-428 m.

Description.—Conical coral, having 10 mm in diameter and 18 mm in height, attached to substrate by a wide pedicel. Calice is shallow. Theca is gray with fine ribbing. Costal ribs are developed only in the upper part of the corallite.

Septa arranged in three cycles. Reinforced septa of the first cycle distinctly project over the other septa, reach columella, not fusing with it. Septa of the second cycle are 1.5-2 times thinner; reach the axis, ending by big trigonal pali. Septa of the third cycle, rarely more than 1/5 of the corallite diameter, are free. Longitudinal surfaces of all septa are finely denticulated, lateral ones—intensely granulated with fine aciculae. Total number of septa is 48. Living corals are deep orange.

Distribution.—Vietnam, Banda Sea, Fiji, Japan, Wollis and Futuna Islands, Funafuti, 323-650 m.

Genera *Trochocyathus* Milne Edwards and Haime, 1848.

Trochocyathus sp.

Figure 2 Y-Figure 2 Z

Material examined.—2 specimens, station 9-8° 41' N, 111° 42' E, South China Sea, depth 360-440 m.

Description.—Trochoid, weakly curved corals, with a calice of 10 mm diameter and 17 mm in height, attached to substrate by small cylindrical pedicel. Calice is not deep. Theca is gray. Costal ribs with medium-acinous granulation, weak.

Septa sphenoid thickened arranged in three cycles. Septa of the first cycle, slightly projecting upwards, reach columella. Septa of the second and third cycles, fusing by longitudinal ends, do not reach columella a little. All septa are twisting and carinated by small ripples. Most septa have pali. Total number of septa is 48. Columella arranged of isolated trabeculae, not greater than 1/4 of the calice diameter. Living corals are deep orange.

Distribution.—Vietnam, 200-428 m.

Genera *Rhizosmilia* Cairns, 1978.

Rhizosmiliaelata Cairns and Zibrowius, 1997.

Figure 2 Q-Figure 2 S

Rhizosmiliaelata sp. nov.—Cairns and Zibrowius, 1997: 134-135.

Material examined.—1 specimen, station 1-15° 31' N, 109° 07' E, South China Sea, depth 90 m.

Description.—Trochoid, weakly bent coral, 11 mm in diameter and 25 mm in height, attached to substrate by expanding cylindrical pedicel. Calice is deep. Theca is rose-brown, ribbed. Costal ribs are distinct, sharp.

Septa arranged in four complete cycles: Septa of the first cycle, projecting slightly up above the other septa, reach columella. Septa of the second cycle also merge with columella, sometimes adjoining the first cycle septa by their longitudinal ends. Septa of the third and fourth cycles do not reach more than 1/5 corallite diameter. Lateral surfaces of all septa intensely covered with small denticles. Total number of septa is 54-64. Crispate columella is solid, occupies slightly more than a third of calice bottom area. Living corals have yellow-brown color.

Distribution.—Vietnam, the Central and Western Pacific, 90-380 m.

Family DENDROPHYLLIIDAE.

Genera *Balanophyllia* Wood, 1844.

Balanophyllia serrata Cairns and Zibrowius, 1997.

Figure 1 F-Figure 1 G

Material examined.—3 specimens, stations: 1-15° 31' N, 109° 07' E; 7-8° 41' N, 111° 42' E, South China Sea, depth 90-113 m.

Description.—Conical corals 25 mm in diameter and 30 mm in height with shapeless 15 mm pedicel. Calice is elliptic, moderately deep. Theca is white porcelain-like with distinct cyclical ribbing, densely granulated by very fine smoothed aciculae. Costae wide, flat, and covered with small spines.

Septa according to Pourtalesplan arranged in four cycles. Septa of the first cycle, highly projecting upwards over the other septa and the upper calice rim, reach columella. Septa of the second cycle, fusing in the periphery with the first cycle septa, diverge from them near the axis and fuse with columella. Septa of the third cycle are twice or a third shorter than the main septa, their axial ends are straight, fuse or not fuse with axial ends of the other septa. Septa of the fourth cycle, 2-4 mm long, fuse by their axial ends and adjoin septa of the second cycle. Lateral surfaces of all septa are very densely covered by fine denticles, arranged in rows, parallel to the axial edge of the septa. Total number of septa is 76. Columella is solid, prominent and ellipsoid. Living corals are fallow.

Distribution —Vietnam, the Central and Western Pacific, 190-194 m.

Family FLABELLIDAE.

Genera *Flabellum* Lesson, 1831.

Flabellum (Flabellum) politum Cairns, 1989.

Figure 2 A-Figure 2 B

Flabellum pavoninum paripavoninum.—Yabe and Eguchi, 1942: 91-93 (in part).

Flabellum politum.—Cairns, 1989: 53-54, —Cairns, 1994: 73.

Material examined.—8 specimens, stations: 1-15° 31' N, 109° 07' E; 4-8° 02' N, 110° 30' E, 6-8° 41' N, 111° 42' E, Macclesfield Bank, depth 200 m; South China Sea, depth 90-350 m.

Description.—Flabelloid corals from 11 x 20 to 25 x 45 mm in diameter and 27-32 mm in height with a small

conical pedicel. Calice is elliptical deep. Theca is white or hazel porcelain with a distinct vertical ribbing and horizontal growth rings.

Septa arranged in five-six cycles: $S_1 = S_2 > S_3 > S_4 > S_5 > S_6$. Equal-sized septa of the first two cycles, projecting upwards and flatly falling near the axis, become vertically sheer. Their axial ends are sinuous. Analogous septa of the third cycle are $1/3$ shorter. Septa of the

fourth cycle do not project, thinner and shorter of the third cycle septa. Septa of the fifth cycle are $1/2$ shorter than septa of the fourth cycle, and septa of the sixth cycle are not greater than $1/3$ of the fifth cycle septa length. Axial ends of all septa are free, their lateral surfaces are intensely covered by fine denticles. Columella is spongy, small, formed in the calice bottom. Living corals are hepatic.

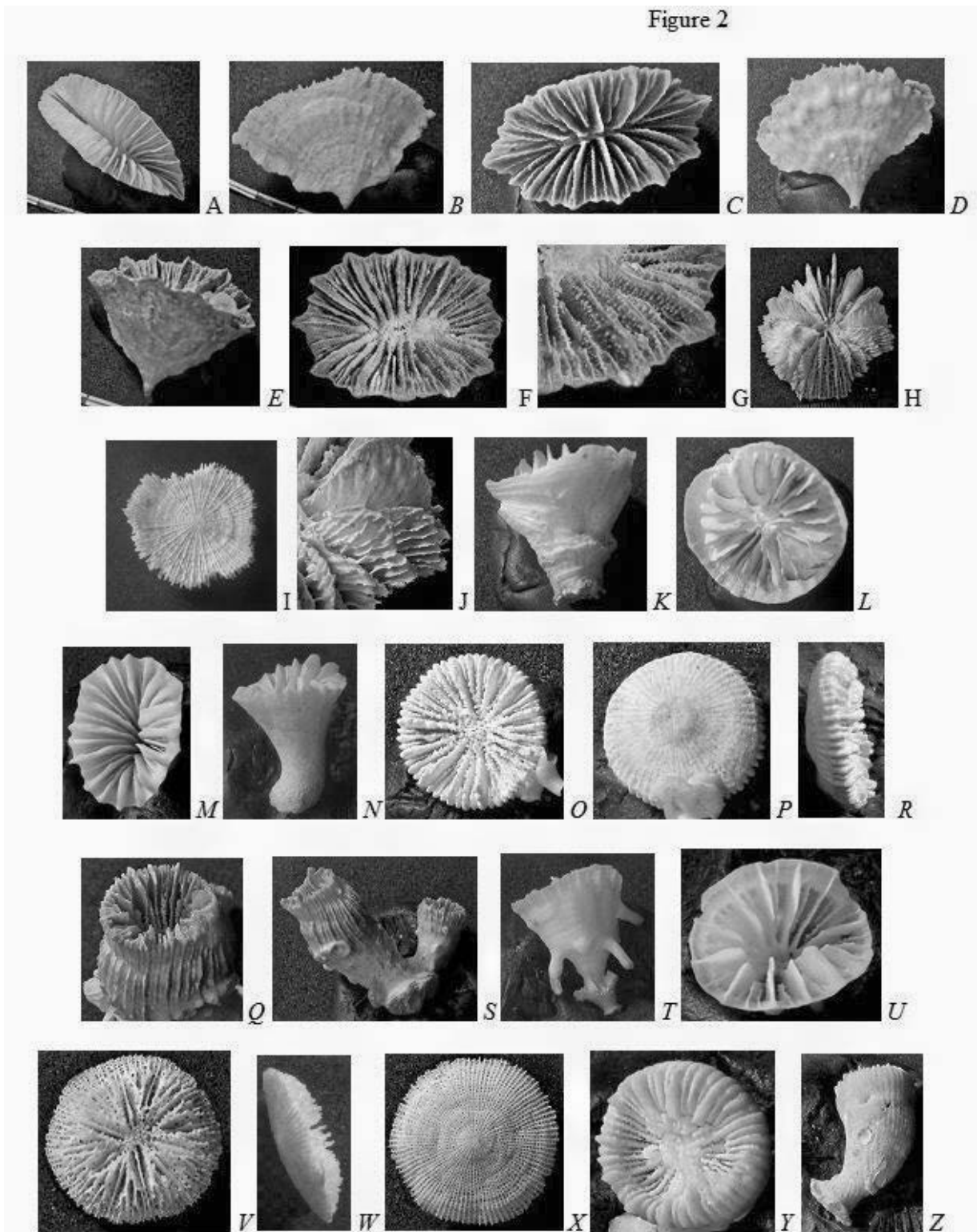


Figure 2. Form calices and septal apparatus of corallite

A-B-*Flabellum (F.) politum*, spec. 18644; C-D-*Flabellum (U.) deludens*, spec. 18640; E-G-*Flabellum septodentatus*, x 1.2 and x 2, spec. 18641; H-J-*Fungiacyathus (F.) stephanus*, x 0.5 and x 4, spec. 18632; K-L-*Gardineriahawaiiensis*, x 1.5, spec. 18650; M-N-*Javaniainsignis*, x 1.2, spec. 18635; O-R-*Peponocyathusaustraliensi*, x 2, spec. 18633; Q-S-*Rhizosmiliaelata*, x 2, spec. 18625; T-U-*Rhizotrochustypus*, x 1.5, spec. 18636; V-X-*Stephanophyllianeglecta*, x 2, spec. 18621; Y-Z-*Trochocyathus* sp, x 2, spec. 18630

Distribution.—Vietnam, The East China Sea, South China Sea, the Korean Strait, Japan, Banda Sea, Philippines, 40-717 m.

Flabellum (Ulocyathus) deludens Marenzeller, 1904.

Figure 2 C-Figure 2 D

Flabellum japonicum.—Marenzeller, 1889: 45-46.

Flabellum deludens.—Marenzeller, 1904: 269-272.

Flabellum (U.) deludens.—Cairns, 1994: 73 (cum syn).

Material examined.—11 specimens, stations: 2-7° 16'S, 109° 23'E; 4-8° 02'N, 110° 30'E; 12-9° 21'N, 111° 43'E, South China Sea, depth 350-379 m.

Description.—Flabelloid corals from 11 x 25 to 13 x 27 mm in diameter and 10-25 m in height with pointed-conical small pedicel. Calice is elliptical deep with sinuous thin margin. Theca is pinky-brown, ribbed-uneven porcelain with pronounced growth zones.

Septa hexa me rally arranged in four-five cycles: $S_1 > S_2 > S_3 > S_4 > S_5$. Septa of the first cycle, projecting upwards over the other septa, sheerly fall to the calice bottom near the axis. Septa of the second cycle are 1 / 3 shorter, arranged in the same way. Septa of the third cycle are twice shorter and thinner than the first cycle septa. Septa of the fourth and fifth cycles, is longer than 2 mm, are formed mainly in the upper part of the calice. All septa are wavy curved and moderately covered by fine denticles. Total number of septa is 82-90. Columella is rudimentary, formed at the calice bottom by axial septal ends. Living corals are red-brown.

Distribution.—Common for the coast of the Pacific, Vietnam, the East China Sea, the Korean Strait, Japan, Philippines, East of the Indian Ocean, 106-1035 m.

Flabellum (Ulocyathus) japonicum Moseley, 1881.

Figure 3 K-Figure 3 L

Flabellum japonicum.—Moseley, 1881: 168-1.

Flabellum (U.) japonicum.—Cairns, 1994: 73-74 (cum sin).

Material examined.—9 specimens, stations: 4-8° 02'N, 110° 30'E; 9-8° 41'N, 111° 42'E; 10-8° 40'N, 111° 42'E, South China Sea, depth 139-440 m.

Description.—Conical corallum in a shape of a bellflower laterally strangulated from 10 x 17 to 17 x 30 mm in diameter and 15-20 mm in height, attached to the substrate by a small cylindrical pedicel. Calice is ellipsoidal with uneven thin margin. Theca is hepatic with sharp ribs of lower half of corallum often discolored.

Sinuous septa hexa me rally arranged in four cycles: $S_1 > S_2 > S_3 > S_4$. Septa of the first two cycles, significantly projecting upwards over the other septa, almost reach the corallite axis. Septa of the third cycle have up to 1 / 3 length of the corallite. Septa of the fourth cycle are thin, short, developed mainly in the upper part of the calice. All septa highly carinated, their axial ends are free. Total number of septa is 46-52. Columella is small, formed in the calice bottom from axial ends of septa. Living corals are hazel.

Distribution.—Vietnam, Japan, Indonesia, Philippines, 119-1141 m.

Genera *Javania* Duncan, 1876.

Javaniainsignis Duncan, 1876.

Figure 2 M-Figure 2 N

Javaniainsignis.—Duncan, 1876: 435, —Cairns, 1994: 80 (cum sin).

Material examined.—3 specimens, station 1-15° 31'N, 109° 07'E, South China Sea, depth 90 m.

Description.—Trochoid, weakly bent corals 10-14 mm in diameter and 15-20 mm in height, attached to the substrate by a massive, stereome-reinforced cylindrical pedicel having 3-9 mm diameter. Calice is elliptic, deep. Theca is porcelain-white, weakly ribbed. Costal ribs are formed only in the upper part of the corallite.

Septa hexa me rally arranged in four cycles. Reinforced septa of the first two cycles, projecting upwards, sheerly fall to the calice bottom. Septa of the third cycles are twice thinner and shorter, arranged similarly. Filiform thin septa of the fourth cycle, not greater than 1 / 5 diameter of the corallite, are developed in the upper part of the calice. Total number of septa is 80-86. Fossa very deep and elongate; no columella visible. Living corals have red-brown color.

Distribution.—Vietnam, Japan, East China Sea, Korea Strait, *Elsewhere*: Widespread, including Aleutian Islands, Hawaiian Islands, Philippines, Indonesia, Red Sea, and southwest Indian Ocean; 73-825 m.

Genera *Truncatoflabellum* Cairns, 1989.

Truncatoflabellum aculeatum (Milne Edwards and Haime, 1848).

Figure 3 C-Figure 3 D

Flabellum aculeatum.—Milne Edwards & Haime, 1848: 272.

Truncatoflabellum aculeatum.—Cairns, 1989: 61 (cum sin).

Material examined.—1 specimen, station 1-15° 31'N, 109° 07'E, South China Sea, depth 90 m.

Description.—Flabellate coral 12 x 30 mm in diameter and 20 mm in height with elliptic 6 x 14 mm pedicel and two lateral roots in the corallite basis. Calice is ellipsoid deep with a thin even rim. Theca is white porcelain with fine longitudinal ribbing and growth rings.

Septa of antho cyathus hexa me rally arranged in four cycles: $S_{1-2} > S_3 > S_4$. Equivalent in size and shape lanceolate septa of the first two cycles fall to the calice bottom parallel to its wall. Similar septa of the third cycle are a quarter shorter. Septa of the fourth cycle, rarely longer than 2 mm, formed along the calice wall up to its basis. All septa are covered by fine denticles, fan-like arranged in rows regarding the corallite wall. Total number of septa is 112. Columella is distinct in the calice bottom, elongated. Living corals are orange.

Remark. Differs from the similar *T. crassum* by longer septa of the first cycle, 2-2.5 times wider pedicel and by dental arrangement on the lateral septal surfaces.

Distribution.—Vietnam, Torres Strait, Philippines, Japan, Western Australia, 2-106 m.

Truncatoflabellum crassum (Milne Edwards and Haime 1848).

Figure 3 G-Figure 3 H

Flabellum crissum.—Milne Edwards & Haime, 1848: 276-277.

Truncatoflabellum crassum.—Cairns, 1989: 64-65.

Material examined.—28 specimens, stations: 1-15° 31'N, 109° 07'E, 6-8° 41'N, 111° 42'E, Macclesfield Bank, depth 200 m, South China Sea, 90-230 m.

Description.—Flabellate corals from 8 x 12 to 11 x 25 mm in diameter and from 10 to 25mm in height with ellipsoid pedicel up to 5 mm and 2-4 lateral root-like offshoots. Calice is ellipsoid deep with even edge. Theca is light-gray and red-brown with fine longitudinal ribbing and growth rings.

Septa arranged in four cycles. Lanceolate septa of the first two cycles, slightly moving off the calice wall, vertically fall in the axial part of the corallite. Analogous septa of the third cycle are a quarter or twice shorter. Septa of the fourth cycle, rarely longer than 2 mm, formed parallel to the calice wall. All septa covered by fine denticles, arranged in parallel rows at a steep angle to the

corallite wall. Total number of septa is 102-116. Columella is rudimentary. Living corals are yellow-orange.

Distribution.—Vietnam, South China Sea, Philippines, 90-230 m.

Truncatoflabellum dens (Alcock, 1902).

Figure 3 E-Figure 3 F

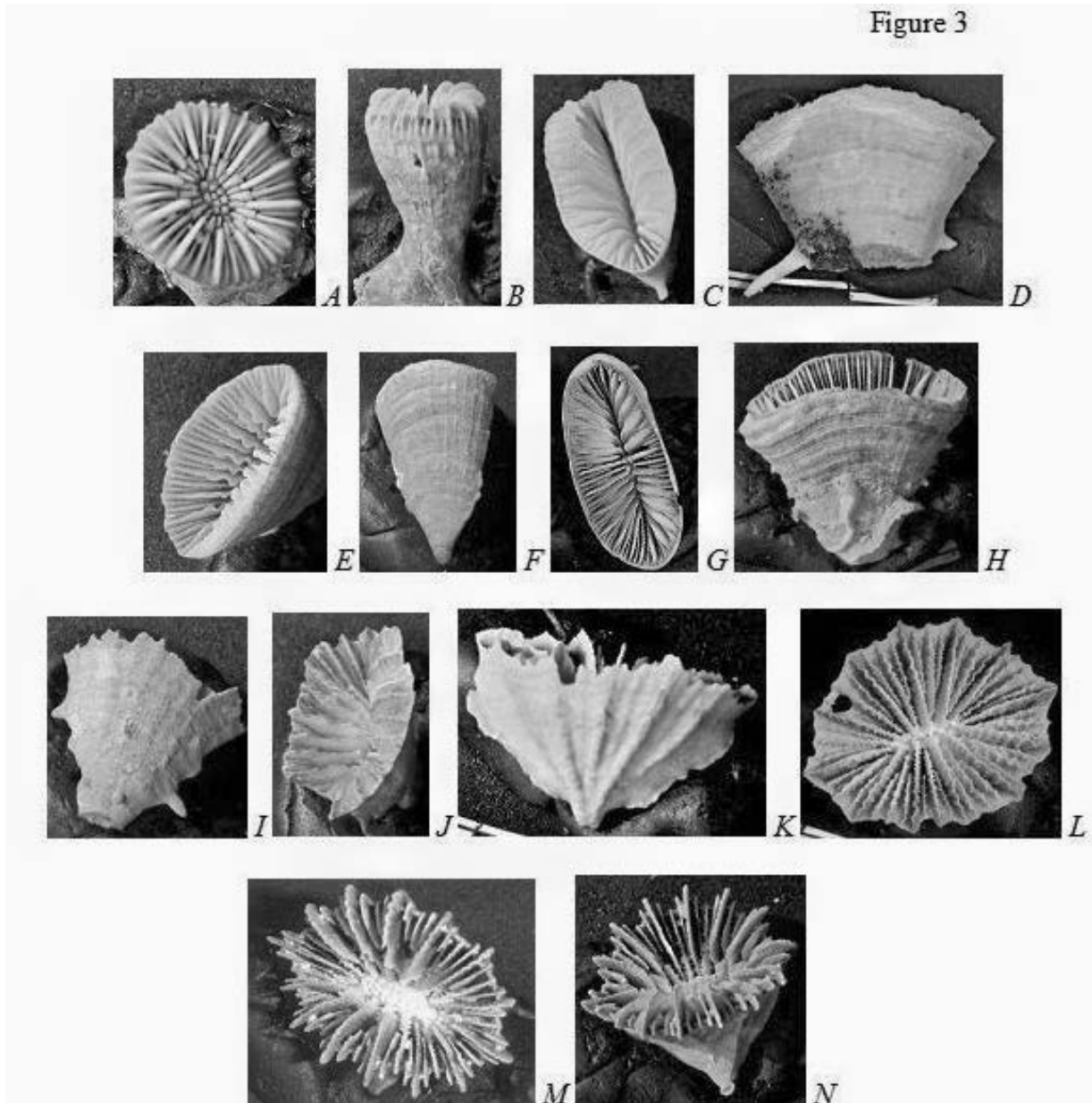


Figure 3. Form calices and septal apparatus of corallite

A-B-Trochocyathus vasiformis, x 2, spec. 18631; C-D-Truncatoflabellum aculeatum, x 1.2, spec. 18643; E-F-Truncatoflabellum dens, x 1.5, spec. 18638; G-H-Truncatoflabellum crassum, spec. 18644; I-J-Truncatoflabellum vanuatu, x 1.2, spec. 18622; K-L-Flabellum (U.) japonicum, x 1.2, spec. 18637; M-N-Caryophyllia (A.) spinicarens, x 1.2, spec. 18642

Flabellum dens.—Alcock, 1902: 106-107.

Truncatoflabellum dens. — Cairns, 1995: 114-115, — Cairns & Zibrowius, 1997: 170-171.

Material examined.—12 specimens, station 2-7° 16'S, 109° 23'E, South China Sea, depth 350-390 m.

Description.—Conical corals highly compressed laterally, from 6 x 11 to 8 x 20 mm in diameter and 15-30 mm in height with a vaguely pronounced small cylindrical pedicel. Calice is elliptic deep. Theca is hazel with distinct longitudinal ribbing and horizontal growth rings.

Sinuus septa hexa me rally arranged in four cycles: $S_1 > S_2 > S_3 > S_4$. Septa of the first two cycles, sheerly falling

down, don't reach the corallite axe a little, their axial ends are greatly sinuous. Septa of the third cycle, rarely longer than 2 mm, sheerly fall along the calice wall. Septa of the fourth cycle, 1 / 3 or twice shorter, are arranged in the same way. All septa are highly carinated. Total number of septa is 58-70. Columella is rudimentary, formed deeply in the calice bottom. Living corals are orange.

Distribution.—Vietnam, Philippines, Western Pacific, Vanuatu, Wollis and Futuna Islands, 286-555 m.

Truncatoflabellum vanuatu (Wells, 1984).

Figure 3 I-Figure 3 J

Material examined.—1 specimen, station 2-7° 16'S, 109° 23'E, South China Sea, depth 350-390 m.

Description.—Flabellate coral 11 x 20 mm in diameter and 20 mm in height with a small ellipsoid pedicel and 2-3 short lateral root-like pins. Calice is ellipsoid deep with a thin uneven edge. Theca is hazel with fine longitudinal ribbing and growth rings.

Septa arranged in three-four cycles. Lanceolate septa of the first cycle project upwards and vertically fall near the corallite axis. Analogous septa of the second cycle are twice or one third shorter. Septa of the third cycle, rarely longer than 2 mm, are formed sub parallel to the calice Theca. Septa of the fourth cycle are short, rudimentary, developed mainly in the upper part of the calice. All septa are covered by fine denticles, arranged in 4-6 vertical rows on the first two cycles septa. Columella is loose small in the calice bottom. Living corals are orange.

Distribution.—Vietnam, Korean Strait, Japan, Pratas Island, Philippines, Wollis and Futuna Islands, 240-390 m. Genera *Rhizotrochus* Milne-Edwards and Haime, 1848.

Rhizotrochustypus Milne Edwards and Haime, 1848.

Figure 2 T-Figure 2 U

Rhizotrochustypus.—Milne Edwards and Haime, 1848: 282, —Cairns, 1994: 81 (cum sin).

Material examined.—1 specimen, station 1-15° 31'N, 109° 07'E, South China Sea, depth 90 m.

Description. Conical coral 13 mm in diameter and 15 mm in height, attached to the substrate by a small cylindrical pedicel and having four lateral spinous roots. Calice is elliptic deep with the denticulated upper edge. Theca is white porcelain-like, with a very fine ribbing and growth rings.

Septa arranged in three cycles. Weakly reinforced, projecting upwards septa of the first cycle, sheerly falling, fuse with columella. Thin septa of the second cycle are very short. Septa of the third cycle, not greater than 2 mm, are formed in the upper part of the calice. Septa of the second and third cycles are highly carinated. Total number of septa is 46. Columella elongate and trabecular is fused from merged septal ends. Living corals are mahogany.

Remark.—Vietnamese specimen differs from the American one by the decreased number of septa and the presence of spinous root-like branches.

Distribution.—Vietnam, Japan, Elsewhere: Philippines, Singapore, Palau, Indonesia, Andaman Islands, Persian Gulf, Red Sea, 20-1048 m.

Family FUNGIACYATHIDAE.

Genera *Fungiacyathus* Sars, 1872.

Fungiacyathus (Fungiacyathus) stephanus (Alcock, 1893).

Figure 2 H-Figure 2 I

Bathyactissymmetrica.—Moseley, 1881: 189 (in part).

Fungiacyathus (F.) stephanus.—Zou et al. 1988: 195, —Cairns & Zibrowius, 1997: 68-69 (cum sin).

Material examined.—1 specimen, station 2-9° 21'N, 111°, 43'E, South China Sea, depth 360-440 m.

Description.—Corallum with subtle very fragile skeleton have 42 mm in diameter and 20 mm high. Epithea white strongly ribbed ribs costal spines are very thin, slightly twisting, covered with small spines.

Septa regularly hexa me rally arranged in five complete cycles and are consist of tall thin plates covered with vertical synapticulae ribs. Septa first cycle reach columella, merging synapticulae ribs with septa of the

fourth cycle. Sized septa are the second and third cycles a little do not reach the columella, merging the centre meet. Septa fourth cycle lengths up to 2 / 3 the diameter of the corallite adjoin the side wall of the third cycle. Septa fifth, not more than one quarter of the diameter of the corallite are adjacent to the lateral surface of the septa the fourth cycle. Columella low small, consists of small tightly merged trabeculae. The color of living coral is yellow-orange.

Distribution.—Vietnam, Vanuatu, the East China Sea, Indonesia, Wollis and Futuna Islands, the Philippines, the West Indian Ocean, 245-1977 m.

Family GARDINERIIDAE.

Genera *Gardineria* Vaughan, 1907.

Gardineria hawaiiensis Vaughan, 1907.

Figure 2 K-Figure 2 L

Gardineria hawaiiensis.—Vaughan, 1907: 65-66, —Cairns, 1984: 23.

Material examined.—1 specimen, station 9-8° 41'N, 111° 42'E, South China Sea, depth 360-440 m.

Description.—Ceratoid corallum 22 mm in diameter and 20 mm in height with cylindrical pedicel 6 mm in diameter. Calice is round deep with thin even rim. Theca is white porcelain-like, epithea covered by thin transversal growth rings.

Septa arranged in three cycles. Weakly wedge-like reinforced septa of the first and second cycles 2-4 mm project over the calice rim. They form paliform lobes near the axis and fuse with columella. Short septa of the third cycle developed along the calice wall. Lateral surfaces and axial edges of septa are even. Total number of septa is 48. Columella is trabecular loose. Living corals are orange-red.

Distribution.—Vietnam, Philippines, Hawaii, 319-602 m.

Family TURBINOLIIDAE.

Genera *Peponocyathus* Gravier, 1915.

Peponocyathus australiensis (Duncan 1870).

Figure 2 O-Figure 2 R

Deltocyathus italicus var. *australiensis*.—Duncan, 1870: 297.

Deltocyathus orientalis.—Duncan, 1876: 431.

Peponocyathus australiensis.—Cairns, 1989: 29, 30 32, —Cairns, 1994: 65-66 (cum syn).

Material examined.—5 specimens, station 3-8° 13'N, 110° 35'E; 5-7° 58'N, 110° 36'E, South China Sea, depth 250-350 m.

Description.—Button-like corals 7-11 mm in diameter and 2-3 mm in height, freely lying on the bottom. Calice is shallow. Theca is dull-white ribbed. Costal ribs are distinct cyclic. Costae rounded and equal in width, separated by very thin (about 0.1 mm) and deep (up to 1 mm at calicular edge) intercostal furrows, which do not afford a view of underlying theca.

Reinforced septa arranged in four cycles: $S_1 > S_2 > S_3 > S_4$. Septa of the first and second cycles fuse with columella. Septa of the third cycle adjoin lateral surface of the second cycle septa near the axis. Septa of the fourth cycle are not more than a quarter of the corallite diameter in length, their axial ends are free and get thread-like thin towards the calice bottom. All septal and palal faces are intensely denticulated and granulated. Septa of the first two cycles have pali. Total number of septa is 52-56. Columella is formed by isolated or fused pali. Living corals have deep-orange color.

Distribution.—Widely distributed in the Indo-West Pacific, including Australia and New Zealand, 44-635 m.

Family MICRABACIIDAE.

Genera *Stephanophyllia* Michelin 1841.

Stephanophyllianeglecta Boschma 1923.

Figure 2 V-Figure 2 X

Fungia patella.—Van der Horst, 1921: 57 (in part).

Stephanophyllianeglecta.—Boschma, 1923: 144-145, —Cairns, 1989: 23-24.

Material examined.—2 specimens, stations: 2-7° 16' N, 109° 23' E; 4-8° 02' N, 110° 30' E, South China Sea, depth 285-390 m.

Description.—Button-like corals 14-17 mm in diameter and 2.5-3 mm in height, is lying freely on bottom. Calices are small. Theca white porous is highly ribbed. Costal ribs thin, sharply delineated by cycles.

Thin porous septa arranged in three-four cycles with sharp bifurcation at the periphery. First cycle septa merge with columella. Second and third cycle septa merge by longitudinal ends near columella. Peripherally bifurcated septa of the third, fourth and sometimes second cycles, not greater than 1 / 6 length of corallite diameter, adjoin lateral surfaces of the first cycles septa. All septa are greatly denticulated. Total amount of septa are 86-92. Columella loose formed by sinuous trabeculae; however, in some specimens it is often lamellar, and even in larger specimens it may be composed of several aligned trabeculae that fuse into a lamellar structure. Living corals have orange color.

Distribution.—Vietnam, Indonesia, Philippine, Australia, Vanuatu, Wollis and Futuna Islands, 110-1080 m.

4. Discussion

New species coral of *Flabellum septodentatus* (Latypov, 2014) found on the weakly silted detritus and differs from all known species *Flabellum* by large and complicated dentation of the lateral septal surface. Differs from the similar *F. angulare* by 1.5 time greater number of septa, and by the presence of the fourth septal cycle. Another new species of *Deltocyathus radiatus* (Latypov, 2014) is also found in similar lithologic conditions and differs from all known *Deltocyathus* more complex by septal apparatus, septa which greatly protrude from the cups corallite.

The resettlement of solitary ahermatypic corals in the Eocene-Oligocene age (30-20 million years) from top to bottom with the shelf in the bathyal zone and abyssal zone or from the bottom up with abyssal in the shallow waters of the oceans (Keller, 2012 b) left their mark on the biogeographic composition of the coral fauna of the South China Sea.

Slightly less than half (40.7 %) species richness of deep-sea corals are scleractinian from two families Caryophyllidae and Flabellidae the most common on Earth in fossil and present state at depths from 12 up to 2030 m (Cairns, 1994; Keller, 2012 a). At all stations met by representatives of the genera *Caryophyllia* and *Flabellum*. The most massive cluster formed two species of *Dendrophylliasp.* (33 species. in samples) and *Truncatoflabellum crassum* (28 species. in samples). The richest in taxonomic relation (4 species) were the coral genera *Flabellum* and *Truncatoflabellum*. The largest coral up to 40 mm wide and 50 mm in height are corals

genus *Flabellum*, while the small scleractinian type *Dendrophylliasp.*, the size of which does not exceed 5 mm. Ahermatypic solitary scleractinian of five genera: *Balanophyllia serrata*, *Deltocyathus andamanicus*, *D. suluensis*, *Trochocyathus vasiformis*, *Truncatoflabellum dens*, *T. vanuatuand Rhizosmiliaelata* first discovered in the South China Sea. Two-thirds of nine genera: *Asterosmilia*, *Balanophyllia*, *Caryophyllia*, *Deltocyathus*, *Javania*, *Flabellum*, *Trochocyathus*, *Trunca* to *flabellunand Rhizosmilia* previously been known in various parts of the Pacific. Smallest depth at which greeted the corals was 90 m, maximum—440 m. Similar characteristic combinations of solitary corals for the different areas mentioned earlier (Yabe & Eguchi, 1932; Wells, 1964; Cairns, 1989; Zibrowius, 1980). In biogeographic for most corals is the Indo-Pacific distribution.

Among tropical biogeographic regions the highest species diversity of these animals found in the Indo-West Pacific. Living here, deep-water coral fauna as fauna of hermatypic corals, is the richest in the world (Cairns, 1984; Veron, 1995; Cairns, Zibrowius, 1997; Latypov, 2011). About 350 species of ahermatypic corals found throughout the Indo-Pacific region. More than 150 species are known from the Malaysian region and 63 from the seas of Australia (Vaughan, Wells 1943). Distribution and bathymetric ranges known about 206 species for Philippine-Indonesian region. 174 species of coral are ahermatypic from Indonesia (Banda Sea-138 species, the islands of Kai-125). In the Indian Ocean: 77 species in Japan, New Zealand, 67-47, in the Atlantic Ocean-11 species (Cairns, Zibrowius, 1997). The number of species with a solitary flat (button-like), the greatest corallites in the oceans (Keller, 2012 a). All this, of course, allows you to review the Indo-Malay zoogeographical province of one of the main centers of origin not only the shallow, but also the main center of origin of deep-water fauna (Ekman, 1953; Latypov, 2005; Keller, 2012 b). Rich in species diversity, as a single deep-water corals (en masse for Vietnam more 40 species) and marked by high diversity of previously hermatypic scleractinian (more 350 species) waters of Vietnam (Latypov, 2007) confirms the earlier opinion (Latypov, 2003; Latypov, 2011) that coast and shelf of Vietnam constitute a single unit in the coral fauna of Indonesian-Malaysian Centre of its origin and belong to the Indo-Polynesian province of Indo-Pacific region.

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