

New Information about the Solitary Deep-Water Corals of the Vietnamese Shelf

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Abstract Described solitary corals collected of the shelf Vietnam when deep-water drilling on the R/V "Akademik Oparin". In general were identified 22 species, 13 genera attributed to the 6 families. One species were not previously known to science, 14 species not previously known for Vietnam. Most massive settlements have formed two species *Flabellum pavonium* (21 spec. in samples) and *Tropidocyathus longiseptum* sp.nov (23 spec. in samples). Most taxonomically rich coral genera were *Flabellum* and *Truncatoflabellum*. The high density of corals noted at stations with depths 136 and 180 m, the greatest variety at a depth of 120-136 m. Deep water corals in Vietnam (54 species) 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 solitary ahermatypic 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 [5,6,13,14,29,38]. They have met with deep dredging of the coast of Alaska, the Kuril Islands, the Commander, the Aleutian and the Galapagos Islands [5,18,38,25,29]. 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 [6]. 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 [43]. 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 [4]. Some information about the solitary corals of the Kuril Islands, the Japanese sea and reefs of Vietnam were in the works of the author [22,23,25,29]. These data complement the general characteristics of the knowledge of the composition, morphology and horology world fauna solitary ahermatypic coral.

Table 1. Location of stations

№ station	North latitude	East longitude	Depth, m	The number of corals	The number of species
6	16°58.5'	107°41.7'	56	2	1
7	15°23.5'	109°21.8'	136	83	8
8	15°15.5'	109°22.8'	120	28	7
9	15°08.6'	109°24.0'	130	12	6
10	15°02.1'	109°29.0'	180	35	5
20	12°09.3'	109°35.7'	142	7	5
21	12°09.6'	109°35.4'	142	20	7
22	12°09.3'	109°35.4'	136	6	5
23	12°09.3'	109°35.7'	142	9	4

2. Material and Methods

Corals collected during the voyage 49 scientific vessel "Akademik Oparin" along the coast and shelf of Vietnam in 2016 at 8 stations in the South China Sea from 15° 23' to 12° 09' North latitude trawl of Zigby with square capture 120 x70 cm at depths of 120 to 180 m. Living corals were recorded in 10 % solution of sodium hydrochloride and oxalic acid to remove soft tissue and clay fractions of cups corallites. Two hundred 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. MIMB 33269 - No. MIMB 33288.

3. Systematic Account

In total, 22 species were identified, which considered 12 genera attributed to the 6 families. (Table 2). One species not previously known to science and 14 species not previously known for Vietnam. Most taxonomically rich coral genera were *Flabellum* and *Truncatoflabellum*. The greatest species richness was 7-8 species at the station. Order SCLERACTINIA.

Family ANTHEMIPHYLLIIDAE.

Genera *Anthemiphyllia* Pourtalès, 1878.

Anthemiphyllia dentata [2].

Figure 1 A-Figure 1B

Disctrochus dentatus.—Alcock, 1902: 104.

Anthemiphyllia dentata.—Yabe and Eguchi, 1942 [42]: 128. —Cairns, 1994 [5]: 44 (cum syn.).-Latypov, 2014 [29]: 6.

Material examined.—2 specimens, station: 22°16'N, 109°23'E; 48°02'N, 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 costae near corallum edge. Corallum white or reddish brown. Septa arranged in four-five cycles: S2 > S3 > S4 > S5. Thick septa of the first cycle fuse with columella. Their axial ends are highly denticulate 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 DENDROPHYLLIIDAE

Genera *Balanophyllia* Wood, 1844

Balanophyllia teres Cairns, 1994

Figure 1 C -Figure 1 D

Balanophyllia teres, sp. nov. —Cairns, 1994: 84.

Balanophyllia fistula Yabe and Eguchi, 1942: 4.

Dendrophyllia fistula.—Eguchi, 1965: 295 (part).

Material examined.—1 specimen, station 7-15°23.5'N, 109°21.8'E, South China Sea, depth 136 m.

Description.— Coral cylindrical to slightly conical and quite elongate, straight to irregularly curved. Specimen is 0,7 mm in calicular diameter and 34.0 mm long. Basal tip of colony free: either pointed and worn or transversely fractured. Buds absent. Coral obviously epithecate, a continuous, smooth, thick epitheca extending virtually to calice. Underlying non costate synapticulotheca visible only on lower half of corallum or on coralla dead when collected. Coral white. Septa arranged in a weak Pourtales Plan of 3-4 cycles. Septa, slightly exsert (0.2-0.4 mm) and relatively narrow, with straight, entire inner edges that fuse with the columella only deep within fossa. S3 slightly wider than the S2, the inner lacinate edges of each pair of S3 within a system fusing before its adjacent S2 near the columella. S3 quite small, each flanked by a pair of larger S4 that loosely fuse near the columella. Total number of septa is 56. Fossa moderately deep, containing a discrete spongy columella.

Distribution.—Kii Strait, Honshu to Fukue Jima, East China Sea, Vietnam 136-237 m.

Genera *Heteropsammia* Edwards et Haime, 1848 [21]

Heteropsammia cochlea (Spengler, 1781)

Figure 1N

Madrepora cochlea: Spengler, 1781.

Heteropsammia michelini.—Edwards et Haime [21], —Veron, Pichon (1979), (cum syn).

Heteropsammia cochlea.— Veron, Pichon (1979), (cum syn), — C. Sheppard, A. Sheppard (1991), —Latypov, Dautova, 1998:77.

Material examined.—11 specimen, station 7-9-15°23.5', 15°08.6'N, 109°21.8', 109°24.0'E, South China Sea, depth 136 m.

Description.— Corallites are rounded or slightly compressed laterally, with diameter 6-12 mm. Corallite wall outside of spongy, framed twisted skeletal elements. Formed 36-48 septa four cycles. Septa the first and second cycles are of the most broad and high, wedge-shaped. Their distal edge rounded and just like lateral surface, densely ornamented with small tubercles. The inner edge of the almost vertical falls to the columella. Septa second cycle a few shorter than protosepta. Short, narrow septum of the third cycle, the considerably lower, but also ornamented on the distal edge. Septa fourth cycle built on the sides of the lateral-septa third cycle, but often above them and a few massive. Closer to the center of the corallite they merge. The distal edge of all partitions except the protosepta, serrated, tilted gently to the columella. Columella, wide spongy, oval. The color of living coral grey or light brown.

Distribution.— Vietnam, widely distributed in the Indian Ocean off the coast of Africa and the Persian Gulf to the Coral Sea on the East coast of Australia, depth 6-136 m.

Genera *Heterocyathus* Edwards et Haime, 1848

Heterocyathus aequicostatus Edwards et Haime, 1848

Figure 1O

Heterocyathus aequicostatus.— Edwards et Haime, 1848,—Latypov, Dautova, 1998 :78.

Material examined.—3 specimen, station 10-15°02.1'N, 109°29.0'E, South China Sea, depth 136 m.

Description.— Solitary corals, unattached, flat base. Corallites are rounded with diameter up to 12 mm. Corallite wall outside costal. Costa intensely ornamented

with small tubercles, continue until the bottom surface of the corallite, where converge at a single point. Formed 30-40 septa four or five cycles. Partitions of the first and second cycles of wedge-shaped, the most broad and high, with free inner edges. Septa second cycle slightly shorter. Partition of the third cycle of narrow, equal width throughout. They are considerably lower and shorter than the first septa cycles. Partitions higher cycles (S3-S4) adjacent to the lateral septa lower cycles (S4-S3). Septa are richly ornamented tubercles on the flanks and under the rim, causing small teeth look. Columella wide spongy. Living coral color light brown and green.

Distribution.— Vietnam, widely distributed in the Indian Ocean off the coast of Africa and the Persian Gulf to the Coral Sea on the East coast of Australia, depth 6-136 m.

Dendrophyllia Blainville, 1830

Dendrophyllia ijimai.—Yabe and Eguchi, 1934.

Figure 1 J

Dendrophyllia ijimai. —Yabe and Eguchi, 1934a: 2026. —Cairns and Keller, 1993 [9]: 280.

Dendrophyllia micranthus.—Eguchi, 1965:294.

Dendrophyllia minuscula.— Utinomi, 1965:257—Tribble and Randall, 1986:159.

Material examined.—2 specimen, station 21-23.5°N, 109°21.8'; E, South China Sea, depth 120-136 m.

Description.— Coral composed of elongate, relatively straight axial corallites, circular in cross section, and gradually attenuating in diameter to terminal calices 6-7 mm in diameter. Numerous stout corallites bud perpendicular and in all directions from the axial corallite, usually only 1-3 mm in height and 3-4 mm in diameter. Costae well defined, 0.1-0.3 mm wide, and separated by deep, porous intercostal furrows about 0.15 mm wide. Costae bear 1, sometimes 2, rows of small pointed granules. Coral white. Septa hexamerally arranged in 4 cycles (48 septa) in a Pourtales Plan. S, largest septa and have vertical, straight, entire inner edges that reach the columella. S2 only about half width of an St and have lacinate inner edges. S3 rudimentary and also have lacinate inner edges. S4 equal in width to an S3 near calice but lower in fossa each pair of S4 are fused before its adjacent S3 and extended toward columella where it unites with the other combined S4 within the system before the common S2 near the columella. Inner edges of S4 highly lacinate. Fossa of lateral corallites of moderate depth and contains a small, spongy columella.

Distribution.—Japan, South Korea, East China Sea, Vietnam. 10-200 m. Elsewhere: Western Indian Ocean, 37-366 m.

Family CARYOPHYLLIIDAE.

Genera *Caryophyllia* Lamarck, 1801.

Caryophyllia spinicarens [34].

Figure 1 E-Figure 1 F

Acanthocyathus spinicarens.—Moseley, 1881: 143-144

Cariophyllia (Premocyathus) spinicarens.—Cairns & Keller, 1993 [9]: 237.

Caryophyllia (A.) spinicarens.—Cairns & Zibrowius, 1997 [8]: 100-101. —Latypov, 2014:7.

Material examined.—1 specimens, station 8· 15°15.5'N, 109°22.8'E, South China Sea, depth 120 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 is 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, 120-477 m.

Genera *Crispatotrochus* Tenison-Woods, 1878.

Crispatotrochus rubescens [34].

Figure 1 G-Figure 1 H

Cyathoceras rubescens.—Moseley, 1881: 157.

Crispatotrochus rubescens.—Cairns, 1991: 15, —Cairns, 1994: 51 (cum syn), —Latypov, 2014:7.

Material examined.—4 specimen, station 7,8, 15°23.5'N, 109°21.8'; E, 15°15.5'N, 109°22.8'E, South China Sea, depth 120-136 m.

Description.—Trochoid, highly expanding upwards coral 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. Coral 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* [5,6] by the corallite shape, as well as septa of complete fourth cycles, which axial ends do not fuse with each other and columella.

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

Family FLABELLIDAE.

Genera *Flabellum* Lesson, 1831.

Flabellum politum Cairns, 1989 [4].

Figure 1 I- Figure 1 K

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

Flabellum politum.—Cairns, 1989: 53-54, —Cairns, 1994: 73, —Latypov, 1994: 9.

Material examined.—3 specimens, stations: 23-15° 31'N, 109° 35'E; 12° 09'N, South China Sea, depth 142 m.

Description.—Flabelloid corals 24 -27 mm in diameter and 25-27 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: $S1 = S2 > S3 > S4 > S5 > S6$. 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. Total number of septa is 152. Columella is spongy, small, formed in the calice bottom. Living corals are hepatic.

Distribution.—Vietnam, The East China Sea, South China Sea, the Korean Strait, Japan, Banda Sea, Philippines, 40-702 m.

Flabellum pavonium Lesson, 1831.

Figure 1L- Figure 1M

Flabeilum pavonium. —Lesson, 1831:2.—Gray, 1849:75.—Cairns, 1994: 70 (cum syn)

Material examined.—27 specimens, stations: 9, 10, 20, 23· 15° 31'N, 109° 35' E; 12° 09'N, South China Sea, depth 142 m.

Description.— Flabelloid corals 34 -17 mm in diameter and 25-35 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 cycles: $S1 = S2 > S3 > S4 > S5$. Equal-sized septa of the first two cycles, projecting upwards and flatly falling near the axis, become vertically sheer. Their axial ends are sinuous. Thecal faces of most specimens examined discolored and worn; however, in well-preserved specimens there are narrow brown stripes associated with the theca overlaying every septum. Calicular edge a smooth arc. S4 of smaller coral about 80% width of an S3 and thus more easily distinguished. S5 about half width of an S1-4 and also have moderately sinuous inner edges. Total number of septa is 130. Fossa very deep and elongate. Columella an elongate fusion of inner edges of S1-4, but often obscured from view by the narrow fossa.



A-B - *Anthemiphyllia dentate*, spec.33271, C-D - *Balanophyllia teres*, spec. 33272, E-F - *Cariophyllia spinicarens*, spec.33273, G-H - *Crispatotrochus rubescens*, spec.33274, J - *Dendrophyllia iijamai*, spec. 33275, I-K - *Flabellum politum*, spec.33276, L-M - *Flabellum pavonium*, spec.33277, N - *Heteropsammia cochlea*, spec.33278, O - *Heterocyathus aequicostatus*, spec.33279, divide by the scale range 1 cm

Figure 1. Form calices and septal apparatus of corallite

Distribution.—Japan, also known from Korea Strait and off Cheju Do, Korea; Formosa Strait; South China Sea, Vietnam 73-658 m. Elsewhere: Hawaiian Islands, southwest Indian Ocean; 98-665 m.

Genera Javania Duncan, 1876 [12].

Javania borealis Cairns, 1994 [6]

Figure 2A,–Figure 2B

Javania borealis, sp. nov. —Cairns, 1994 [6]: 30.

?*Javania caillieti*. —Wells, 1983: 238

Javania n. sp.—Cairns, 1989 [4]

Material examined.—5 specimens, stations: 9, 20, 22-12° 09', 15°08.6'N, 109°24.0',109°35.7' E; N, South China Sea, depth 130-142 m.

Description.—Coral massive and trochoid, the thecal walls growing upward at a constant angle (not flared). Holotype 36.4 x 27.8 mm in calicular diameter and 34.4 mm in height, firmly attached through a robust stereome-reinforced pedicel 10.6 mm in diameter. A broken cross

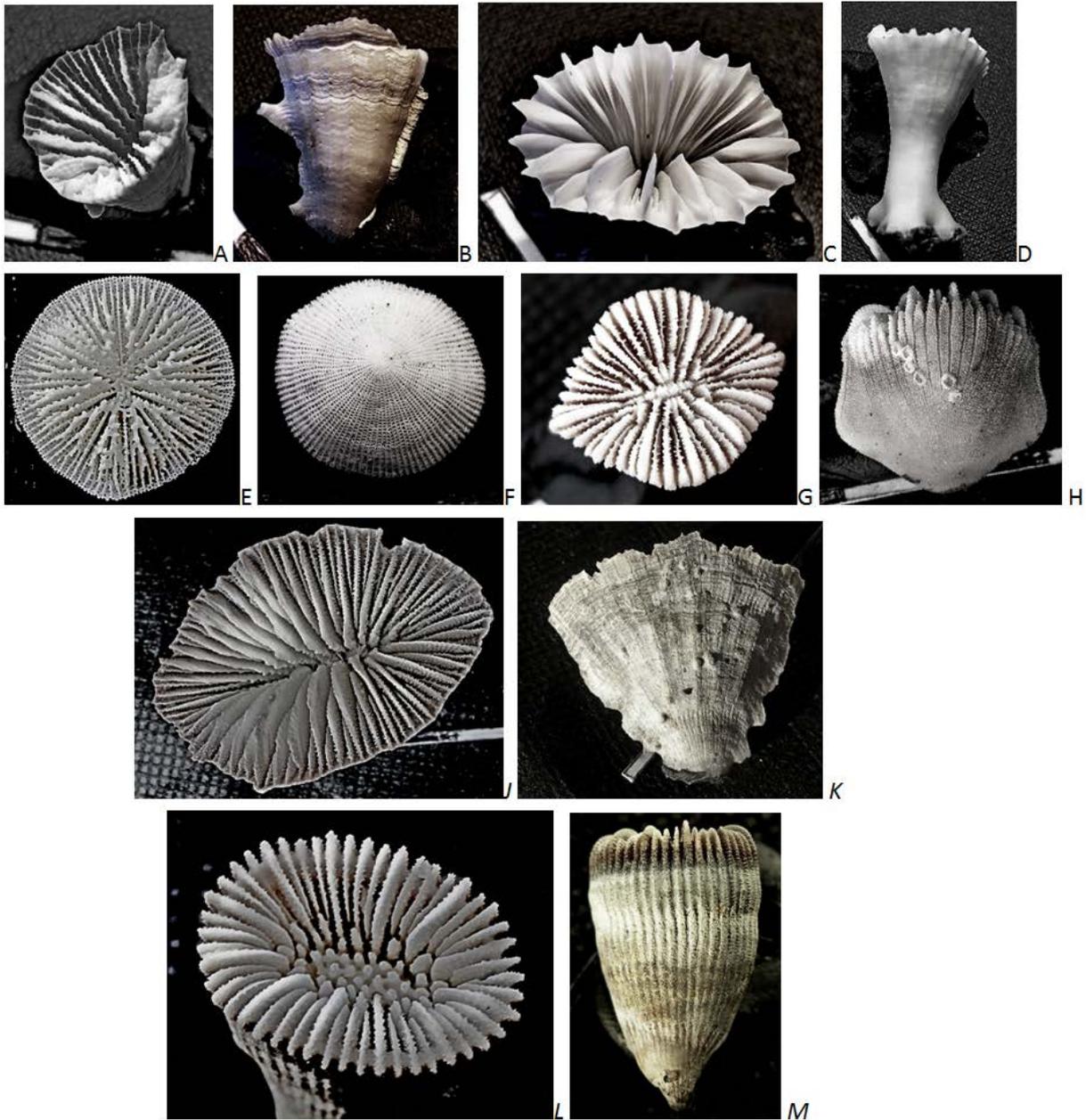
section of a pedicel of a paratype revealed 11 concentric layers of solid stereome. Calice elliptical; calicular edge slightly serrate, each S1_4 rising to a small triangular apex around calicular perimeter. Costae glister white. Theca and septa thin and fragile, easily broken, both about 0.2 mm thick. Septa hexamerally arranged in 5 complete cycles (96 septa) according to the formula: S1-2>S3>S4>S5. All septa have slightly sinuous inner edges and faces sparsely covered with low, pointed granules. Upper, inner edges of opposing S2 almost meet in center of fossa, and fuse into a rudimentary columella deeper in fossa. S3 about 80% width of Su2 and non exsert, their lower inner edges also fused with the S2 even deeper within fossa. S4 about half width of S3, S5 rudimentary, only about one-fourth width of S4. Fossa elongate and quite deep, defined by inner edges of S6.

Distribution.—Known from Vietnam, Attu Island, Sea of Japan, 247-348 m.

Table 2. Distribution of corals

Species	7	8	9	10	20	21	22	23
<i>Anthemiphyllia dentata</i>	-	-	-	-	-	-	+	-
<i>Balanophyllia teres</i>	+	-	-	-	-	-	-	-
<i>B.cedronensis</i>	+	-	-	-	-	-	-	-
<i>Caryophyllia spinicarens</i>	-	+	-	-	-	-	-	-
<i>Crispatotrochus rubescens</i>	+	+	-	-	-	+	-	-
<i>Dendrophyllia californica</i>	-	-	+	-	+	-	-	+
<i>D. ijimai</i>	-	-	-	-	-	+	-	-
<i>Flabellum pavonium</i>	-	-	+	+	+	+	-	+
<i>Flabellum politum</i>	-	-	-	-	-	-	-	+
<i>Heteropsammia cochlea</i>	+	+	+	-	-	-	-	-
<i>Heterocyathus aequicostatus</i>	-	-	-	+	-	-	-	-
<i>Javania borealis</i>	-	-	+	-	+	-	+	-
<i>J. californica</i>	-	-	-	-	-	+	-	-
<i>Stephanophyllia neglecta</i>	-	-	-	+	-	-	+	-
<i>Truncatoflabellum aculeatum</i>	-	-	+	-	-	-	-	+
<i>Tr. aff. candeunum</i>	-	-	-	-	+	-	-	-
<i>T. crassum</i>	-	+	-	-	-	-	-	-
<i>Tr. spheniscus</i>	+	-	+	-	-	-	-	-
<i>Truncatoflabellum stokesi</i>	+	+	-	-	-	+	+	-
<i>T. vasiformis</i>	+	+	-	+	-	+	-	-
<i>Tropidocyathus lessoni</i>	-	+	+	+	-	+	-	-
<i>Tropidocyathus longiseptum sp.nov</i>	+	+	-	-	-	-	-	-

Note: Numbers stations marked by numerals



A-B – *Javania borealis*, spec.33280, C-D – *Javania californica*, spec.33281, E-F – *Stephanophyllia neglecta*, spec.33282, G-H – *Tropicocyathus lessoni*, spec. 33283, J-I – *Truncatoflabellum sphenicus*, spec. 33287, L-M – *Trochocyathus vasiformis*, spec. 33288, divide by the scale range 1 cm

Figure 2. Form calices and septal apparatus of corallite

Javania californica Cairns, 1994

Figure 2C,–Figure 2D

Flabellum montereyense. —Durham, 1947 [13]: 37.

Javania californica sp. nov. —Cairns, 1994 [6]:30.

Material examined.—3 specimens, stations: 22° 12' 09'E, 15°08.6'N, South China Sea, depth 130-142 m.

Description.—Coral trochoid and relatively small, attached by a thick, stereome-reinforced pedicel. Largest specimen (holotype) only 12.6 x 10.7 mm in calicular diameter and 12.6 mm in height, with a pedicel diameter of 3.6 mm. Calice elliptical; calicular edge highly serrate. Theca white, porcellaneous, and relatively thin in upper corallum. Septa hexamerally arranged in 3 complete cycles (only 24 septa) according to the formula: S1>S2>S3. Each S1 forms a triangular apex about 1.2 mm high at calicular edge and has a straight inner edge that

thickens lower in fossa. S2 also form triangular calicular apices of equal size and are about 80% width of S1 their lower, inner edges also thickened and fused with those of the S1 into a rudimentary columella. S3 much smaller, only about 20%-25% width of S2, have slightly sinuous inner edges, and form smaller calicular apices of about 0.5 mm height. Septa thin (about 0.2 mm thick) and widely spaced, separated by approximately 1.1-1.2 mm from one another. Fossa deep and elongate.

Distribution.—Known from Vietnam, Monterey Bay and Cordell Bank, 62-170 m.

Family MICRABACIIDAE.

Genera *Stephanophyllia* Michelin 1841.

Stephanophyllia neglecta Boschma, 1923 [3]

Figure 2E–Figure 2F

Fungia patella.—Van der Horst, 1921 [36]: 57 (in part).

Stephanophyllianeglecta.—Boschma, 1923 [3]: 144, —Cairns, 1989 [4]: 23, —Latypov, 2014 [39]: 14.

Material examined.—2 specimens, stations: 10, 15°02.1', 12°09.3'N, 109°29.0', 109°35.7'E; South China Sea, depth 120-136 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 denticulate. 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, Wallis and Futuna Islands, 110-1080 m.

Family TURBINOLHDAE

Genera *Tropidocyathus* Milne Edwards and Haime, 1848a [33]

Tropidocyathus lessoni (Michelin, 1842)

Figure 2G-Figure 2H

Flabellum lessoni Michelin, 1842: 119

Tropidocyathus lessonii.—Milne Edwards and Haime, 1848 [33]: 327

Tropidocyathus lessoni. —(Michelin, 1842) – Cairns, 1994 [6]: 66

Material examined.—14 specimens, stations: 7-10 · 15°02.1', 12°09.3'N, 109°29.0', 109°35.7'E; South China Sea, depth 120-180 m.

Description.—Coral cuneiform, usually with a rounded base without evidence of original attachment. Thecal faces convex. Largest specimen is 17x 13 mm in calicular diameter and 17 mm tall. Calice variable in shape, ranging from diamond shaped to elliptica. Costae broad and flat about 0.5 mm wide, bearing 3 or 4 granules across their width about 0.31-0.35 mm wide, bearing only 2 granules across its width. Theca pale orange; septa white. Thecal thickness about 0.26 mm. Septa hexamerally arranged in four cycles. S1 highly exsert (as much as 2.5 mm above upper theca), the farthest extend to the columella, and bear a small, independent palus about 0.3 mm broad. S2 equally exsert but do not extend as far toward columella, usually bordered internally by a slightly larger palus about 0.5 mm broad; S3 considerably less exsert than S2 and extend only about half the distance to columella, each bearing a very large palus up to 1.6 mm broad, S4 less exsert than S3 but often extend slightly farther toward columella than the S3. The total number of septa 56. Fossa moderately shallow and filled with three cycles of pali and the columella. Columella elongate in alignment with the greater calicular diameter, composed of small basally fused papillae. In larger coralla the fused papillae produce a solid, almost lamellar, columella.

Distribution.—Pleistocene: Ryukyu Islands. Recent: East China Sea, South China Sea off Hong Kong; Vietnam, Philippines, Indonesia off Kenya, Gardiner and Waugh's outlying record from the Anton Bruun that range from Natal, South Africa, to Somalia; 68-421 m.

Tropidocyathus longiseptum sp.nov

Figure 3A-Figure 3D

Holotype.—Specimen no. MIMB 33269, Museum of the Zhirmunsky Institute of Marine Biology, FEB RAS. South China Sea, depth 120-180 m, silted and rounded sand from skeletons of shell and dead corals. *Paratype*. Specimen no. MIMB 33270, found in the same site.

Material examined.—23 specimens, stations: 7, 8 · 15°02.1', 12°09.3'N, 109°29.0', 109°35.7'E; South China Sea, depth 120-180 m.

Description. - Coral cuneiform, usually with a rounded base without evidence of original attachment. Thecal faces convex. Largest specimen is 32x20 mm in calicular diameter and 22 mm tall. Calice variable in shape, ranging from diamond shaped to elliptica. Costae broad and flat about 0.5-0.7 mm wide, bearing 3 or 4 granules across their width about 0.31-0.35 mm wide. Theca buffy; septa white. Lanceolate septa hexamerally arranged in five cycles: S1-2 > S3 > S4>S5, reach to the columella. The upper edge of the S5 and S1 is noticeably thickened and protrude over the edge of the cup. Axial ends septa first and fifth cycles are free. Septa third cycle are merge half the length from the base of the cup. S4 thin are located between S3. Axial edge all septa very finely toothed, their lateral surface radial granular. The total number of septa is 122. Columellae narrow long from small interwoven trabeculae.

Comment. From all known *Tropidocyathus* a new species different large size of corals, long, with numerous thin lanceolate septums.

Distribution.—Vietnam, dept 120-136 m.

Genera *Truncatoflabellum* Cairns, 1989.

Truncatoflabellum aculeatum [33].

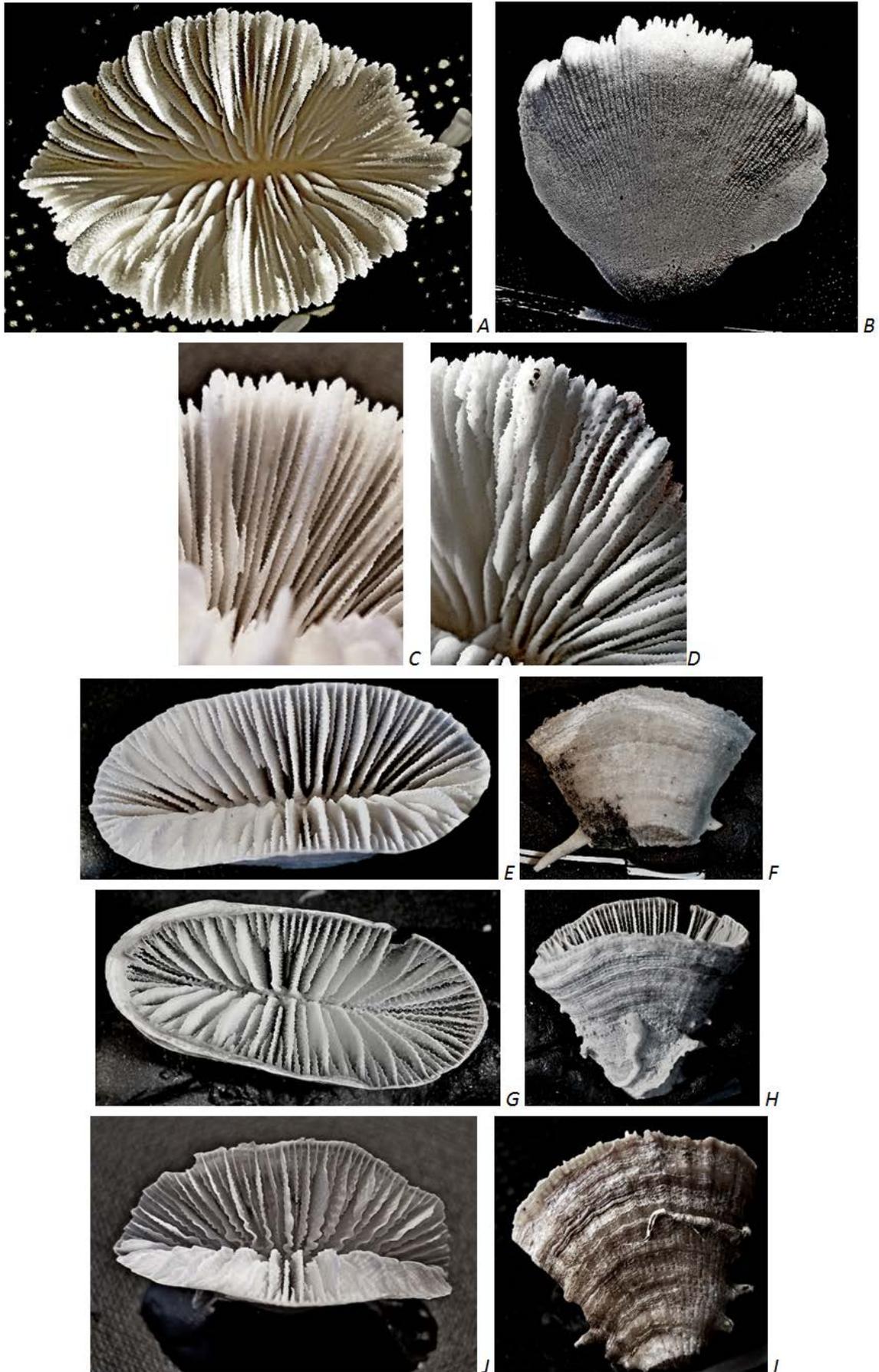
Figure 3 E-Figure 3 F

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

Truncatoflabellum aculeatum. Cairns, 1989: 61 (cum sin), —Latypov, 2014:12.

Material examined.—4 specimen, station 9, 12°09', 15°08.6'N, 109°24.0', 109° 35'E, South China Sea, depth 120-142 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 anthocyathus hexamerally arranged in four cycles. 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.



A-D - *Tropidocyathus longiseptum* sp. nov., spec. MIMB 33269, E-F - *Truncatoflabellum aculeatum*, spec. MIMB 18643, G-H - *T. crassum*, spec. MIMB 18644, J-I - *T. stokesi*, spec. MIMB 33286, divide by the scale range 1 cm

Figure 3. Form calices and septal apparatus of corallite

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 [33].

Figure 3 G—Figure 3 H

Flabellum crassum.—Milne Edwards & Haime, 1848 [33]: 276-277.

Truncatoflabellum crassum.—Cairns, 1989 [4]: 64-65.

Material examined.—1 specimens, stations: 8° 31' N, 109°22.8' E, 15°15.5' N, South China Sea, 120 m.

Description.—Flabellate corals from 8 x 12 to 11 x 25 mm in diameter and from 10 to 25 mm 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 spheniscus (Dana, 1846)

Figure 2 J —Figure 2 I

Euphyllia spheniscus. —Dana, 1846:160.

Flabellum debile. —Milne Edwards and Haime, 1848:270-271.

Flabellum spheniscus. —Milne Edwards and Haime, 1848:279

Flabellum rubrum stokesii. —Yabe and Eguchi, 1942:98-99 [in part] —Cairns, 1989 (cum syn.)

Material examined.—1 specimens, stations: 8° 31' N, 109°22.8' E, 15°15.5' N, South China Sea, 120 m.

Description.—Angle of thecal edges 82°-86°; inclination of thecal faces 20°-25°. Upper thecal faces strongly arched. Largest anthocyathus 41x25.1 mm in calicular diameter and 38.1 mm tall, with a basal scar of 5.0 x 3.0 mm. Two- three or pairs of thecal spines present on anthocyathus. Septa arranged in four size classes, consisting of 20-24 primary, 20-24 secondary, 28-38 tertiary, and 2-7 pairs of quaternary septa, producing a total of up to 120 septa. Primary septa notched near calicular edge, slightly exsert; slightly concave midway down fossa. Inner edges of all septa straight; slightly sinuous in small specimens. Theca white and usually encrusted. Fossa deep. Columella well developed, about 1 mm wide

Distribution.—?Neogene: Java. Recent: Japan, Singapore, Sir Charles Hardy and Albany Islands, Torres Strait, Vietnam, Western Australia; 2-106 m.

Truncatoflabellum stokesi [33],

Figure 3 J —Figure 3 I

Flabellum stokesii. —Milne Edwards and Haime, 1848 [33]: 278,—Faustino, 1927:54 [in part].

Flabellum owenii. —Milne Edwards and Haime, 1848 [33]: 279

Flabellum stokesi.—Milne Edwards and Haime, 1857: 96.—Cairns, 1989 [4]: 66 (cum syn).

Material examined.—4 specimens, stations: 7, 21°15'23.5' N, 109°21.8' E, 12°35.2' N, 109°40.7' E, South China Sea, 120-176 m.

Description.—Angle of rounded thecal edges 53°-67°; inclination of thecal faces 24°-29°. Upper thecal faces only slightly arched. Largest anthocyathus examined 23.7x9.1 mm in calicular diameter and 20 mm tall. Basal scar quite large and V-shaped, 6.1-2.9 mm. Three pairs of thecal spines generally present on anthocyathus, the lowest just above basal scar. Theca whitish-brown and relatively smooth, bearing shallow longitudinal intercostal striae about 0.07 mm wide that delimit flat costae about 0.45 mm wide.. Ssepta arranged in three size groups: hexamer symmetry according to the formula: S1>S2>S3>S4>S5, for a total of 112 septa. S1 (or primary septa) slightly exsert but not notched near calicular edge. These septa have moderately sinuous inner edges that attain the columella. S4 (or secondary septa) about half size of S1, have straight inner edges and do not reach the columella. Fossa deep; columella robust and elongate, 1-2 mm wide, and up to 12 mm long.

Distribution.—Miocene: Java. Recent: Vietnam, Philippines, Arafura Sea, Great Nicobar, Indian Ocean, 12-256 m.

Genera *Trochocyathus* Milne Edwards and Haime, 1848 [33].

Trochocyathus vasiformis Bourne, 1903.

Figure 2 L—Figure 2 M

Material examined.—25 specimen, station 7, 8, 10, 21-11-8° 41' N, 111° 42' 5'' E, South China Sea, depth 120-142 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, Wallis and Futuna Islands, Funafuti, 120-650 m.

4. Discussion

New species coral of *Tropidocyathus longiseptum* found on silted and rounded sand from skeletons of shell and dead corals. It differs from all known species *Tropidocyathus* by large corallite and double lots of long thin septa five cycles. 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 [20] 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 [4,19]. At all Vietnamese stations met by representatives of the genera *Truncatoflabellum* and *Flabellum*. The most massive cluster formed two species of *Flabellum pavonium* (21 species in samples) and *Tropidocyathus longiseptum* (23 species in samples). The richest in taxonomic relation (5 and 3 species) were the coral genera *Truncatoflabellum* and *Flabellum*. The largest coral up to 41 mm wide and 50 mm in height are corals genus *Truncatoflabellum*, while the small scleractinian species *Dendrophyllia ijimai*, the size of which does not exceed 7 mm. Ahermatypic solitary scleractinian of five genera: *Balanophyllia teres*, *Dendrophyllia californica*, *D. ijimai*, *Javania borealis*, *J. californica*, *Tropidocyathus lessoni* and *Truncatoflabellum spheniscus* first discovered in the South China Sea. Two-thirds of nine genera: *Asterosmilia*, *Balanophyllia*, *Caryophyllia*, *Deltocyathus*, *Javania*, *Flabellum*, *Trochocyathus*, *Truncatoflabellum* and *Rhizosmilia* previously been known in various parts of the Pacific [29]. Smallest depth at which greeted the corals was 90 m, maximum—180 m. Similar characteristic combinations of solitary corals for the different areas mentioned earlier [4,40,41,43]. 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 [8,28,29,39]. 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 [38]. 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 [8]. The number of species with a solitary flat (button-like), the greatest corallites in the oceans [19]. 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 [15,20,26]. Rich in species diversity, as a single deep-water corals (for Vietnam 54 species) and marked by high diversity of previously hermatypic scleractinian (376 species) waters of Vietnam [30] confirms the earlier opinion [24,28,29] 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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References

- [1] Alcock, A., (1898). An Account of the Deep-Sea Madreporaria Collected by the Royal Indian Marine Survey Ship "Investigator." 29 pp.
- [2] Alcock, A. (1902). Diagnoses and descriptions of new species of corals from the Siboga Expedition. Tijdschrift der Nederlandsche Dierkundige Vereeniging, (2)7: pp. 89-115.
- [3] Boschma, H. (1923). The Madreporaria of the Siboga Expedition, Part 4: Fungia patella. Siboga-Expeditie, (16 d), 20 pp.
- [4] Cairns, S.D. (1989). A revision of the ahermatypic Scleractinia of the Philippine Islands and adjacent waters, part 1: Fungiacyathidae, Micrabaciidae, Turbinoliinae, Guyniidae, and Flabellidae. Smithsonian Contributions to Zoology, 486: p 136.
- [5] Cairns, S.D. (1991). A Revision of the Ahermatypic Scleractinia of the Galapagos and Cocos Islands. Smithsonian Contributions to Zoology, 504: p 32.
- [6] Cairns, S.D. (1994). Scleractinia of the temperate north Pacific. Smithsonian Contributions to Zoology, 557: p 150.
- [7] Cairns, S.D. (1995). The marine fauna of New Zealand, Scleractinia (Cnidaria, Anthozoa). New Zealand Ocean. Inst. Mem., 103: 210 pp.
- [8] Cairns, S.D. & Zibrowius, H. (1997). Cnidaria Anthozoa, Azooxanthellate Scleractinia from the Philippine and Indonesian Regions. Mém. Mus. Nat. d'Hist. Naturelle, 172 (2): 27-243 pp.
- [9] Cairns, S.D. & Keller N.B. (1993). New Taxa and Distributional Records of Azooxanthellate Scleractinia (Cnidaria: Anthozoa) from the Tropical Southwest Indian Ocean, with Comments on Their Biogeography and Biology. Annals of the South African Museum, 103 (5): 213-292 pp.
- [10] Chevalier, J.P. (1966). Contribution à l'étude des Madreporaires des Cotes Occidentales de l'Afrique Tropicale. Bulletin de l'Institut Fondamental d'Afrique noire (I. F. A. N.), 28 (4): 1356-1405 pp.
- [11] Duncan, P.M. (1870). On the Fossil Corals (Madreporaria) of the Australian Tertiary Deposits. Quart. J. Geol. Soc. London, 26: 284-318 pp.
- [12] Duncan, P.M. (1876). Notices of Some Deep-Sea and littoral Corals from the Atlantic Ocean, Caribbean, Indian, New-Zealand, Persian Gulf, and Japanese & c. Seas. Proc. Zool. Soc. London, 1876: 428-442 pp.
- [13] Durham, J.W. (1947). Corals from the Gulf of California and the North Pacific Coast of America. Geol. Soc. Amer. Mem., (20): 158 p.
- [14] Durham, J.W. & Barnard, J.L. (1952). Stony Corals of the Eastern Pacific Collected by the Velero III and Velero IV. Allan Hancock Pacific Expeditions, 16: 110 p.
- [15] Ekman, S. (1953). Zoogeography of the Sea. London: Sidgwick and Jackson.
- [16] Kent, W.S. (1871). On Some New and Little-Known Species of Madreporae, or Stony Corals, in the British Museum. Proc. Zool. Soc. London, 275-286 pp.
- [17] Gravier, C. (1916). Note Préliminaire sur les Madreporaires recueillies au cours des Croisières de la Princesse Alice et de l'Hirondelle, de 1893 à 1913 inclusivement. Bul. Inst. Ocean., Monaco, 12: 22 p.
- [18] Keller, N.B. (1978). Morphological and ontogenetic especially deep corals. Trudy Instituta Oceanologii, 113: 44-50 pp.
- [19] Keller, N.B. (2012 a). Deepwater of Scleractinian corals. Moscow.
- [20] Keller, N.B. (2012 b). Scleractinian penetration into the depths of the ocean. Priroda: 57-64 pp.
- [21] Kitahara, M.V. & Cairns, S.D. (2009). A revision of the genus *Deltocyathus* Milne Edwards & Haime, 1848 (Scleractinia, Caryophylliidae) from New Caledonia, with the description of a new species. Zoosystema, 31 (2): 233-248 pp.
- [22] Latypov Yu. Ya. (1995). Community structure of scleractinian reefs in the Baitylong Archipelago (South China Sea). Asian Mar. Biol. 12: 27-37 pp.
- [23] Latypov, Yu. Ya. (2002). New Data on Scleractinians from the Northwestern Sea of Japan. Rus. J. Mar. Biol., 28: 340-343 pp.
- [24] Latypov, Yu. Ya. (2003). Reef-Building Corals and Reefs of Vietnam: 1. The Gulf of Thailand. Rus. J. Mar. Biol, 29: S22-S33.
- [25] Latypov, Yu. Ya. (2004). New Records of Ahermatypic Scleractinian Corals from the Kuril Islands. Rus. J. Mar. Biol, 30: 414-417 pp.

- [26] Latypov, Yu. Ya. (2005). Reef-Building Corals of Vietnam as a Part of the Indo-Pacific Reef Ecosystem. *Rus. J. Mar. Biol.*, 31: S34-S40.
- [27] Latypov, Yu. Ya. (2007). Coral reefs of Vietnam. Moscow, Nauka.
- [28] Latypov, Yu. Ya. (2011) Scleractinian corals and reefs of Vietnam as a part of the pacific reef ecosystem. *Open J.Mar. Sci.*1: 50-68 pp.
- [29] Latypov Yu.Ya. (2014). New information about the ahermatypic solitary scleractinian of the shelf Vietnam. *Rus. J. Mar. Biol.* 40 (2): 82-87 pp.
- [30] Latypov Yu.Ya. Results of Thirty Years of Research on Corals and Reefs of Vietnam. *Open J. Mar. Sci.* 2016, 6: 283-292 pp.
- [31] Marezeller, E. (1889). Ueber das Wachstum der Gattung Flabellum Lesson. *Zoologischen Jahrbucher*, 3 (1): 25-50 pp.
- [32] Marezeller, E. (1904). Steinkorallen. *Wissenschaftliche Ergebnisse der Deutschen Tufsee-Expedition auf dem Dampfer "Valdivia" 1898-1899*, 7 (3): 261-318 pp.
- [33] Milne Edwards, H., & Haime, J. (1848). Recherchessur les Polypiers, deuxièmémémoire, Monographie des Turbinolides. *Ann. Sci. Nat. Zool.* (3) 9: 211-344 pp.
- [34] Moseley, H.N. (1881). Report on certain hydroid, alcyonarian, and madreporian corals procured during the voyage of H. M. S. Challenger, in the years 1873-1876. Report on the Scientific Results of the Voyage of H. M. S. Challenger during the Years 1873-76, *Zoology*, 2: 248 p.
- [35] Saville Kent, W. (1871). On some new little known species of Madreporae, or stony corals, in the British Museum collection. *Proceeding Of the Zoological Society of London*, (1871), 275-286 pp.
- [36] Van der Horst, C.J. (1921). The Madreporaria of the Siboga Expedition, Part 2: Madreporaria Fungida. *Siboga-Expeditie*, 16 b: 46 p.
- [37] Vaughan, T.W. (1907). Recent Madreporaria of the Hawaiian Islands and Laysan. *United St. Nat. Mus. Bul.* 59: fa + 222 pp.
- [38] Vaughan, T.W. (1941). New Corals: One Recent, Alaska; Three Eocene, Alabama and Louisiana. *J. Paleont.* 15: 280-284 pp.
- [39] Veron, J.E.N. (1995). Corals in Space and Time: The Biogeography and Evolution of the Scleractinia. Cornell University Press, New York.
- [40] Wells, J.W. (1984). Notes on Indo-Pacific Corals, Part 10: Late Pleistocene Ahermatypic Corals from Vanuatu. *Pac. Sci.* 38: 205-219 pp.
- [41] Yabe, H. & Eguchi, M.A. (1932). Study of the Recent Deep-Water Coral Fauna of Japan. *Proc. Imperator Acad. Japan*, 1: 387-390 pp.
- [42] Yabe, H. & Eguchi M.A. (1942). Fossil and Recent Flabellum from Japan. *Sci. Rep. Tuhoku Imperial Univ.*, ser. 2 (Geology), 22 (2): 87-103 pp.
- [43] Zibrowius, H. (1980). Les Scléactiniaires de la Méditerranée et de l'Atlantique Nord-Oriental. *Mem. L'Inst. Océan.*, Monaco, 11: 284 pp.