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FAR EAST BRANS RASSIAN ACADEMY OF SCIENSCE
INSTITUTE OF MARINE BIOLOGY

Yuri Ya. Latypov

SCLERACTINIAN CORALS OF VIETNAM

PREFACE

This monograph is the English translation of 5 books which originally appeared in Russian, and was published by Nauka in Moscow (Latypov, 1990, 1992, 1995, Latypov, Dautova, 1996, 1998), advanced and added with data on all Vietnamese reefs and corals distributed on them. They were translated into English by Elena Kogan and Yuri Latypov at 2006. The translation was supported by a grant from the International Society for Reef Studies. The translation into the Vietnamese was carried out by Dr. Pham Quoc Long.

Laboratory and underwater photos of corals were made by the author.

The described collection is kept in the A.V. Zhirmunsky Institute of Marine Biology of the Far-Eastern Branch of the Russian Academy of Sciences under №№ 9501, 1/9502-1/95297.

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INTRODUCTION

The productivity of the coastal waters of Vietnam – the abundance of fish, shrimp, lobsters, mollusks and commercial algae – is considerably (if not mainly) determined by the state of the coral reefs. Nevertheless, corals of this region have been little studied until now.

Past reports of Vietnamese corals have consisted mainly of species lists. They include lists of the South Vietnam corals – 230 species (Davydoff, 1952), corals of Gulf of Tonkin – 12 names, mainly genera (Gurianova, 1972), and lists in the reports of the Institute of Marine Research, including 227 species. There were many synonyms among the genera and species. The only attempt to analyze the distribution of Scleractinia was made for Nha Trang Bay by Loi (1967), who distinguished four typical facies for some island and cape reefs, and listed 78 scleractinian species.

One of the main goals set by the National Research Center of the Socialist Republic of Vietnam before the Institute of Marine Biology of the Far-Eastern Branch of the Russian Academy of Sciences in the early 1980's was the investigation of the coastal coral reefs of Vietnam for the purpose of their rational use and protection. The use and protection of reefs should be based on the knowledge of what should be used and in what amount and what should be protected. Coral reefs and rainforests are the most productive natural ecosystems, which are interesting and important for mankind in various ways. In addition to the fact that they are an especially important source of food for many people inhabiting tropical regions, their high primary productivity contributes to the overall oceanic reserves due to shallow water reef and near reef fish. Hormone-like prostaglandins, fatty acids derivatives, extracted from corals, have been widely used in various medical treatments (Colwell, 1983). For many thousands of years, reef ecosystems along the coastline and around numerous islands in Vietnam determined and continue to determine not only the material but also the spiritual culture of the Vietnamese people. All these make governmental and scientific organizations of many countries consider coral reefs as an especially important component of their economy. Scleractinian corals, being the main reef-builders and forming coral reefs, create shelter and provide food for many hundreds of plant and animal species. Because of all of the above-said, our main tasks are the inventory and monographic description of the scleractinian corals of Vietnam.

Corals were studied in 12 areas of the Vietnamese coast from the northern Gulf of Tonkin to the western Gulf of Thailand on 56 islands and coastal reefs (Figs. 1, 2). At every island or reef we studied its morphology, zonation, species composition and distribution of Scleractinia from the lower horizon of the intertidal zone to 48 m depth. Percent coverage of corals, number of branched, massive, and encrusting colonies, and a qualitative collection of Scleractinia in every physiographic zone were taken at every section (a total of 83 sections). In general about 5000 scleractinian specimens were examined, and more than 800 underwater photos of corals in their habitat were taken.

While identifying and systematizing corals we followed the principles of population taxonomy advocated by E. Mayr (1969), and also principles and methods of population systematics, qualitative and quantitative analysis of individual variability, elaborated and applied for corals (Veron and Pichon, 1976; Tesakov, 1978; Latypov, 1984). In particularly difficult identification cases we used a chemotaxonomic approach, comparing fatty acids content in species with weakly distinguishable morphological features. After isolation from the skeleton, soft tissues were extracted in ethanol (Bligh and Dyer, 1963), and then fatty acids were determined according to the method developed in the Institute of Marine Biology (Latyshev et al. 1986) using a Shimadzu 5GS gas chromatograph. The system of Scleractinia, developed by J. Wells (1955), and monographs by J. Veron and co-authors (Veron and Pichon, 1976; Veron et al. 1979; Veron and Wallace, 1984) were used as the taxonomic basis of our study. The species range and distribution information from outside of Vietnam were used by J. Veron (1995).

Part 1. REEF-BUILDING CORALS OF VIETNAM AS A PART OF THE INDO-PACIFIC REEF ECOSYSTEM

The coastline of Vietnam is over 3200 km long and covers 15 degrees in latitude, from the Gulf of Siam in the south (8°N) to the Chinese border in the north (23°N). The nearshore water area (up to 50-m deep) of Vietnam, including some 3000 islands, is about 206000 km^2 . Vietnam and its coastline are divided into 5 parts, the Gulf of Tonkin, Central and Southern Vietnam, Gulf of Siam, and Spratly Islands (Thanh, 1999). Reef-building corals and reef accumulations are confined to hard grounds, typical of the Vietnam coast. Between 16°and 19°N, the coastline is formed mostly by moving sand with a minor presence of hard substrates. The temperature varies between 18–32°C, and the salinity, 28–40‰. One hundred and fourteen rivers are registered along the coastline. The spread of the reef is limited near the mouths of two large rivers, the Red River in the north and the Mekong in the south, due to adverse conditions. The ecosystems of the coral reefs of Vietnam feature high bioproductivity, with a primary production of up to 30–100 mg C/m^3 per day, which is almost 100 times that in open waters (Sorokin, 1986; An, 1994).

Vietnam is situated in the tropics, affected by two sorts of monsoons: the wet southwest, lasting from May till September, and the dry northeast, occurring in October–April. Heavy rain showers during the wet monsoon period result in a huge (5–400 million m^3) freshwater influx and a substantial (up to 200 thous. tons) terrigenous sediment influx into the sea. The daily suspended matter precipitation rate in the reef reaches 70–100 g/m^2 and increases tenfold during typhoons (Dautova et al. 1999; Vo and Hodgson, 1997). This results in a remarkable decrease in water transparency, affecting, together with other factors, the development of coral settlement in this region.

The reef-building corals and reefs of Vietnam attracted scientific attention as early as the first half of the twentieth century (Sérene, 1937; Dawydoff, 1952). Loi (1967) was the first to analyze the zonation of reef-building corals in reefs of the Khanh Hoa province. He distinguished four scleractinian-dominated facies. These investigators determined the species composition of scleractinians and demonstrated its similarity to that of Australia and Indonesia. Beginning in 1980, systematic studies of Vietnam corals and reefs have been performed in joint expeditions by the Institute of Marine Biology, Nha Trang Institute of Oceanography, Haiphong Institute of Oceanology, and WWF (World Wide Fund for Nature). The published results were mainly related to scleractinian composition and distribution, with some papers analyzing common accompanying macrobenthos species and a few publications providing the general characteristics of the reefs. Part of the data obtained was presented only in unpublished reports. Some findings were published in difficult-to obtain regional works, including Vietnamese ones.

To date, in a region bordered by the Gulf of Tonkin in the north, the Gulf of Siam in the south, and the Spratly Islands in the South China Sea, all reef-building areas including large islands and shoals have been studied (Fig. 1).

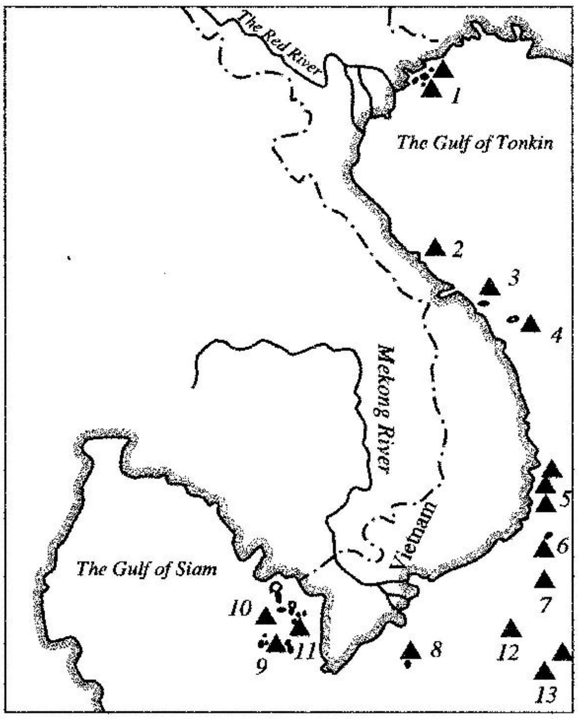


Fig. 1. Schematized map of the surveyed regions. 1- Bai Tu Long Archipelago, 2 - Ze Island, 3 – Cape Danang, Cham and Son Tra islands, 4 - Re Island, 5-reefs of the Khanh Hoa Province, 6-Thu Island, 7- Ca Thuik Islands, 8- Con Dao Islands, 9- Tho Chu Island, 10 –An Thoi Archipelago and Namsu Islands, 11 Rach Gia bay, 12 -Royal Bishop and Astrolab shoals, 13 - Spratly Islands.

It is thus topical to review the data available on the coral composition and distribution and development of Vietnam's reefs, as well as on their relation to the Indo-Pacific reef ecosystem. The rapid growth of the country's population of 70 million, together with travel industry development and marine aquaculture intensification (Cheung, 1994), has resulted in increased anthropogenic pressure on this unique ecosystem. Generalizing data on the composition, structure, and environmental conditions of Vietnam's reef communities will allow one to evaluate the degree of their degradation and the outlook for their conservation and recovery.

Both along the coastline and around the islands, reef-building corals form diverse reef topographies. These include small fringing reefs along the coastline, barrier reefs separated from the continent (Re Island and Jang Bo Reef), and atolls (Spratly Islands) in the open South China Sea (Latypov, 1990; Ken, 1991; Yet, 1997). Vo and Hodgson (1997) reported Vietnam's reefs to include both true reef frameworks and coral gardens. Various calcareous structures occurring on reefs might be formed by coral settlements, usually called coral layers, communitites, or specialized settlements. Such structures are typical of early reef development stages and lack any geomorphological and vertical biological zonation (Habbard, 1974; Pichon, 1974; Loya, 1976a; Latypov, 1995, 1997). All Vietnam reefs display distinct biological and more or less prominent morphostructural zonation. By the specificity of geomorphological and climate conditions, Vietnam's fringing reefs are clearly distinguished into two types (Fig. 2).

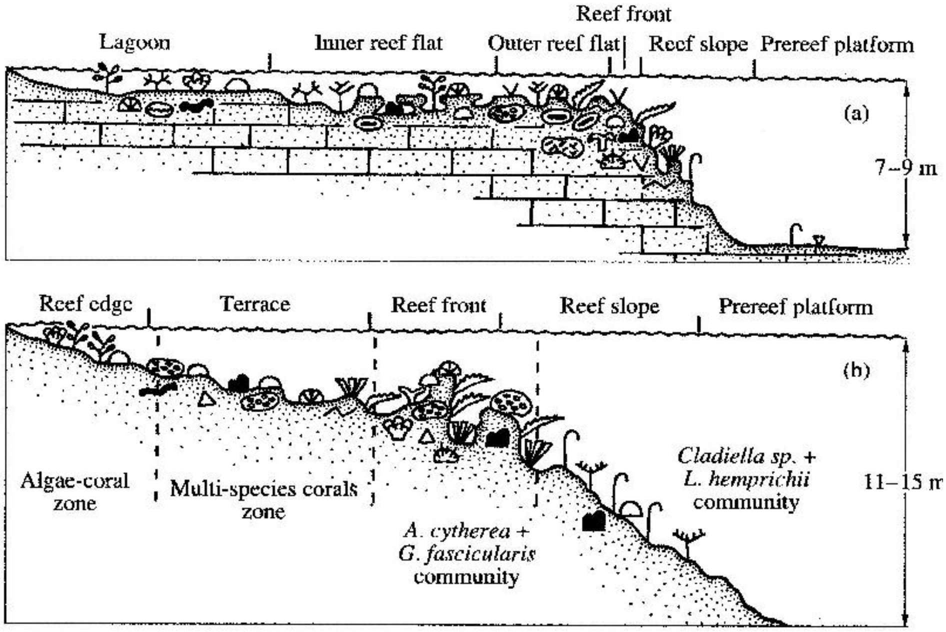


Fig. 2. Schematized profiles of structural (a) and unstructured (b) reefs. See the text for comments.

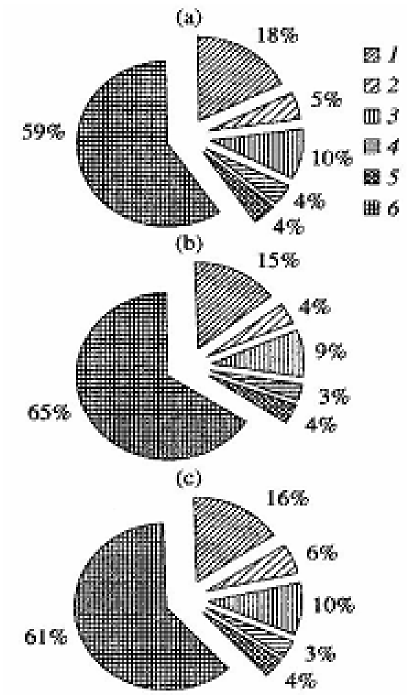
Reefs of the first type have a distinct zonation (reef lagoon, reef-flat, etc.) with a developed carbonate framework, so-called structural reefs (Wainwrite, 1965) common for the tropical zone of the World Ocean. Reefs of the second type display a weak morphostructural zonation, with some zones occasionally absent. Carbonate deposits in such reefs comprise only coral settlements of a low thickness, hardly changing the overall substrate profile. These are so-called structureless (Wainwrite, 1965) or encrusting (Latypov, 1995) reefs. Vietnam's structural reefs are mainly formed in closed bights and on the organogenic base of Holocene reefs (Latypov, 1982; Preobrazhenskii, 1986), while structureless reefs are formed off promontories and in open bights, mostly on stone and rocky substrates (Latypov, 1986, 1987; 1995, Yet and Ken, 1996; Yet, 1997).

Vietnam's reefs pertain to the epicontinental monsoon type (Dawydoff, 1952; Latypov, 1982; Sorokin, 1990). They are situated at the South China Sea periphery. The shoal waters of this region are highly eutrophicated, and the grounds are highly silted due to the huge amount of terrigenous influx. Other hydrological conditions are also not optimal for reef-building coral growth. Thus, in the Gulf of Tonkin, the salinity may drop to 26‰, and winter water temperature to 16°C. Heavy northeast monsoon winds generate coastal waves up to three meters high with a 6-s period. During southwest monsoons, the Vietnam coast is struck by 5–10 typhoons per year (Vo and Hadgson, 1997). Vietnam's reefs feature a moderate vertical and horizontal spread and low thickness of modern reef-derived deposits. Their offshore spread usually does not exceed 200–300

m. They rarely extend to a depth of over 20 m. Sometimes they lack distinct morphological zonation. Most of Vietnam's reefs have an indistinct reef flat and slope. In some reefs, mostly ones on stone and boulder substrates, the only distinct zone is the reef slope. However, they all have a distinct vertical biological zonation, showing up in the dominant species succession and in the change in the composition and structure of coral communities and accompanying macrobenthos.

According to the studies performed in the last decades of the twentieth century, Vietnam's reef-building coral fauna comprises 382 species, pertaining to 80 genera (including 9 ahermatypic corals), of which 131 species, belonging to 26 genera, were not previously known for that region, and 12 species from 6 genera were described for the first time (Latypov, 1987, 1990, 1995, 2003a,b; Ken, 1991a; Vo, Yet, 1997; WWF Vietnam., 1994). As in most Indo-Pacific reefs (Latypov, 1987, 1997; Best et al. 1989; Veron and Hodgson, 1989; Veron, 1995; Vo and Hodgson, 1997), the species diversity of Vietnam's reefs consists mainly of the members of 5 families, Acroporidae (110 species), Faviidae (38 species), Fungiidae (32 species), Poritidae (31 species), and Dendrophylliidae (25 species), making up altogether 64.48% of the total scleractinian species composition (Fig. 3).

Fig. 3. Relative species diversity of major coral genera in Vietnam (a), Indonesia (b), and Philippines (c) reefs. 1 - *Acropora*, 2 - *Porites*, 3 - *Montipora*, 4 - *Favia*, 5 - *Fungia*, 6 - the rest genera.



The five genera most diverse and widespread in all reefs comprise *Acropora* (56 species), *Montipora* (28 species), *Porites* (18 species), *Favia* (13 species), and *Fungia* (11 species). In all, some 20 scleractinian species form monospecific settlements, varying from small "spots" (tens of square meters) to extended zones (hundreds of square meters), with a coverage reaching 60–100%. One fifth of all scleractinians occur throughout the Vietnam coast.

As a whole, the species diversity of reef-building scleractinians in different areas of the Vietnam coast is quite comparable, ranging from 190 species in the Gulf of Tonkin to 265 in the South Vietnam (Fig. 4). Similar (193–256) numbers of species were reported for reefs of Indonesia, the Philippines, and Western Australia (Veron, Marsh, 1988; Veron, 1995). Central and

South Vietnam reefs are most similar in species composition and are quite comparable to Spratly reefs.

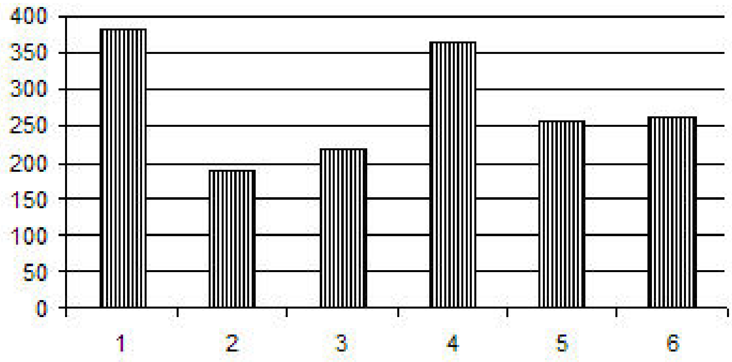


Fig. 4. Scleractinian species diversity in different regions of Vietnam. 1 - total number of species (382), 2 - Gulf of Tonkin (190), 3 - Central Vietnam (219), 4 - South Vietnam (365), 5 - Gulf of Siam (256), 6 - Spratly Island (261).

The peculiarity of the coral faunas of the Siam and Tonkin gulfs as revealed by cluster analysis (Fig. 5) is consistent with their ecological peculiarities (Dawydoff, 1952; Latypov, 1986, 1999, 2000). Their scleractinian diversity is partly caused by their similar hydrological regimes. Both gulfs are shallows with high water eutrophication and turbidity, with a predominanace of clay sediments.

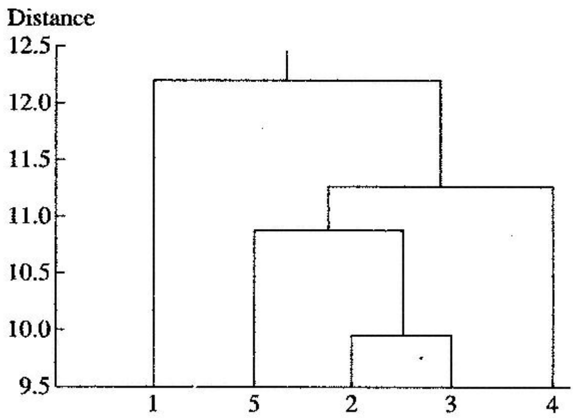


Fig. 5. Similarity dendrogram of scleractinians faunas in different regions of Vietnam. 1 - Gulf of Tonkin, 2 - Central Vietnam, 3 - South Vietnam, 4 - Gulf of Siam, 5 - Spratly Island.

These factors cause a similarity of the biological and morphostructural zonation of reefs and species composition of reef communities in the gulfs. At the same time, certain differences in climatic and geomorphological conditions of the gulfs result in some dissimilarities in their scleractinian species composition. The development, zonation, species composition, and structure of the reefs in the gulfs were reported previously (Latypov, 1986, 1990, 2000; Sakai et al. 1986; Ken, 1991a), so here, only major similarities and differences will be mentioned.

The reef communities in both gulfs lack members of *Palauastrea* and *Caulastrea* and *Acropora cuneata*, the latter occurring in most Vietnam reefs. *Plerogyra* and *Physogyra* are absent in the closed part of the Gulf of Tonkin, and *Pachyseris, Mycedium*, and *Pectinia*, in the innermost and coastal areas of the Gulf of Siam. However, some members of the latter three genera and rare *Physogyra* and *Plerogyra* species are found in the open parts of both gulfs, off Hainan and Tho Chu islands. Corals having large polyp forms and capable of selfcleaning—*Galaxea, Echinopora, Lobophyllia, Echinophyllia, Turbinaria, Podobacia, Lithophyllon, Fungia*, and *Goniopora*—are widespread in both gulfs. The reefs in both gulfs are dominated by many species of these genera (*Galaxea fascicularis, Goniopora stokesi, Echinopora lamellosa*, and *Lobophyllia hemprichii*), as well as by *Acropora cytherea, A. nobilis*, *Montipora hispida, Porites lobata*, and *P. cylindrica*, widespread in Indo-Pacific reefs. Altogether, these species cover 60–80% of the substrate. Massive *Porites* colonies (at least 10 species) forming vast monospecific settlements are typical of both gulfs. At the same time, members of *Pocillopora*, abundant in most Indo-Pacific reefs (5-7 species), only rarely occur in the innermost parts of the gulfs (2 species maximum) but are common for island reefs in the open parts of the gulfs (Tho Chu, Hainan). By and large, the two gulfs are quite similar in coral diversity and share 74.3% of species.

The distribution and peculiarities of benthic communities in the coastal part of Vietnam reefs is rather constant (See Fig. 2). As a rule, these are algal–coral communities, composed of several biocenoses (zones, facies), dominated by individual algal or coral species or by groups of species. The predominance of *Laurencia, Turbinaria*, and *Sargassum* algae in the coastal zones of the reefs has been reported for many reef development areas. This may be indicative of an increase in water eutrophication or later stages of reef development (Mergner, 1979; Dollar, 1982; Dai, 1993, Latypov, 1999).

Both along the Vietnam coast and in the whole Indo- Pacific, in reef zones characterized by relatively stable conditions (lagoons, deep stony and coral terraces, and reef slopes), branched, plate, and trumpet colonies of *A. cytherea, A. hyacinthus, Montipora danae, M. foliosa, Porites cylindrica, P. nigrescens*, and others successfully compete with differently shaped scleractinian colonies (Liddel and Ohlhorst, 1987; Latypov, 1988; Dai, 1993).

A wider distribution of encrusting and plate colonies of *Euphyllia, Echinophyllia, Mycedium, Pachyseris*, and *Turbinaria* compared to that of branched forms is directly caused by lowered illumination. This is also the case in many reefs of the Indo-Pacific and Caribbean basins (Loya, 1976b; Porter, 1976; Tomascik and Sander, 1987). In Vietnam's reefs, such corals are common for communities of the slope base, bioherm zone, and forereef platform.

Caused by abiotic factors, the vertical distribution of reef-building corals has a strong effect on the development of biotic zonation across a whole reef community, beginning with settlement-site choice and ending with interspecific trophic relationships. The relationships between the species composition of benthic communities of some reefs as revealed by cluster analysis correlated with the ecological and physiographical zonation of the reefs (Fig. 6).

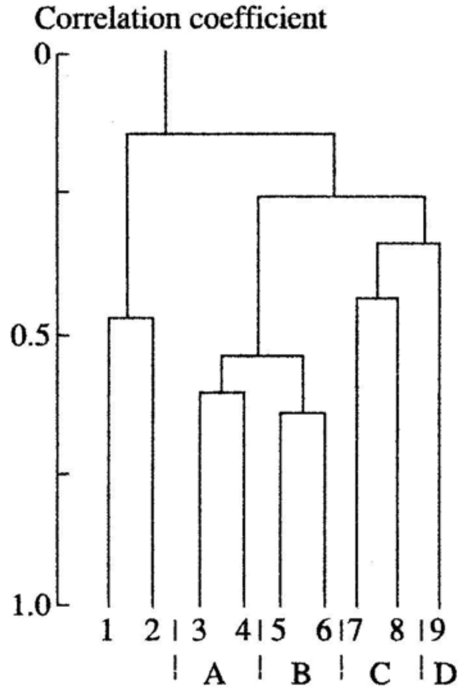


Fig. 6. Cluster dendrogram of the species composition of benthic communities. Algal–coral community, unstructured (1) and structural (2) reefs; *Acropora* community, unstructured (3) and structural (4) reefs; *Acropora*+*Diploastrea* community, unstructured (5) and structural (6) reefs; (7) bioherm community (reef slope); (8) *Junceella*+*Diaseris* community; (9) *Maleus*+J*unceella* community. A - lagoon, B - reef flat and terrace zone, C - reef slope, D - for-reef platform.

Algal–coral lagoon and reef flat communities dominated by red and brown algae and similar in coral and common macrobenthos species composition formed a single cluster group, that of communities developing under similar conditions. The high similarity between coral faunas from different sites reflected similar, sometimes extreme, conditions of reef flat and shallow-water stone terrace. At the same time, communities of these reef zones were set apart from those of neighboring reef zones. Both in structural and unstructured reefs, polyspecific reef slope communities sharing a relatively greater number of corals also formed a distinct cluster.

To summarize the above, both structural and unstructured reefs feature vertical biological and geomorphological zonations. The latter is mainly determined by peculiarities of the underwater reef slope substrate. Similar biological zonation reflecting interzonal differences in environmental conditions (substrate, wave regime, sedimentation rate, illumination) has been reported for many of Vietnam's reefs and various Pacific and Caribbean reefs (Dollar, 1982; Latypov, 1986; Sakai et al.1986; Dai, 1993).

Shallow-water Vietnam reefs growing in highly eutrophic conditions lack thick reef deposits Latypov, 1986, 1995) and feature high coral diversity and distinct biological zonation, that is, the presence of inner heterotrophic (lagoon, reef flat) and outer autotrophic (reef slope) zones (Preobrazhenskii, 1982; Sorokin, 1990; Latypov, 1994), which is characteristic of typical Indo-Pacific reefs.

In reefs of Indonesia and Philippines and in the Great Barrier Reef, a total of 360–410 reef-building scleractinians pertaining to 70 genera have been recorded (Veron, 1995). This region of the Western Pacific is considered the center of origin of tropical coral faunas. The maximum coral diversity is observed in the so-called Coral Triangle (Ekman, 1953; Stehli, Wells, 1971; Veron, 1995) with apices in the Philippines, the Malacca Peninsula, and New Guinea (Fig. 7).

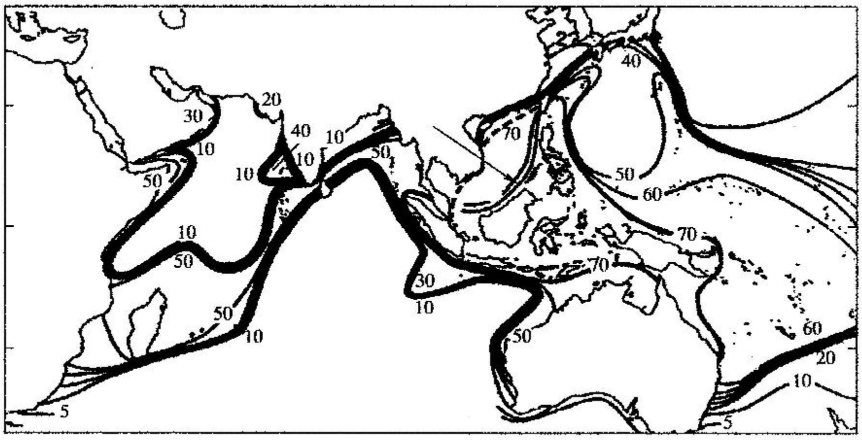


Fig. 7. Schematized map of the generic diversity of of reef- building corals in different regions of the Indo-Pacific (partly after Veron, 1995). The dotted line and arrow indicate new and old 70 genera diversity isolines, respectively.

Vietnam's reefs, too, obviously belong to this center, which is evidenced by their high similarity in coral species composition to reefs of Thailand, Indonesia, and the Philippines (76.4, 72.3, and 81.6%, respectively). In the greater Western Pacific Coral Triangle (with apices in Vietnam, South Japan, and the Great Barrier Reef), coral faunas are also highly similar and homogenous. The similarities between the Vietnam coral fauna and those of Japan and Australia are 77.5 and 86%, respectively, suggesting homogeneity of the coral fauna of the Western and Southwest Pacific. As a whole, the species complex of Vietnam scleractinians, as well as those of alcyonarians and gorgonarians, belongs to the tropical fauna as the majority of Vietnam corals are also common for the equatorial Indo-Pacific reef zone. The scleractinian species composition of this area exceeds 80% of that of the Pacific, and the alcyonarian diversity of Vietnam's reefs is one of the greatest in the Indo-Pacific (Malyutin and Latypov, 1991; Latypov, 1995).

The species composition and high diversity of Vietnam's coral fauna, as well as its close similarity to the Southwest Pacific coral fauna, allow one to refer it to the Indonesia–Polynesian center of origin of the coral faunas of the tropical Indo-Pacific. The whole Vietnam coast, from the Gulf of Tonkin to the Gulf of Siam, is a biogeographically single whole and is part of the Indo-Polynesian Province of the Indo-Pacific Area.

Part 2. THE PROBLEM OF SPECIES FOR CORALS

Up to the end of the 80's of the XIX century the problem of species was absent in coral descriptions. Taxonomic or simply identification works were conducted on the basis of single specimens or a very sparse series of samples. It is quite natural and especially revealing that the investigation of variability in these animals was almost impossible. Lack of knowledge about variability resulted in description of "new" species, which very often were only local variants, nevertheless they received a taxonomic status. Other identifications were conducted only by way of comparison with specimens identified earlier, and it was rather difficult to identify species without a described sample at hand (Studer, 1901). The presently recognized problem of coral identification due to very wide variability of their morphological features appeared only with investigation of large collections, which give the opportunity to compare similar samples within a series.

For the first time we knew properly about the variability of corals. The collections of the Challenger expeditions were actually the first to contain representative series of many species, reported by J. Quelch (1886). He wrote that for most genera he presented, little or nothing was known about the early stages of the corals, colonial or solitary. Quelch mentioned that information about coral ontogenesis and their variability could be obtained in the future. Naturalists will be well informed on these issues when they collect and study types of coral variability. In the same work this researcher wrote about the necessity of critical comprehension of data on ancient rugosa in connection with modern corals, and vise versa. He wrote that comparison is an essential part of characterization of main groups of modern and fossil corals (1886, p. 8).

S. Pace (1901) showed in *Turbinaria* that many morphological features and growth forms of corals, which were used for distinguishing species in a given coral group, in fact have only a secondary value, especially colony shape, and in most cases reflect environmental effects. On the other hand, not all variations between two variants (in any of a variety of genera) are simply expressions of adaptive modification. According to Pace's opinion (he mentions experimental observations of three species of clearly-distinguishable *Turbinaria*, inhabiting the same place), some variations of specimens, living close to each other, cannot be explained by environmental conditions but have a hereditary nature. This researcher underlined that determination of the limits of variability of any species is not an easy task, especially if investigation is not based on the materials of museum collections. In the case with corals it becomes a very difficult problem.

In conclusion, speaking on the problem of species, Pace wrote that everyone who studies nature not only in museums or laboratories, but also in the field, will inevitably face facts which will leave him face to face with the question, which always arises: "What are species?" This question, which cannot be answered satisfactorily until taxonomical investigations are conducted at a higher level, when a large series of specimens and other data, collected as a result of special observations and facilitating the solution of this problem, residing in the familiar word "species", are available for zoologists.

The main arguments on the problem of species started after the work of G. Bernard (1903, 1905, 1906) who refused to use Linneaus nomenclature and used a taxonomical unit named "local shape." Such an attack on the existing classification of corals demonstrates the importance of the problem in full as early as at the beginning of coral taxonomy, but unfortunately, as it was correctly noted by J. Veron and M. Pichon (1976), such works add very little to our knowledge of coral taxonomy. Bernard's works were subjected to criticism immediately after publication (Gardiner, 1904; Bedot, 1907; Vaughan, 1907; and others).

F. Wood-Jones (1907), highlighting the investigation of living corals in their habitats, pointed to difficulties in establishing the meaning of growth form as a species feature. Various vegetative forms of the same species can be produced by different environmental conditions, and very dissimilar coral forms of the same species, formed under the effect of extremely different conditions, can be found at the same atoll. However, conditions intermediate between those that produce extreme colony variants exist in various parts of an atoll, and intermediate coral growth forms can be found in such places. He did not make an attempt to classify genetic coral growth forms, but he believed that every coral could have any colony form, since vegetative form is a result of the type of division characteristic of polyps. In Wood-Jones' opinion, various types of division, though typical for certain growth forms, are not unchangeably fixed, and variations of vegetative growth forms cannot be taken as species-specific.

The first critical review of coral classification (only one genus) we find was by G. Brook (1893). He considered schemes of J. Dana, H. Milne-Edwards and J. Haime, and C. Klunzinger and found that they were based only on the form of colonies, and many sub-divisions of coral types overlapped each other in distinguishing features. Brook, when describing and classifying *Acropora*, took into account differences in colony form, and small-scale skeleton variations, especially in corallites. He underlined that variation in polyp morphology between corals should be considered.

T. Vaughan (1907) was the first who presented the problem of coral species. Not emphasizing any one concept of species, he pointed out that this problem is of biology as a whole. This researcher critically reviewed views of Gardiner and Bernard and noted that even the system of local shapes of the latter cannot be considered completely preposterous, as in certain cases when working with large series of specimens, this method can help to estimate the limits of variability. Vaughan especially underlined the importance of investigation of intra-specific variability for coral taxonomy. "As we know, coral variations are great and complicated. If we get to know their limits, we shall have to know the limits of variability of different species" (Vaughan, 1907, p. 4). Species definition is given in the same place: "A species is a group of individuals connected by common intergrading features and separated from the other individuals by distinct gaps". Underlining again the importance of knowledge about variability of intra-specific skeleton elements of corals, Vaughan wrote that any theory of species can be correct if identification of a species is based on knowledge of the pattern of variability.

As it can be seen, immediately after the formulation of the biological concept of species, coral taxonomists were offered a theoretical basis supported by a practical work on the description and classification of the corals of Hawaii. Unfortunately, during the following decades, up to the present time, these statements were not used by coral taxonomists except in very rare cases.

N.N. Yakovlev (1904, 1913, 1956) wrote repeatedly about the uncommon variability of corals, their "unlimited capacity to change, vary, adapt to requirements of the environments," and the necessity to take into account this variability when classifying modern and fossil corals. He urged paleontologists to take care to study a sufficiently large number of specimens of the same shape, underlining that even modern coral division to species is highly subjective and obviously not natural as it is not in any other groups of animals. This outstanding expert of rugosa underlined that in order to have a full notion of species variability it is necessary to have a considerable amount of material to establish a connection between individuals belonging to the same species.

Up to the 1950's some taxonomists held the opinion of Bernard, others – that of Vaughan, and the majority took an intermediate position. Investigations were mainly carried out on the basis of small coral groups from separate collections. Previously distinguished and considered valid features and studies, based only on investigation of hard skeleton, were rejected, and many species were considered synonymous. Various systems of "shapes" and "facies" were offered, up to naming different part of a colony by different names. But all arguments and doubts somehow or other were concentrated on the multiplicity of growth forms and variability of corals. They served as the main obstacle for coral classification in the majority of works. A necessity arose to place "previous" species in synonymy, or to revise the principles of classification of whole coral groups.

Studying reef corals and their variability, J. Hoffmeister also faced the problem of their identification. In this connection he devoted a special part of his writing to the problem of species (Hoffmeister, 1925). Mentioning that this problem is of biology as a whole, he underlined its uncommon acuteness in such a variable living form as corals, which are strongly affected by environmental influences. Pointing to insufficient knowledge on species evolution, Hoffmeister wrote that the term "species" could be used in a more or less artificial manner for the purpose of classification. In the opinion of this researcher, in coral taxonomy the definition of species made by T. Vaughan can be used, and we have to obtain as clear and full a picture of our main object as it is possible in order to complete our classification. "If our knowledge about corals were greater and we knew the limits of variability of every species, than we would have been able to use Linneaus's system as it is, without any problems" (1925, p. 5).

Speaking about problems of species identification, this author mentioned that if a given specimen is sufficiently far from a known and described species by a complex of initially observed features, we give it some other species name. Other researchers can consider that this species is not so different as to to require giving it a different name. Hoffmeister asked the polemic question: "Who is right?" He showed for *Pavona* as an example that in a large series of specimens a high degree of variability of features can be observed. When there is a long series of graded forms, the extreme forms of the series can be especially different, and nevertheless they should be referred to the same species. It often happens that two clearly different species are in fact series members, connected by forms with intermediate features. Instead of giving new species names to two forms which seem to be intermediate, or naming them as variants, Hoffmeister offered to use some symbols. These symbols had to show an attitude of a researcher to a sampling, and to give the opportunity to determine its position in the nomenclature. If, for example, some problems arise with identification of specimens, possessing a combination of *Leptoria gracilis* and *L. phrygia* features, and their appearance is close to the latter species, we can identify them as *L. phrygia* → *gracilis*. From the logic of such a definition, in Hoffmeister's opinion, it can be clear what features are variable in the given case. This researcher believed that this taxonomic method not only gives the notion of a taxon, but also informs a researcher about the trend of evolutionary variations. Hoffmeister continued the discussion about the problem of species, holding the same points of view, in a separate article (Hoffmeister, 1926).

Perhaps J. Umbgrove (1939, 1940) was the first who followed Vaughan in the study of corals, but a real systematic work with a considerable collection of corals from the Great Barrier Reef of Australia was carried out by C. Crossland (1952). He noticed again extraordinary variability of these animals not only in the growth form, but also in things which were considered fundamental structures, such as the number of septal cycles, and even in very fine components of septal ornamentation. Crossland called for care when applying data, found for one genus, to some other taxa members without criticism and publication of arguments. In his opinion, it is necessary to be especially careful with some details, which seem to not be significant, but in one group they are a basis for specific difference, and in the other group they can be fixed and do not show any variation. Showing that many species are in fact only ecological variations, this author called for us to determine the limits of these variations, typical for every species, and until these limits have been established, it is not possible to make conclusions on their taxonomic category. Crossland considered that it is possible to attribute ecological variants to different species in order to make it convenient for future investigators. In his opinion, it is better to consider them variations, but not species, and to give them different names than to integrate them initially and to separate them afterwards. Unfortunately Crossland did not participate in the expedition to the Great Barrier Reef, and that is why variability of some corals was not always properly reflected in his works. On the whole, the work of this researcher even now remains very important and remains within the sight of specialists, involved in the study of corals, and especially in their taxonomy.

Works of A.B. Ivanovsky (1975, 1976, 1978) are devoted to principles of coral systematics in general, and rugosa in particular. In these works he emphasizes that a biological species is an objective notion, not dependent on the fact of whether it is fossil or modern, when and what conception of it was elaborated, and that it is necessary to use the same principles of systematization of organisms in paleontology and neontology. Ivanovsky thought that underestimation of intraspecific variability was the weakest point in the classification of fossil corals. He stated that when identifying specific and intraspecific affiliation it is necessary first of all to introduce a definition of variability; only after that is it possible to state a zoological population and an appropriate category for paleontological material. In the opinion of this author, when systematizing rugosa it is necessary to be guided by the following principles:

1. Phenons of the same stratigraphical horizon can be different species or a result of intraspecific variation.
2. Subspecies can be established only regarding allopatric populations.
3. It is practically impossible to distinguish sibling species in paleontology.

Species of the same genus can be identified on the basis of morphological differences of mature growth stages with obligatory verification of ecological criteria in case of substantial variation of one morphological feature or minor morphological variations of a complex of features. Species of different genera, which develop in parallel, differ by ontogenetic process. Forms (morpha) can be established on the basis of partial morphological deviations of mature growth stages of corals inhabiting the same areas, and statistical methods are very important for their verification.

The problem of species and intraspecific variability was considered in a special chapter of a work of J. Veron and M. Pichon (1976), in which a critical monographic investigation of the taxonomy of Scleractinia from the Great Barrier Reef of Australia was conducted based on long-term underwater observations and well labeled samples of huge series of corals. When considering the history of the species problem for scleractinians, these researchers noted that T. Vaughan's views were the first in many new trends of coral taxonomy, but unfortunately he had few followers. Veron and Pichon considered in detail the concept of "ecomorphose", introduced by Laborel (intraspecific skeletal variations determined by environmental factors), and showed that this notion was not clearly defined and was most often applied to groups of individuals and populations inhabiting homogenous conditions. They also do not consider the term "ecotype", as it was understood by Wijsman-Best, as a good one for characterization of skeletal variations of reef-building corals.

In order to avoid incorrect interpretations of their own position, these researchers offered the concept of "ecomorphs." "Ecomorph is hereby defined as "intraspecific skeletal variations phenotypically and/or genotypically, determined in response to specific ecological conditions." Veron and Pichon understood quite well that their concept of ecomorph had its limitation and did not help to solve the problems of taxonomy, but they hoped that it would improve somehow the existing situation. They stressed that the concept of ecomorph had the same problems as the notion of "ecotype", and these problems were mentioned by Mayr. "Ecotype is not good because it is unusually intermittent, rarely well delineated, often polyphyletic and always abundant inside ecotypical variability." As Veron and Pichon wrote, variation happens because it is hardly possible to find homogenous environmental conditions, and that is why a homogenous population has variation as well, in coral reefs. Even polyps of the same colony are subjected to the effect of different light, hydrodynamic, and sedimentation conditions, as well as to the effect of commensals or parasites. Therefore, variations, determined in these cases, are quite likely phenotypic, which can be many times observed in different parts of the same colony. Maximizing the study of intraspecific variability of corals, these scientists established its limits for every species by three successive methods.

1. One large colony with more than one microhabitat, located lower, higher and at the same level was under study; the limits of variability of such a colony were established with various degree of variability between the central and peripheral colony parts.
2. The limits of growth form variability in the same biotope were determined.
3. Variability between interconnected biotopes was determined.

Later J. Veron (1995), analyzing various modern species concepts (Dobzhansky, 1935; Simpson, 1944; Paterson, 1981; Cracraft, 1987; Templeton, 1989), concluded that the majority of taxonomists and paleontologists accepted Simpson's concept of population. The evolutionary species concept (Simpson, 1944) is, by default, the concept of most taxonomists and paleontologists, where species are envisaged as populations, or groups of populations that have had a common evolutionary history. Species are held together by developmental, genetic and ecological constrains, not just heredity. This is the nearest any general concept comes to operational coral taxonomy. As a concept, however, it is empty, contributing no guidance as to what are acceptable criteria for taxonomic decisions.

Y.I. Tesakov (1974, 1978) paid much attention to the problem of species and in general to investigation of fossil tabulate corals. He showed that the quantity of identified species and intraspecific subdivisions greatly depends on the concept of species accepted by a researcher, as well as from the available material and methods of study. Tabulata can be completely investigated from the position of biological species using population analysis, as well as biological, paleontological, ecological, biometrical and even genetic methods. In his opinion, tabulata hierarchy – a colony, population generation and inhabitants, population, subspecies – as a species subdivision, fully reflects the structure of biological species. Emphasizing the variability of tabulata, Tesakov showed clearly that with the increase of quantity of material studied, the variability of features can be revealed more completely, every species possesses certain features and their values. That is why it is necessary to establish the mode of species variability, and after that to establish its range.

"Taxonomists are inclined to believe that problems they face when studying their objects are the most difficult in comparison with those of the other investigation objects. Probably coral specialists are the exception, but the permanence of these problems and their visible intensification in the process of coral investigation history serve as a circumstance which seems to deserve a detailed discussion." B. Rosen wrote these words in a review (Rosen, 19??) devoted to the problem of species for Scleractinia. Based only on English language publications, he considered all known concepts of species and intraspecific subdivisions, as well as simple systematic reviews, and came to the conclusion that corals are very difficult for identification, and the problem has not become much easier than 70 years ago. In his opinion, these are the following reasons for the difficulties.

1. No two corals can be absolutely similar, and it is very difficult to distinguish intraspecific variations from interspecific ones.
2. Limitations in collection. Large collections are often an inaccessible ideal, whereas collections of separate fragments are of little interest and unimportant.
3. Coral researchers know very little (especially in the past) about the biology of living corals, that is why they were not careful when naming them.
4. Species are based on skeletal morphology, and soft tissue is not taken into consideration.
5. Corals genetics have not been studied, which is why these is no basis for a strong theory of species for them.

Rosen formulated the key conclusions of his review in the form of questions.

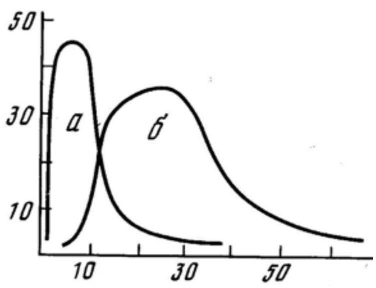
1. Does every distinctly observable coral represent a separate species, even if the observed difference is the result of habitat?
2. If not, then where is a boundary between variations within one species and variations between different species?
3. What is the source of variability, especially for the growth forms?
4. Can Linneaus's system be applied to corals, and if not, what is an alternative? (This question practically contains at least three separate disputed problems: species concept for corals, type concept in the procedure of classification, and limitations of bionomial nomenclature.)
5. What is a species for corals? For the authors in the beginning of the century this question was actually the same as point 2, that is why the prevailing morphological concept of species was accepted by the majority of biologists.

Thus, the issue of unusual intraspecific variability and its limits for every specific taxon or population was extremely essential in the problem of coral species from the outset. Researchers, who had large collections and great experience of living coral observations, could clearly see that without understanding of the variability pattern it was impossible to identify either modern or fossil corals. "A sound theory of species" for corals was formulated by Vaughan in the very beginning of the current century, and it was similar to the biological species concept which appeared two years earlier. At the same time it was emphasized that the question was not in application of various species concepts, but in a single biological approach while studying corals.

In our work we do not deal with species as such. We study individuals, samples and series of samples, and combine them in groups of phenotypically similar specimens – phenones. Phenones, gathered in one place, can represent various species or intraspecific differentiates. In order to have an option of alternatives, it is necessary to thoroughly study individual variability, having analyzed it completely, qualitatively and quantitatively. The variability of corals is especially high and diverse, and "if we know its limits, we shall be able to know the limits of different species" (Vaughan, 1907). Values of some features can vary 10-30 times even within the same population (Tesakov, 1978; Latypov, 1980; Latypov, 1984).

No matter how high the variability is of different communities of individuals inhabiting the same biotope, two alternatives can be revealed after its comprehensive analysis. Value complexes of several series features can be arranged in certain limits, being connected by a full row of transitions, and peculiarities and variations of individual development are similar fundamentally and in details in all samples; or value complexes of several series features have evident gaps, and peculiarities and variations of individual development have distinctions of kind. In the first case individual communities represent a system of potentially interbred populations, relating to the same species and representing a pattern of intraspecific variability of features. In the other case we have a right to consider communities of individuals with gaps as reproductively isolated populations, since gaps in their feature complexes and ontogenetic peculiarities could be easily seen both in one and in various habitats.

Even at a very high degree of features variation, intraspecific variation will have its specific limits. In this case variation in values of features is continuous. In some populations they will form successive series, and the greater the sampling there is, the more regular and continuous these series are. Interpopulation variations will be connected between each other with a full row of features value transitions. In the compared phenones a value of every feature, if they belong to the same species, will be positioned between the value extremes of their variability without gaps in values of qualitative and quantitative features. For example, the width of branch ends of different *Stylophora pistillata* colonies can be 10-20 and 60-70 mm, the distance between branches – 5-10 or 30-40 mm. In a representative sample maximal and minimal values of these features have successive transitions. The fact that these are continuous variations of features is confirmed by coefficients of fatty acids composition proportion, which differ by fractions of a percent (Fig. 8, 9, Table 1).



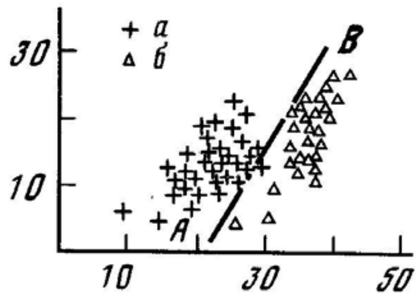


Fig. 8 Fig. 9

Fig. 8. Distribution of the number of specimens according to the modal size of branch ends of *Pocillopora damicornis* (a) and *P. verrucosa* (b). It can be well-seen that sizes of thickenings of branch ends of the both species are partially overlap, but one of the species includes mainly branches of up to 10 mm thickness, whereas another species – up to 15-30 mm. Axis of abscissa shows sizes of branch ends; and axis of ordinates - occurrence frequency.

Fig. 9. Division of two *Pocillopora* species according to the ratio of branch diameter to the number of corals per area unit of a branch. a – *P. damicornis*; b - *P. verrucosa*; AB – a line of the best division. Axis of ordinates shows branch diameter, and axis of abscissa – number of corallites per area unit.

Properties of phenones, belonging to different species, will necessarily have qualitative and quantitative gaps for one or several features, no matter whether these are peculiarities of morphology or percentage ratio of fatty acids composition.

In this case variations of features values, their gaps and peculiarities will not have only modifying character, but will also show differences in biology of carriers of such variations, determined by discrete gene pool which form various phenotypes together with environments. Different *Pocillopora* species have distinctions in branches width, in a number of corals per area unit, which partially overlap. They have an evident gap in the frequency of laying floors (the first ones laid them 4-5 times oftener), differ by the presence and absence of verrucosa bifurcation on main branches, and proportions of some fatty acid compositions differ by 2-3 fold (Fig. 8, 9; Table 1).

Table 1. Proportion of fatty acids composition in various scleractinian species

A	B	C	D	E
14:0	2.4	2.3	2.8	2.5
16:0	**21.5**	**30.4**	30.9	29.0
16:1	2.3	2.1	2.0	2.5
18:0	7.5	8.0	5.9	4.9
18:1	8.2	8.8	9.4	11.3

18:2ω 6	1.3	11	0.5	0.7
18:4ω3	5.9	**4.8**	2.2	2.5
20:1	2.9	**4.3**	1.3	1.7
20:2	0.5	0.5	0.5	0.4
20:3 ω 6	**3.0**	5.6	**5.2**	6.4
20:4 ω 6	6.1	3.3	2.3	2.1
20:4 ω 3	1.4	2.1	3.0	3.1
20:5 ω 3	**5.2**	**3.0**	1.7	1.8
22:4 ω 6	**4.5**	*2a*	1.0	0.9
22:5 ω 6	0.2	0.3	0.2	0.4
22:5 ω 3	0.9	0.9	1.1	1.1
22:6 ω 3	22,7	**24,3**	**28,5**	25,3

Note. A – names and composition of fatty acids; B – *Pocillopora damicornis*; C-D – *P. verrucosa*; E- *Stylophora pistillata*. It can be well seen that quantitative and qualitative variations in fatty acids composition in representatives of the same species have modification character, and such variations in different species have quantitative and qualitative gaps.

While working with corals having extraordinary variability of practically all features and, as a rule, polytypic species, a question often arises whether distinctions between samples (populations) are great enough to consider them as different species. In such cases it is useful to conduct statistical investigations. At that, absolute values of some features do not give unequivocal results because of the very high scattering, whereas the ratio of two measurements often give either more information or more satisfactory results. Thus, branch diameter of *Pocillopora* corals from a large sample varied from 1 to 36 mm, their length – from 18 to 110 mm, the number of corallites per surface area unit – from 10 to 64. At the same time the sample could be divided into two parts. One set of corals had longer and thinner branches (rarely longer than 20 mm) with fewer corallites, whereas other corals had considerably shorter and thicker branches (as a rule 20-40 mm) with a greater number of corallites. The construction of scattering diagrams allowed us to identify clearly two species - *P. damicornis* and *P. verrucosa* - according to these features (See Figs. 8, 9). Using the known principles and methods of population taxonomy in zoology and in studying corals (Mayr, 1971; Tesakov, 1978; Latypov, 1984), it is possible to solve taxonomic problems of any difficulty, at that it is better not to trust in “peculiarities” of the object of study, but to rely on the data of population analysis and intraspecific variability.

In 1998 the book “The principles and methods of the CNIDARIAN classification” (Latypov et al. 1988) was published. This book presents the principle results of more than 20 years of investigations into the systematics and taxonomy of the cnidarians, which is a difficult subject for taxonomy. The modern ideas about the criteria for taxon definition for the fossil and recent corals, actinia, and hydroids are presented. Morphologic and genetic differences and the taxonomic value of ethological and ecological characteristics are considered. Using numerous examples, the significance of the various features, definition of the limits of their variability, and methods of the resolving the inevitable problems which take place in the identification and classification of CNIDARIA, are shown.

Part 3. DESCRIPTION OF CORALS

ORDER SCLERACTINIA

The anatomy of scleractinians, the morphology of their skeleton and terminology have been described in detail in a number of works (Wells, 1956; Chevalier, Beauvais, 1987; Veron, 2000). Morphology, terminology, methods and principles of taxonomy of cnidarians have also been considered in Russian publications (Soshkina et al. 1962; Ivanovsky, 1965; Latypov, 1984, 1990, Latypov et al. 1998). That is why in this monograph we shall consider the peculiarities of morphology and taxonomic history of some most complicated scleractinian families.

3.1. Family Thamnasteriidae Vaughan and Wells, 1943

Genus *Psammocora* Dana, 1846

Type species: *Psammocora obtusangula* (Lamarck, 1816).

Diagnosis. Colonies are massive, ramose, columnar or encrusting. Small corallites are limited by branching septa. Corallites borders are low, rounded, surrounding several or a series of calice centers. The axial structure is simple, made of trabeculate columns. Petaloid septa are often grouped in a flower-like appearance.

Psammocora contigua (Esper, 1797)

Fig. 10-1

Psammocora contigua: Esper (1797), Dana (1846), Edwards and Haime (1851), Ortmann (1888), Gardiner (1898, 1905), Whitelegge (1898), Van der Horst (1921,1922), Hoffmeister (1925), Faustino (1927), Eguchi (1938), Yabe et al. (1936), Umbgrove (1939, 1940), Matthai (1914), Crossland (1952), Stephenson and Wells (1955), Nemenzo (1955, 1964), Searle (1956), Veron and Pichon (1976), Krasnov and Latypov (1978), Scheer and Pillai (1983), Nakamori (1986).

Psammocora plicata: Dana (1846), Van der Horst (1922), Umbgrove (1940).

Psammocora ramosa: Quelch (1886), Umbgrove (1940).

Psammocora gonarga: Gardiner (1898), Vaughan (1918), Van der Horst (1922), Umbgrove (1940), Stephenson and Wells (1955), Scheer, (1967).

Psammocora divaricata: Gardiner (1905), Van der Horst (1921).

Psammocora vaughani: Yabe et al. (1936).

Branched and submassive colonies are formed of irregularly-shaped or anastomosing stick-like branches of very variable width. In reef zones with permanent currents colonies have a hemispheric shape with thick short branches. Corallites are small (0.4-1.2) and have no clearly developed wall. Calices in the shape of shallow holes are located uniformly on the colony surface at 1-2 mm distance, and sometimes they can be grouped in rows in shallow grooves (0.8-1.5 mm between centers of corallites). The axial structure is distinctly bulging, it can have a shape of a column, a peg, etc. Its surface is grainy with small spines. Sometimes the columella is surrounded with a synapticular circle. Petaloid septa are often formed in a shape of inflorescence, and the number of septa varies from 6 to 20. Septa and coenosteum lobes are covered with a mass of slightly branching spines.

Living colonies are from light pale-yellow to brown.

Similar species. The fine superficial corallites are like those of *P.superficialis* but the different growth-forms are always distinctive.

Common.

Location. Baitylong Archipelago, Cham, Thu, Con Dao Islands, reefs of Khanh Hoa Province and Gulf of Siam.

Distribution. Widely distributed over the entire Indo-Pacific area at depths from 0 to 31 m.

Psammocora nierstraszi Van der Horst, 1921

Fig. 10-2, 12-1

Psammocora nierstraszi: Van der Horst (1921), Wells (1954), Loya and Slobodkin (1971), Veron and Pichon (1976), Scheer and Pillai (1983), Head (1980).

Psammocora samoensis: Hoffmeister (1925).

Massive and encrusting colonies with thick feston-bent branches. Corallites are large, up to 3.5 mm diameter, polygonal, with thin irregular ridges and well-developed fallacious walls.

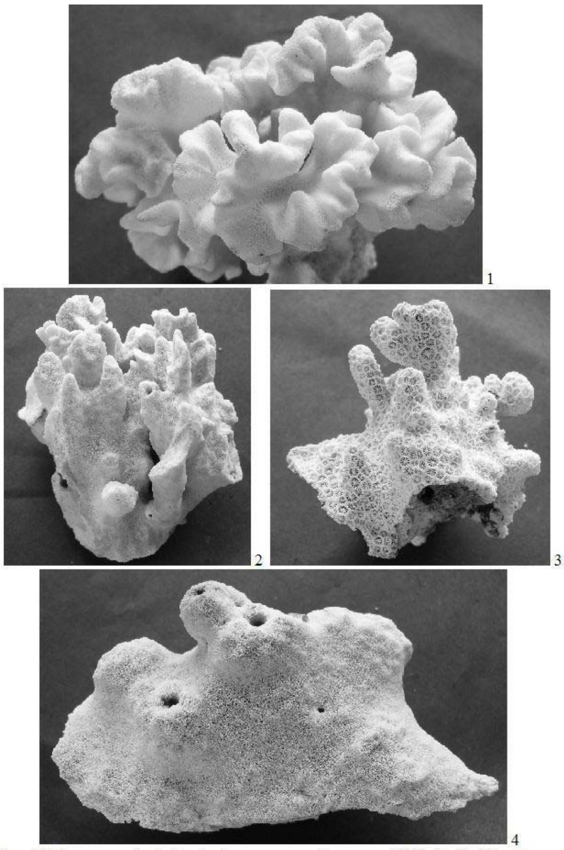


Figure 10. Appearance of colonies. 1 – *Psammocora contigua*, spec. 4/9501, An Thoi Islands; 2 – *P. nierstrassi*, spec. 8/9501, Tho Chu Island; 3 – *Madracis kirbyi*, spec. 6/9501, Con Dao Islands; 4 – *P. superficialis*, spec. 7/9501, Tho Chu Island

Calices are small and polygonal, clearly separated from each other by common borders. Vertical rows of calices, separated by clear ridges, with clearly visible rows of synapticular circles, can be formed. The columella is well developed, and includes several columns, which are often connected with the axial ends of septa. Mainly petal-shaped septa are situated one by one, merging in groups near the axis, and their number varies from 12 to 32. Lateral sides of septa, their peripheral ends are densely covered with branching spines.

Living colonies are light brown color.

Similar species *P. profundacella* also has valleys but corallites are aligned along the valley floors and petaloid septa are not exsert.

Common.

Location. Baitylong Archipelago, Re, Con Dao, Tkhotu, Spratly Islands, Khanh Hoa Province.

Distribution. Eastern Africa, Aldabra Atoll, La Reunion, Island Sokotra, Seychelles, Chagos Islands; South Vietnam, South China, Indonesia, the Great Barrier Reef of Australia, Samoa, Tuamotu, and the Marshall Islands, depths from 0 to 35 m.

Psammocora superficialis Gardiner, 1898

Fig. 10-4, 12-3, C24-

Psammocora superficialis: Gardiner (1898), Hoffmeister (1925), Faustino (1927), Eguchi (1938), Yabe et al. (1936), Gardiner and Waugh (1939), Veron and Pichon (1976).

Psammocora vaughani: sensu Wells (1955).

Massive, massive-encrusting and encrusting colonies without any signs of branching. Corallites are medium-sized (1-2 mm). They are rather evenly distributed on the entire colony surface, sometimes are grouped in series, with rarely more than five calices in a series. Irregular ridges, separating corallites, are very variable in height, width and length. Intercorallite walls are not developed.

Calices are very small and show little sign of corallite series. The columella is simple, needle-like, with light granulation. Septa, mainly petaloid, are often merged in clusters in such a way that the axial ends of only 6-12 septa reach the calice area, and their total number varies from 12 to 28. Upper surfaces of septal plates are granulated similar to carina. Synapticular septotheca are formed in the periphery of some corallites.

Living colonies are pale-yellow and brown.

Similar species *P. nierstraszi* has similar corallites but has well defined ridges between them.

Relatively common.

Location. Baitylong Archipelago, An Thoi, Tkhotu, Re, Con Dao, Tam, Spratly Islands.

Distribution. Mozambique, Gulf of Aden, Vietnam, Japan, Caroline Islands, Funafuti, Samoa, and the Great Barrier Reef, depths from 0 to 40 m.

Psammocora explanulata Van der Horst, 1922

Fig. 11-3

Psammocora explanulata: Van der Horst (1922), Wells (1954),Veron and Pichon (1976), Head (1980), Scheer and Pillai (1983).

Massive-encrusted and encrusted thin colonies (4-8 cm) with smooth or slightly uneven surface. Medium-sized corallites (1.2-2 mm) are uniformly distributed throughout the entire colony and separated by flat ridges, walls are not developed.

Calices are small and situated irregularly, the distance between their centers is 2-4 mm, they do not form corallite series. The columella is simple with one or several knobs with light granulation. Septa are petaloid, clearly radial, rarely merge into clusters near the axis. Peripheral septal ends of neighboring corallites can merge forming septal ribs. Upper and peripheral margins are densely covered with small, rough, often arborescent denticles. The number of septa is 12-18.

Living colonies are pale-yellow and brown.

Similar species: Resembles *Coscinaraea wellsi* more than other *Psammocora*.

Rare.

Location. Islands An Thoi, Cham, Re.

Distribution. Providence, Amirante, La Reunion, Chagos Archipelago, South Vietnam, the Marshall Islands, and the Great Barrier Reef, depths 10-16 m.

Psammocora digitata Edwards and Haime, 1851

Fig. 11-1, 12-4

Psammocora digitata: Edwards and Haime (1851), Veron and Pichon (1976).

Psammocora exaesa: Dana (1846), Brüggemann (1879), Quelch (1886), Rehberg (1892), Gardiner (1905), Van der Horst (1921, 1922), Yabe and Sugiyama (1935b), Eguchi (1934), Yabe et al. (1936), Crossland (1952), Memenzo (1955), Zou Ren-lin (1975).

Psammocora togianensis: Umbgrove (1940), Wells (1950, 1954), Searle (1956), Pillai and Scheer (1973), Pillai et al. (1976).

Massive, encrusting and columnar colonies with irregular growths and uneven surface. Corallites are of medium and large sizes up to 4 mm diameter. They are evenly distributed throughout the entire colony, sometimes forming series from 3 to 6 calices. Intercorallite costae are well developed and can merge in irregular ridges. Walls are not developed.

Calices as a rule have a distinct fossa, though they can be at the same level with the colony surface. The columella is weakly developed and is represented by small pointed columns that are slightly granulated. The maximum number of septa fused together is two-three, they are arranged in a petal-like formation, and from 7 to 16 septa reach the center of a calice. Some septa, being connected to septotheca and coenosteum, form ribs between neighboring corallites. The total number of septa varies from 12 to 20 per corallite. All septal structures and coenosteum are densely granulated with small dentate irregular growths.

Living colonies are from pale-yellow to green-brown.

Similar species: The growth-form is unlike any other *Psammocora* species but colonies of *Coscinaraea exesa* may be similar in shape.

Uncommon.

Location. Reefs of Khanh Hoa Province, Thu, Con Dao, Tho Chu, Nam Su, Spratly Islands.

Distribution. Widely distributed in Indo-Pacific zone from the Seychelles Islands to Fiji and the Great Barrier Reef, depths 0-35 m.

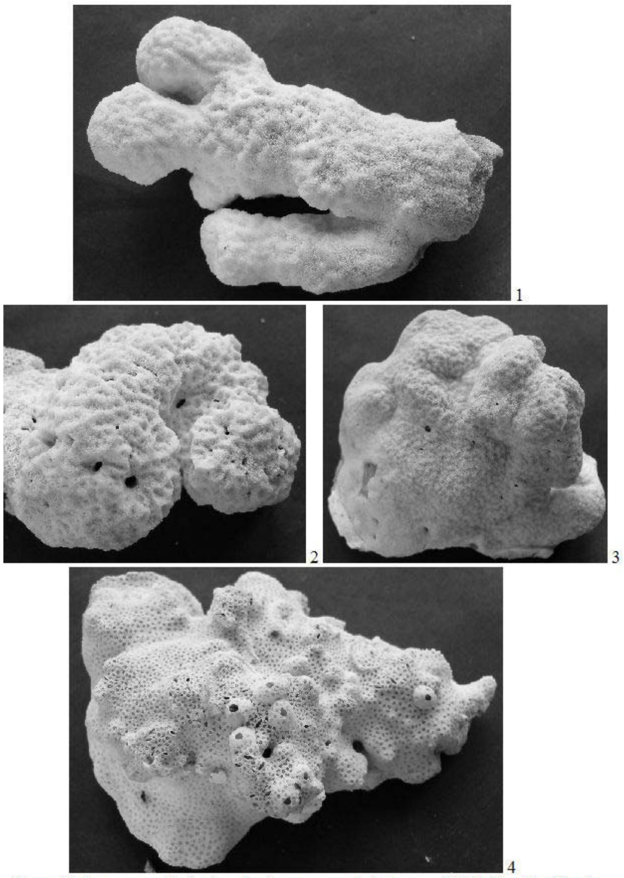


Figure 11. Appearance of colonies. 1 – *Psammocora digitata*, spec. 9/9501, Con Dao Islands; 2 – *P. profundacella*, spec. 11/9501, Hon Mjeu Island; 3 – *P. explanulata*, spec. 10/9501, An Thoi Island; 4 - *Stylocoeniella guentheri*, spec. 14/9501, Thu Island

Psammocora profundacella Gardiner, 1898

Fig. 11-2, 12-5, C16-3, C24-

Psammocora profundacella: Gardiner, 1898), Vaughan (1918), Matthai (1914), Yabe et al. (1936), Crossland (1948), Nemenzo (1955), Veron and Pichon (1976), Scheer and Pillai (1983), Hakamori (1986).

Thick, encrusting, submassive and massive colonies with uneven surfaces. Corallites are of medium size, 2-3 mm. They are evenly distributed throughout the entire colony and often form series up to 11 calices. Individual corallites and their series are distinctly separated by lines, which often bulge in the form of sharp ridges.

The fossa is well developed. The columella is usually reduced. Sometimes several simple columns can be developed within the columella. Septa are petaloid, radial, can be arranged in a form of inflorescence, merging and expanding towards periphery. The number of septa is 24, and only 8-12 of them reach the center of a coral. Septal plates are perforated and have dentate edges and spinulose lateral sides. A distinct synapticulotheca is formed at the boundary between neighboring corals. Its upper part is projected in a form of a clearly developed sharp ridge, forming an impression of a wall. There are one or two synapticular rows on the "wall" of every corallite.

Living colonies are light brown.

Similar species *P. superficialis* has less distinctive corallites with distinctly petaloid primary septo-costae.

Relatively common.

Location. Cham, Thu, Con Dao, Tho Chu, An Thoi, Nam Su Islands, reefs of Khanh Hoa Province.

Distribution. South Africa, La Reunion, Mascarene, the Seychelles Islands, Island Socotra, Chagos Island, Andaman Islands; South Vietnam, the Philippines, Taiwan, Japan, Funafuti, Fanning Atoll, and the Great Barrier Reef, depth 0-30 m.

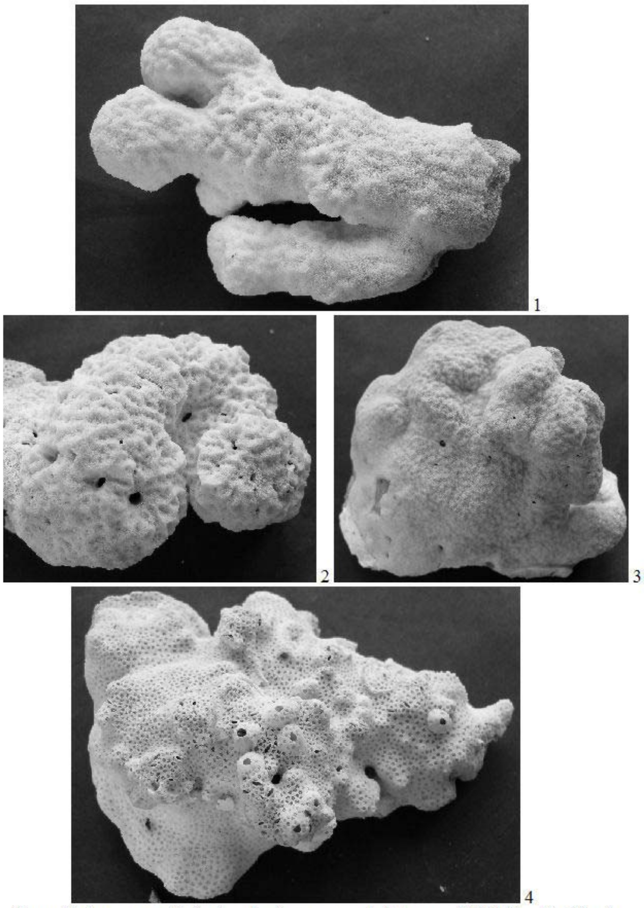


Figure 11. Appearance of colonies. 1 – *Psammocora digitata*, spec. 9/9501, Con Dao Islands; 2 – *P. profundacella*, spec. 11/9501, Hon Mjeu Island; 3 – *P. explanulata*, spec. 10/9501, An Thoi Island; 4 - *Stylocoeniella guentheri*, spec. 14/9501, Thu Island

3.2. Family Astrocoeniidae Koby, 1890

Genus *Stylocoeniella* Yabe and Sugiyama, 1935

Type species: *Stylocoeniella armata* (Ehrenberg, 1834).

Diagnosis. Colonies are massive, ramose or encrusting. Corallites are small, cylindrical with distinct deep calices. The columella is styliform and well developed. Septa of two cycles can be clearly distinguished. Intercorallite coenosteum is densely covered with pointed columnar spines.

Stylocoeniella guentheri (Basset-Smith, 1890)

Fig. 11-4, 12-6

Stylophora guentheri: Basset-Smith (1890).

Stylophora guentheri: Basset-Smith (1890), Wells (1966), Veron and Pichon (1976), Scheer and Pillai (1983), Hakamori (1986).

Stylocoeniella sp.: Wells (1954).

Encrusting, massive and nodular colonies with uneven surfaces, often deformed by commensals. Corallites are small – 0.75-1.25 mm. They are evenly distributed throughout the entire colony at the distance of 0.5-1.5 mm, sometimes coming close and forming subcerioid areas.

The fossa is deep, and distinct. The columella is well developed; it is styliform and slightly petaloid expanding upwards. Septa are of two cycles, which can be clearly distinguished by sizes. Septa of the first cycle reach the center of the corallite, merging with the columella at the basis of the calice. Second cycle septa are half the length of the first cyle of septa. Axial edges of septa are dentate; lateral sides are ornamented with simple spines. Some corallites have a hooded coenosteum elevation, formed near the primary septa. The number of septa is 12, some corallites have 24. Intercorallite coenosteum is densely covered with short pointed columns.

Living colonies are light brown.

Relatively common, cryptic.

Similar species *S. armata* has more corallites with more prominent coenosteum styles.

Location. Thu, Con Dao, Spratly Islands, Baitylong Archipelago, Khanh Hoa Province.

Distribution. Madagascar, La Reunion, Socotra, the Maldives, Chagos Islands; Thailand, South Vietnam, Taiwan, Japan, Eniwetok, Tulear, Addu Atolls, Macclesfield Bank, the Great Barrier Reef, and the Marshall Islands, depth 0-21 m.

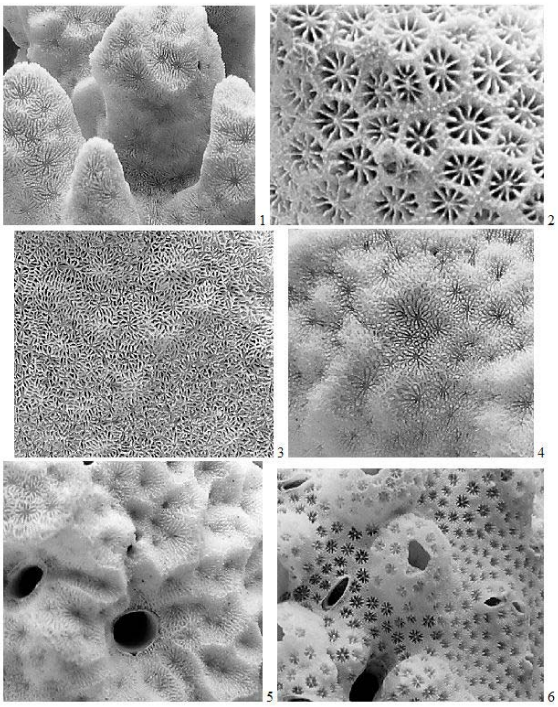


Fig. 12. Appearance of part colonies. 1 – *Psammocora nierstrassi*, spec. 8/9501, Tho Chu Island; 2 – *Madracis kirbyi*, spec. 6/9501, Con Dao Islands; 3 – *P. superficialis*, spec. 7/9501, Tho Chu Island; 4 – *P. digitata*, spec. 9/9501, Con Dao Islands; 5 – *P. profundacella*, spec. 11/9501, Hon Mjeu Island, Khanh Hoa Province;; 6 - *Stylocoeniella guentheri*, spec. 14/9501, Thu

3.3. Family Pocilloporidae Gray, 1842

Genus *Pocillopora* Lamark, 1816

Type species: *Pocillopora acuta* Lamark, 1816.

Diagnosis. Ramose, rarely submassive colonies with strongly variable branch shapes – from thin cylindrical and broad lamellar to short submassive. Small corallites cover verrucae as well as the rest of the colony surface. The columellar structure, if any, has a shape of a simple low column. Septa are weakly developed and are low ribs or spikes, which are not clearly distinguished by cycles. Tabulae are complete and flat-convex. Intercorallite coenosteum is covered with needles.

Pocillopora damicornis (Linnaeus, 1758)

Fig. 13-1, C1-1

Millepora damicornis: Linnaeus (1758).

Pocillopora scuta: Lamarck (1816), Vaughan (1918), Crossland (1952), Pillai et al.., (1976).

Pocillopora brevicornis: Lamarck (1816), Hoffmeiater (1925, 1929), Veils (1954), Pillai and Scheer (1973).

Pocillopora bulbosa: Ehrenberg (1834), Hoffmeister (1925, 1929), Umbgrove (1939), Crossland (I952), ?Wells (1954).

Pocillopora caespitosa: Dana (1846), Vaughan (1918), Hoffmeister (1925, 1929), Umbgrove (1939), Crossland (1952).

Pocillopora favosa: Ehrenberg (1834), Haeckel (1876), Marenzeller (1907), Rossi (1954), Scheer (1967).

Pocillopora damicornis: Linnaeus (1758), Ortmann (1888), Gardiner (1897), Vaughan (1918), Hoffmeister (1925), Crossland (1952), Wells (1954), Scheer and Plllai (1974), Veron and Pichon (1976), Head (1980), Scheer and Pillai (1983), Hakamori (1986).

Branched colonies with thin dichotomized branches, with ends that expand and have several short branchlets. Corallites (0.6-1.6 mm in diameter) densely cover the surface of branches, often adjoining each other, especially at branch ends.

The calice is shallow with a flat floor. The columella is present in single corallites in a form of a small bump or column. Septa, which are weakly distinguishable by cycles, have the shape of short low bumps or rows of needles along the calice floor perimeter, and do not reach half of a corallite radius. The total number of septa rarely exceeds 18. Tabulae are thin and frequent (five tabulae per 1 mm of linear growth). Intercorallite coenosteum is covered with simple needle-shaped spines.

Living colonies are yellow, pale-yellow, light brown.

Similar species *P. nae* has thicker branches and does not have intergrading verrucae and branches.

Common.

Location. Everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely distributed throughout the entire Indo-Pacific area, at depths from 0 to 42 m.

Pocillopora verrucosa (Ellis and Solander, 1786)

Fig. 13-2, C1-3

Pocillopora verrucosa: Ellis and Solander (1786).

Pocillopopra hemprichi: Ehrenberg (1834).

Pocillopora nobilis: Verrill (1864).

Pocillopora meandrina var. *nobilis*: Verrill (1864).

Pocillopora molokensis: Vaughan (1907).

Pocillopora danae: Verrill (1864).

(A complete list of synonyms with re-descriptions of analogous species contains more than 80 names, that is why only the names of originally described species are given.)

Colonies are branched, sometimes spherical. Branches are thick (10-25 mm), rounded or broad flat with parallel flat surfaces, sometimes dichotomously branching, and, as a rule, lateral branching is absent. Branches are densely covered with thick verrucae 2-3 mm high, at angle of 45-90º with the branch and having from 4 to 7 corallites. Corallites also cover the entire surface of the main branches.

Calices are small (0.3-1.5 mm diameter) with vertical walls and flat floors. Columellas are styliform and low, and are not present in all calices. Two cycles of septa (6-18 septa each) can be observed in many corallites. They vary from simple, weakly protruding ribs, covered with small denticles, to vertical plates with sharp edges. The directive septa can reach the center of a corallite and join with the columella at the floor of the calice. Tabulae are complete, weakly bulging, and rare (six tabulae per 5 mm). Intercorallite coenosteum is covered with numerous pointed spines with very fine granulation.

Living colonies are yellow, purple, light brown, green.

Similar species *P. meandrina* has shorter, more flattened branches and smaller verrucae.

Common.

Location. Can be found everywhere.

Distribution. They are widely distributed throughout the entire Indo-Pacific area at depths from 0 to 25 m.

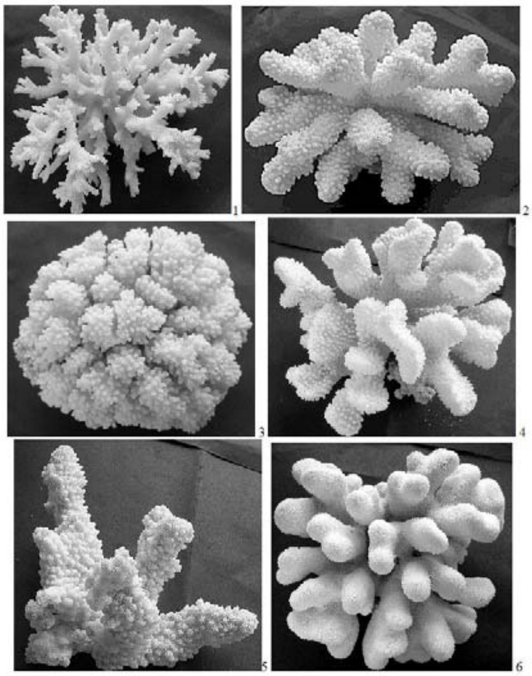


Figure 13. Appearance of colonies. *Pocillopora damicornis*, spec. 15/9501, Tho Chu Island; 2 – *P. verrucosa*, spec. 17/9501, Thu Island; 3 – *P. meandrina*, spec. 18/9501, Con Dao Islands; 4 – *P. eydouxi*, spec. 19/9501, Thu Island; 5 – *P. woodjonesi*, spec. 21/9501, Tho Chu Island; 6 – *Stylophora pistillata*, spec. 25/9501, Tho Chu Island

Pocillopora meandrina Dana, 1846

Fig. 13-3

Pocillopora meandrina: Dana (1846), Edwards and Haime (1860), Gardiner (1897), Studer (1901), Vaughan (1907), Veron and Pichon (1976),

Pocillopora nobilis: Verrill (1864), Quelch (1896), Studer (1901).

Pocillopora meandrina nobilis: Zou Ren-lin (1975)

Colonies are branched and often have a spherical shape. Branches are thick (15-25 mm) and flat, widening upwards, lateral branches are rare. The main branches are covered with numerous verrucae, at an angle of 30-45º with the branch and having 7-17 corallite calices. Corallites also cover all the rest of the surface of a colony.

Calices are small with vertical walls and flat floors. Septa can meet the needle-like columella in single corallites on the ends of branches. 12 septa are developed, which are poorly distinguished by cycles. They project as short ridges at the base of a calice wall, or as a row of small spines on its floor and the wall. Tabulae are bulging and widely spaced (not more than 5 per 3 mm). The coenosteum is covered with fine, small granulated denticles.

Living colonies are yellow or light brown.

Similar species *P. verrucosa* has relatively prominent verrucae.

Relatively common.

Remark. Probably the species is widely distributed throughout the entire Indo-pacific area, but appears under some other species names.

Location. Con Dao Islands, Tho Chu, Re Island, Khanh Hoa Province.

Distribution. Thailand, South Vietnam, Tuamotu and Eniwetok Atolls, Great Barrier Reef, Hawaii, depths from 0 to 20 m.

Pocillopora eydouxi Edwards and Haime, 1860

Fig. 13-4, C1-2

Pocillopora grandis: Dana (1846), Gardiner (1897).

Pocillopora elongata: Dana (1846).

Pocillopora eyudoxi: Edwards and Haime (1860), Vaughan (1907, 1918), Hoffmeister (1925), Yabe et al. (1936), Umbgrove (1939, 1940), Crossland (1952), Wells (1954), Scheer and Pillai (1983), Veron and Pichon (1976) cum syn..

Lamellar branched colonies. Branches are large (20-45 mm in diameter), flat, dichotomously branching and widening upwards up to 60-100 mm, additional branching is not observed. Branch surfaces are evenly covered with short verrucae, located at angle of 60-90º to the branch and having up to 30 corallites.

Calices have a depth of up to 2 mm with vertical walls and flat floors. Columellas are styliform and covered with small denticles. 12-18 septa of two orders are developed. Septa of the first cycle reach half of a corallite radius. The directive primary septa are distinguished by their size and can merge with the columella. Second order septa bulge in the form of short spines. Axial edges of septa are covered with thin irregular denticles. Tabulae are complete, slightly bulging, and widely spaced (eight per 10 mm). The coenosteum has numerous spikes with ends that are are finely granulated.

Living colonies are shades of yellow or brown.

Similar species *P. woodjonesi* has intercorallite coenosteum, which is covered with small denticles, often forming radial waves around calices edges.

Common.

Location. Cham, Thu, Re, Tho Chu, Con Dao Islands, reefs of Khanh Hoa Province.

Distribution. The Red Sea, Eastern Africa, Seychelles, Mascarene, La Reunion, the Maldives, Chagos Islands, Thailand, South Vietnam, Philippines, New Guinea, Fiji, the Marshall Islands, and the Great Barrier Reef, depths 0-30 m.

Pocillopora woodjonesi Vaughan, 1918

Fig. 13-5, C1-4

Pocillopora woodjonesi: Vaughan (1918), Veron and Pichon (1976).

Colonies are branched. Branches are large, rounded and fan-like. Branches do not branch further. Branches surfaces are evenly covered (at an angle of 90º) with short verrucae, having 10-17 corallite calices.

Calices are small with vertical walls and slightly bulging floors. The styliform columella is slightly flattened and noticeably widened towards the floor of the calice. Septa are of two cycles (12 septa) and almost of a uniform length, which is half of a corallite radius. The primary septa are distinguished by their size and merge with the columella. Septal edges are noticeably notched, lateral surfaces have a slight ornamentation. Tabulae are complete, slightly bulging, and widely spaced (12 lamellae per 10 mm of linear growth). Intercorallite coenosteum is covered with small denticles, often forming radial waves around calices edges.

Living colonies are light brown.

Similar species *P. eydouxi* has a similar shape but branches are bigger and more splayed.

Usually common.

Location. Reefs of Khanh Hoa Province, Re, Cham, Con Dao, An Thoi, Nam Su, Spratly Islands.

Distribution. South Vietnam, and the Great Barrier Reef of Australia, depths 2-15 m.

Pocillopora capitata Verill, 1864

Fig. C1-5

Pocillopora capitata: Verill (1864), Veron (2000).

Colonies form irregular mounds or are openly branched. Branches are tall and upright, almost cylindrical in section, becoming flattened towards the tip. Branch surfaces are evenly covered (at an angle of 90º) with short verrucae each having 12-20 corallites.

Verrucae are elongate but are of irregular size and are irregularly distributed on branches. The columella is styliform, well developed and covered with small denticles. The coenosteum has numerous spines which ends are finely granulated.

Living colonies are light brown.

Similar species *P. zelli* which has rregular branches and longer, less irregular verrucae.

Rare.

Location. Reefs of Khanh Hoa Province.

Distribution. South Vietnam, and the central Pacific, depths 2-15 m.

Pocillopora kelleheri Veron, 2000

Fig. C1-6

Colonies are branched and often have a spherical shape with prostrate branches that are usually evenly spaced. Colonies are usually attached on one side and do not form clumps. The main branches are covered with numerous verrucae. Verrucae are crowded and uniform in size. Corallites also cover all the rest surface of a colony. Calices are deep with vertical thick walls, they can merge adjacent walls. The columella is flattened and styliform can be small on the top part of branches.

Living colonies are light brown, rarely purple or green.

Similar species *P. eydouxi* has larger branches and *P. verrucosa*, which has less flattened branches.

Rare.

Location. Reefs of Khanh Hoa Province.

Distribution. South Vietnam and Japan, and the South-West Pacific, depths 2-15 m.

Genus *Seriatopora* Lamark, 1816

Type species: *Seriatopora subulata* Edwards and Haime, 1850.

Diagnosis. Ramose colonies with anastomosing thin branches, with ends that branch dichotomously at angles of 30-90º.. Numerous fine corallites are oriented in series along the branches. The columella structure is simple and lens-shaped. There are two cycles of septa and primary septa are clearly fused to the theca.

Seriatopora hystrix Dana, 1846

Fig. 14-1, C1-8

Seriatopora hystrix: Dana (1846), Edwards and Haime (1860), Bruggemann (1877), Quelch (1886), Studer (1901), Bedot (1907), Vaughan (1918), Yabe and Sugiyama (1932b, 1935b), Yabe et al. (1936), Umbgrove (1939, 1940), ossland (1952), Wells (1954), Stephenson and Wells (1955), Searle (1956), Nemenzo (1964), Chevalier (1968), Scheer and Pillai (1974, 1983), Veron and Pichon (1976) cum syn.

Growth form, corallite structure and skeleton peculiarities of *Seriatopora* colonies are highly variable. J.Veron and M. Pichon studied this species in detail and rather completely described the main features of *S. hystrix*, which are given below.

Colonies are formed by the mass of anastomising branches of a very variable shape, size and appearance. Branches are usually round in the lateral section, but sometimes they anastomose in flat lamellae, which are several centimeters in diameter. The following features are variable:

1. Branch diameter varies from 1.5 to 4.5 mm (10 mm below the tops) and 2.5-8 cm near the base of a colony.
2. The angle of branching varies from acute (approximately 30º) to right angles.

3. Branchs may taper slowly or abruptly to form sharp points, or may taper little and have blunt, rounded points.

The branching angle is probably the most variable feature. Large colonies usually have acute angles of branching in their center and right angles at the periphery. In these cases acute angles of branching are approximately equal, but right ones are not similar.

Cellular calices at the branch ends are tightly adjoined, and at a branch point they are oriented in series along branches. The columella is styliform or lens-shaped. Six short septa project from the theca. The directive septum is distinguished by its size. Septa of the second cycle are not always easily seen. Deep interseptal chambers are noticeable. The thecal edge usually supports a number of high needle-shaped spines, which form ornamentation rows between calices along branches on coenosteum.

Living colonies are shades of yellow-brown.

Similar species *S. caliendrum* has thicker branches which do not taper.

Common.

Location. Reefs of Khanh Hoa Province, Thu, Con Dao, Tho Chu, An Thoi, Cham, Re, Nam Su, Spratly Islands.

Distribution. Widely distributed throughout the entire Indo-Pacific area at depths from 0 to 55 m.

Seriatopora caliendrum Ehrenberg, 1834

Fig. 14-2

Seriatopora calendrum: Ehrenberg (1834), Dana (1846), Edwards and Haime (1860), Quelch (1886), Ortmann (1888), Von Marenzeller (1901,1907), Gravier (1911), Faustino (1927), Yabe and Sugiyama (1935b), Eguchi (1934), Yabe et al. (1936), Nemenzo (1964), Scheer (1967), Mergner and Schuhmacher (1974), Scheer and Pillai (1974, 1983), Veron and Pichon (1976), Nakamori (1986).

?*Seriatopora stellata*: Zou Ren-lin (1975).

Branching anastomosing colonies similar to *S. hystrix*, but of smaller sizes and with more compact branches. Branches are thicker (3-8 mm), with blunt ends, sometimes petaloid, flattenings are not observed. All these distinctions are seen in the same biotopes where both species live.

In principle calices of *S. calendrum* are similar to those of *S. hystrix*, but they have their own peculiarities: practically all calices have a hood on one side; more than six septa can always be found; deep interseptal chambers are also visible in practically all corallites.

Living colonies are shades of yellow-brown.

Similar species. See *Seriatopora hystrix.*

Uncommon.

Location. Thu, Con Dao, Tho Chu Islands, reefs of Khanh Hoa Province.

Distribution. It is widely distributed throughout the entire Indo-Pacific area at depths from 0 to 21 m.

Genus *Stylophora* Schweigger, 1819

Type species: *Madrepora pistillaris* Esper,1797.

Diagnosis. Septa of two cycles can be rarely observed. Six primary septa clearly diverge peripherally and reach the columella at the floor of a calice. Tabulae are plano-convex.

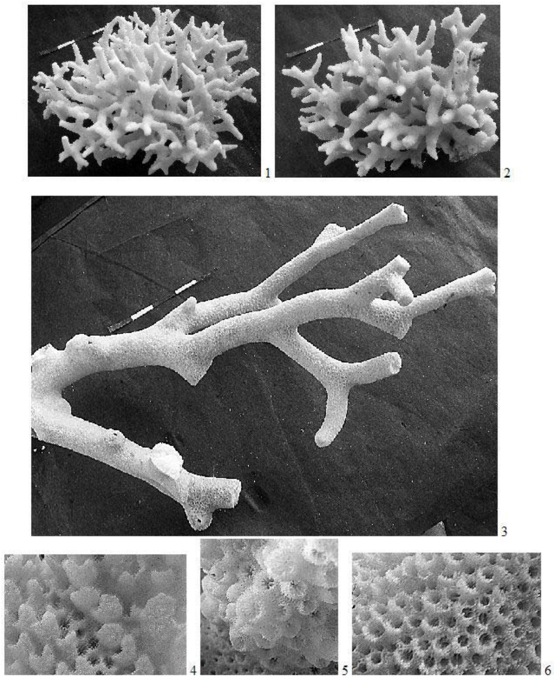


Fig. 14. Appearance of colonies. 1- *Seriatopora hystrix*, spec. 22/9501, Con Dao Island; 2 – *S. caliendrum*, spec. 23/9501, Con Dao Island; 3 – *Palauastrea ramosa*, spec. 26/9501, Con Dao Island; appearance of corallites, 4 – *Acropora squamata*, spec. 1/9577, Tho Chu Island; 5 – *A. fasciculare*, spec. 1/9678; Cape Danang; 6 – *A. papillare*, spec. 1/9679, Con Dao Island

Stylophora pistillata (Esper, 1797)

Fig. 13-6, C1-7, C16-6

Madrepora pistillaris: Esper (1797).

Porites subdigitata: Lamarck (1816).

Stylopora pistillaris: Esper (1797), Schweigger (1B19), Blainville (1830).

Stylophora palmata: Blainville (1830), Edwards and Haime (1857), Brüggemann (1879), Quelch (1886), Ortmann (1888), Gardiner (1898).

Porites pistillate: Eaper (1797), Ehrenberg (1834).

Sideropora mordax: Dana (1846).

Sidepora pistillata: Esper (1797), Dana (1846).

Stylophora digitata: Pallas (1766), Edwards, and Haime (1857), Studer (1881), Quelch (1886), Bassett-Smith (1890), Gardiner (1898), Whitelegge (1898), Bedot (1907).

Stylophora pistillata: Esper (1797), Edwards and Haime (1857), Ortmann (1888),Bassett-Smith (1890), Gardiner (1898), Von Marenzeller (1901, 1907), Gravier (1911), Vaughan (1918), Faustino (1927), Thiel (1932), Yabe and Sugiyama (1932b, 1935b), Eguchi (1934), Yabe et al. (1936), Umbgrove (1939, 1940), Crosaland (1952), Wells (1954), Rossi (1954), Nemenzo (1964), Scheer (1964,1967), Eguchi (1968), Chevalier (1968), Veron and Pichon (1976), Scheer and Pillai (1983 cum syn.), Nakamori (1986).

Stylophora stellata: Verrill (1864), Ortmann (1888).

Stylophora prostrate: Queich (1886), Bassett-Smith (1890).

Stylophora cellulosa: Queich (1886), Faustino (1927).

Stylophora septate: Gardiner (1898), Crossland (1952).

Stylophora mordax: Vaughan (1918), Yabe and Sugiayma (1935a,b), Eguchi (1934),Yabe et al. (1936), Umbrgove (1939), Vaughan and Wells (1943), Wells(1954), Scheer and Pillai (1974), Krasnov and Latypov (1978).

Colonies are branched, with very variable shaped and sized branches, branching dichotomously at their outer ends. They can be long (60-100 mm) and thin (6-16 mm) or wide (12-50 mm) and short (25-50 mm), or very short, not more than 10 mm, merging in a submassive colony. Branch ends are wide and round. Small corallites are evenly distributed throughout the entire colony, merging in cellular corallites on the upper ends of branches.

Calices (1-1.5 mm diameter) have a hood on one side. They are deep on the branch ends (2 mm), whereas on branches and near the branch bases they are shallower and have thicker skeletal elements. The columella is simple and styliform. Two septal cycles are developed in many corallites. They reach 1/3-2/3 of the corallite radius, and can reach the columella on the calice floor. The directive septa are distinguished by their enlarged sizes. Tabulae are complete and flat, or weakly bulging and widely spaced (two lamellae per 1 mm). The coenosteum is densely covered with thin, short needle-like spines.

Living colonies are yellow, pale-yellow, cherry-red, and brown.

Location. Everywhere from the Gulf of Siam to the northern Gulf of Tonkin.

Distribution. Widely distributed throughout the entire Indo-Pacific area at depths from 0 to 40 m.

Stylophora subseriata (Ehrenberg, 1834

Fig. C24-8

Colonies have broad (up to 22 mm in breadth and 10 mm thikness), irregular, slightly anastomosing branches with slightly blunt ends. Branches have suborthogonal form. Corallites are prominent but do not have prominent hoods.

Calices are little 1 mm, submerged edged of small hillok, which are densely covered of coenosteum spinules. They have style-like columellae and six primary septa. They reach 1/3 of the corallite radius, and do not reach the columella. The coenosteum is covered by fine spinules. Tentacles are often extended during the day.

Living colonies are uniform cream or yellow, occasionally greenish.

Similar species S. kuehlmanni and S. pistillata, which can have fine branches but only in deep or turbid water.

Common.

Location. Namsu and Thu Islands, dept 6-10 m.

distributed throughout the entire Indo-Pacific area at depths from 0 to 40 m.

Genus *Palauastrea* Yabe and Sugiyama, 1941

Type species: *Palauastrea ramosa* Yabe and Sugiyama, 1941

Diagnosis. Colonies are ramose and plocoid, branches frequently branch dichotomously in the course of growth. Small corallites are irregularly arranged around branches. The styliform columella is well developed. Septa are in two cycles.

Palauastrea ramosa Yabe and Sugiyama, 1941

Fig. 14-3

Palauastrea ramosa: Yabe and Sugiyama, 1941, Veron and Pichon (1976).

Palauastrea ramosa iwayamaensis: Yabe and Sugiyama (1941).

Branched colonies with round (0.8-1.5 cm) branches repeatedly branching dichotomously (3-8 times) during the growth process. Terminal branches are short, somewhat flat or bumpy. Small corallites densely cover branch surfaces.

Calices are superficial with slightly prominent thecal edges. The columella is well developed. It is styliform, extending near the floor up to 1/3 or ½ of the calice diameter. Septa are of in cycles, but only six primary septa reach columella at the floor of the calice. Secondary cycle septa are half as long. All septa rise slightly over the edge of the calice. The total number of septa is 12. The coenosteum is densely covered with simple spines.

Living colonies are light brown spotted with pale-yellow oral disks.

Similar species. *Palauastrea* is most readily confused underwater with the much more abundant poritid *Porites cylindrica* which may have exactly the same colony shape. Corallites of *Palauastrea* resemble those of *Stylocoeniella* without the coenosteum styles, but these genera are readily distinguished by their different growth-forms (part Veron, 1986).

Rare.

Location. Con Dao, Spratly Islands.

Distribution. South Vietnam, Socotra, Palau, South Japan, and the Great Barrier Reef of Australia, depth 1.5-16 m.

Genus *Madracis* Edwards and Haime, 1849

Type species: *Madracis asperula* Edwards and Haime, 1850.

Diagnosis. Encrusting, submassive, plocoid, and sometimes ramose colonies. Branching is weakly developed in the form of bumps or prominences. Corallites are rounded - polygonal with distinct walls. The columella is dense, merging with septa, which are not divided by cycles.

Madracis kirbyi Veron and Pichon, 1976

Fig. 10-3, 12-2

Encrusting and encrusting-massive colonies with small bumpy-nodular branching. Corallites are cerioid and polygonal, medium-sized, with a diameter of 1.8-3 mm.

Calices are polygonal with deep interseptal chambers with clear walls, on which rows of spikes and grains, sometimes merging in curving dotted lamellae, can be clearly seen. The columella is well developed. It is fused with the septa and bulges in the form of a pointed hillock. Thin lamellate septa (8-18 septa) reach the center of a corallite, merging with the columella. Usually one septal paliform lobe bulges on every septal lamella. Septa of the second cycle sometimes protrude as a small spine on the calice wall.

Living colonies are shades of green and brown.

Similar species *M. decactis* has relatively uniform branches and corallites.

Relatively rare.

Location. Baitylong Archipelago, Con Dao, Tho Chu, Re, Thu Islands.

Distribution. Thailand, Vietnam, Tuamotu, and the Great Barrier Reef of Australia, depth 5-25 m.

3.4. Acroporidae

Family Acroporidae consists of four genera – *Montipora*, *Acropora*, *Astreopora* and *Anacropora*. The latter genus includes several species, which at the present are known mainly on the reefs of Australia and Philippines. One *Anacropora* species has been found on some reefs of the Spratly Archipelago and the Indian Ocean. Whereas corals of the first three genera, being only 3.79% of the generic structure of reef-building scleractinians, substantially determine their species diversity on practically all reefs of the Pacific and Indian Oceans, and compose 39.89% of more than 1500 nominal species of the Indo-Pacific area. *Acropora* and *Montipora* have the greatest taxonomic diversity of all scleractinians of the Indo-Pacific area: 364 and 211 nominal species, respectively (80-85 and 48-50 of valid species). Acroporids are able to have all the growth forms known for hermatypic corals. Branching and lamellar colonies of *Montipora* and *Acropora*, and particularly the latter ones, are able to constitute dense populations on reef flats and reef slopes, which can extend along reefs for many hundreds of square meters.

Being distributed everywhere and having a leading part in reef-formation, at the same time acroporids are the most difficult for identification. The extremely variable growth form of the colonies – from massive encrusting to finely branching forms, small corallites, quite similar for all representatives of the family, the small number of "good" diagnostic features, permitting one to distinguish one species from another one, result in the fact that many species often have 5-10 synonymous names. The number of nominal species of *Acropora* and *Montipora* is 4-5 times greater than that of the number of valid species in those genera. The acroporids of the Great Barrier

Reef (Australia), the Philippines, Japan, the Maldives, and the Red Sea have been described and redecribed in the modern times, and species lists of the Seychelles Islands have been revised, but in many regions the species composition of acroporids, as well as that of the other scleractinians, still contains many synonyms, or, on the contrary, is far from being complete and contains only the main species.

Acroporids, except for *Anacropora*, are distributed on all the reefs of Vietnam from the northern islands of the Gulf of Tokin to the islands and banks of South Vietnam, including the Gulf of Siam. They constitute about one fourth of the species composition of all Vietnamese reef-building scleractinians, inhabiting all reef zones. Some branching *Acropora* and *Montipora* form vast mono-specific stands in shallow waters of Vietnamese reefs, which cover 100% of the substrate. Colonies of *Acropora* and *Montipora* of lamellar-trochal growth forms are often wedged in such colonies, or sometimes they replace them. On a reef-slope they can form multilayered constructions.

3.4.1. Taxonomic history

The genus *Montipora* was established by H.Blainville in 1830 (Blainville, 1830) though the description appeared in 1833 (Quoy and Gaimard, 1833). J. Dana (1846) discussed such corals under the name *Manopora*. He included 29 species in this genus, 16 of which were new ones. M. Edwards and J. Haime again revised *Montipora*, restored its status, and included species of other genera, especially that of *Porites* (Edwards and Haime, 1849, 1850).

H. Bernard (1897), discussing the confusion with identification of *Montipora* type species, came to the conclusion that *Montipora obtusata* Quelch, 1866 can be identified as the type of the genus. He studied the *Montipora* collection of the British Museum (presumably 135 species), described it in detail, re-described and systematized it. Describing *Montipora* species, Bernard divided them into five main groups according to the morphology of their colonies: glabrous, glabro-foveolate, foveolate, papillaete, and tuberculate. The latter three had further subdivisions. Bernard described and re-described a total of 89 nominal *Montipora* species, which make up 75% of all species of this genus.

After Bernard, issues of nomenclature of some species and partially revision of the genus *Montipora* were dealt with by T.Vaughan (1918), C. Crossland (1952), J. Wells (1954), and F. Nemenzo (1967). Nevertheless, corals of this genus, which is the second most diverse genus, were described mainly based on a small number of specimens without the study of their variability in natural conditions. That is why the majority of them retained their unexplained problems of synonymy, problems of geographic and genetic variability in the given region.

J. Veron and C. Wallace (1948) re-considered the majority of type specimens (holotypes, syntypes) of *Montipora*. Based on the data they obtained, and investigating variability of these corals on the basis of facts of their own observations on the Great Barrier Reef, these researchers made a revision of most of the nominal species names. After Bernard, these authors subdivided morphologically all *Montipora* into five types. When describing *Montipora*, they used new terms – papillae and tubercule – for the series of structures formed on coenosteum. Veron and Wallace described 36 species of *Montipora* from the Great Barrier Reef, two of which were new ones. Numerous other names were placed in synonymy with these 36 species.

Anacropora was distinguished as an individual genus by S. Ridley in 1884 (Ridley, 1884). Nine nominal species are known, and four of them are synonymous by their type specimens with *Anacropora forbesi* Ridley, 1884 (Veron and Wallace, 1984). The rest of the species can be differentiated clearly enough systematically. Veron and Wallace, describing *Anacropora* of the Eastern Australia, briefly considered taxonomic problems of all known species of this genus, and showed synonymy of some species with respect to the others (Veron and Wallace. 1984).

Perhaps *Acropora* is one of the most important coral groups among scleractinians, having the largest number of species and the greatest importance in reef-formation of the reefs of the Pacific and Indian Oceans. No wonder that genus *Acropora* has the greatest number of taxonomic problems of any genus of corals. Due to their wide polymorphism, extraordinary diversity of variations of colony shapes (forms) even within the same biotope, not to mention geographical variability and variability due to environmental fluctuations, *Acropora* species are one of the most difficult to identify. Suffice it to say that the status of genus *Acropora* Oken, 1815 was restored by the International Committee on Zoological Nomenclature only in the second half of the XXth century (Boschma, 1961; China, 1963), though many researchers after A.Verrill (1902), who provided grounds for restoration of replacement of *Madrepora* by *Acropora*, applied the latter genus mane.

At the first stages of investigation of a large group of branched corals with numerous similar corallites, densely covering colony branches, they were described mainly under the generic name *Madrepora* (Lamark, 1816; Ehrenberg, 1834). The first attempt to systematize branched madrepores was undertaken by J. Dana (1846). He described and re-described 64 *Madrepora* species, based on his own observations and on investigation of museum collections. When classifying these corals, Dana emphasized colony shape and construction of radial corallites. This researcher distinguished seven (non-taxonomic) groups of colonies: from lamellar to branched:

1. Horizontal or inclined leaflike colonies without regular branching on top.
2. Horizontal or inclined colonies with straight or upwards rising branches.
3. Conical colonies, straight, densely subdivided branches with short nariform corallites.
4. Arborescent colonies with proliferous branching.
5. Arborescent or bushy colonies.
6. Arborescent colonies with long stems diverging from the common base, single branches or rarely branching.

7. Colonies consisting of straight lamellae instead of real branches, axial corallites are not developed.

Edwards and Haime, describing not only modern, but also fossil corals, used approximately the same principles of *Madrepora* subdivision (Edwards and Haime, 1850, 1857-1860). They distinguished five *Madrepora* groups according to the mode of colony formation, and rarely applied corallite construction for this purpose:

1. Arborescent colonies, short or moderately exsert corallites.
2. Arborescent colonies, tubular and very long corallites.
3. Arborescent colonies, having a shape of rosettes or tufts.
4. Caespitose or vase-form colonies.
5. Plate-like and scarcely branching colonies.

Early investigations of *Madrepora* corals were more descriptive than taxonomic. It was the process of accumulation of isolated data, and the first attempts to interpret and classify the materials.

The first monographic investigation of *Madrepora* was conducted by G. Brook at the end of the XIXth century (1893). He critically examined the schemes of the previous researchers (Dana, 1846; Edwards and Haime, 1860; Klunzinger, 1879), showing that they were based only on colony habitus, and many of their subdivisions of colony types overlapped in the distinguishing features. Taking into account distinctions in colony shape, skeletal peculiarities of corals, and analyzing their variability, Brook re-described all known species, and described 93 new species from the collection of the British Museum. He divided all species into ten subgenera within the *Madrepora* genus, using the following features: 1) colony habitus; 2) shape of radial corallites; 3) condition of the corallites' surfaces; 4) degree of grouping of colony branches; 5) form of original growth of colonies – encrusting or stem-like; 6) sizes and shapes of axial corallites. Despite the fact that Brook did not investigate *Madrepora* in natural conditions and his descriptions were based on museum collections, many species identified by him are used by taxonomists today.

In the first half of the XX th century *Acropora* were investigated in detail together with the other scleractinians by many researchers (Vaughan, 1918; Hoffmeister, 1925; Crossland, 1952; Wells, 1954); however there were no special works devoted to just *Acropora*. C.Wallace was actually the first researcher who studied *Acropora* in situ and type material in museum collections (Wallace, 1978). She revised *Acropora* of the Great Barrier Reef of Australia, described 41 species and synonymized about 100 species. Wallace thought that the main features characterizing a genus are the form of colony branching due to lengthwise growth of axial polyps, and peculiarities of budding of radial polyps. She distinguished 6 varieties of the main colony forms, and 14 forms of radial corallites and ways of their budding from the wall of the axial corallite, and used these features when identifying and describing species.

Wallace's work became the basis of revision of all *Acropora* by Veron and Wallace based on the investigation of these scleractinians in natural conditions on the Great Barrier Reef of Australia and all type materials of museum collections (Veron and Wallace, 1984). Australian researchers provided a list of all known *Acropora*, which included 364 species with information on their habitats. Studying variability in detail, they showed that many tens of species were synonyms of those described earlier.

Emphasizing that *Acropora* have the greatest number of taxonomic problems among the Scleractinia, Veron and Wallace distinguish the following difficulties of their identification and taxonomy:

a. Many of 364 nominal species (not including 24 fossil ones) have no original descriptions, and even type specimens may have no such necessary data such as type location and depth.

b. Zoogeography of the species is more intricate than that of the other scleractinians. Thus, among Eastern Australia *Acropora* there are endemic species and species widely distributed throughout the entire Indo-Pacific, as well as species dwelling in one or several isolated regions, but rare for the other regions. And in every case one encounters the problem of establishing either geographic variability or geographic subspecies.

c. In some field situations the presence of rare species is usually masked by the presence of one or more similar common species. Such rare species ususlly can be identified in situ only in case when they have clear distinctions or they are widely distributed in a specific biotope or in a specific geographic situation, where the low species diversity can be observed.

When classifying and describing *Acropora* species, Veron and Wallace used as main features the mode of colony formation, nature of budding of radial corallites and the shape of their calice, as well as the morphology and structure of the coenosteum, and other features which are normal for scleractinians: construction of vertical and horizontal skeletal elements. They used and distinguished 15 variants of colony formation, 11 variants of budding and shapes of radial corallites and inclination towards the axial corallite, and 5 variants of coenosteum structure. All together these researchers described 73 species, and 11 of them for the first time. All species were united in 14 non-taxonomic groups according to colony shape and in two subgenera of genus *Acropora: Acropora* (*Isopora)* and *Acropora* (*Acropora*).

Genus *Astreopora* was introduced by H. Blainville in 1830 (Blainville, 1830), when isolating four species of this genus from the genus *Astrea* (Lamark, 1816). In the following years the genus was enlarged by other species (Dana, 1846; Verrill, 1872; Gardiner, 1898; Hoffmeister, 1925; etc.). Minor revisions and re-identifications of species on the basis of field investigations and investigations of type species were conducted in the first half of the XXth century (Yabe and Sugiyama, 1941; Wells, 1954).

Revision of all 19 nominal *Astreopor*a species, based on investigation of his own materials from more than 100 Indo-Pacific reefs and on museum collections, was conducted by A. Lamberts (1982). He briefly considered the history of study of these corals, paying special attention to the methods of *Astreopora* classification by different authors, and stressed their rather considerable differences in opinions. Speaking about the investigation methods, Lamberts enumerated 12 morphological and ecological features, which were taken into account by him when describing and identifying *Astreopora*. While considering in detail the anatomy and morphology of corals and their variability, he reduced 19 species to 9 with synonyms and described 1 new species. In an earlier paper (Lamberts, 1980), he described 2 additonal species.

Somewhat later Veron and Wallace (Veron and Wallace, 1984), describing *Astreopora* of the Great Barrier Reef, gave a list of 27 nominal species with their type location. They re-described 5 species (instead of the former 12 due to synonyms), and described 2 new ones. When describing the species these authors pointed out possible synonyms among many other nominal species.

In the fundamental monography " Corals of the World " (Veron, 2000) J. Veron has described more than 260 species Acroporidae (Acropora -170 species, Montipora -73 species).

3.4.2. Terminology and morphology

Since acroporids are one of the most complicated coral groups, it is necessary to pay special attention to peculiarities of terminology and construction of skeletal elements, used in identification and systematization of corals of this family.

Acroporids do not have or have rudiments of many skeleton elements, which are usually used in species identification and investigation of variability of most other corals: columellae, dissepiments, and septal structures. That is why colony shape, modes of branching, features of coenosteum structure, construction of axial and radial corallites and their interrelations serve as the main characteristics for identification of genera and species.

Most *Montipora* species have massive or massive-encrusting colony shapes. For some species colony shape can vary from horizontally-lamellar to digitate-branching and subarborescent even within the same biotope. In such cases colony shape as a distinguishing feature can be used together with the other characteristics, and primary among these are peculiarities of a corallite form (shape) together with coenosteum structure.

Coenosteum consists of a basal formation termed reticulum, as well as a series of combined coenosteum structures, distributed among corallites and termed papillae and tuberculae. Papillae protrude in a form of digitate branchlets on the surface of the reticulum, having a diameter equal or less than that of a corallite (Fig. 15). Papillae may surround corallites (thecal papillae), or may be scattered independently of the corallite (reticular papillae). Both types of papillae can be simple or compound.

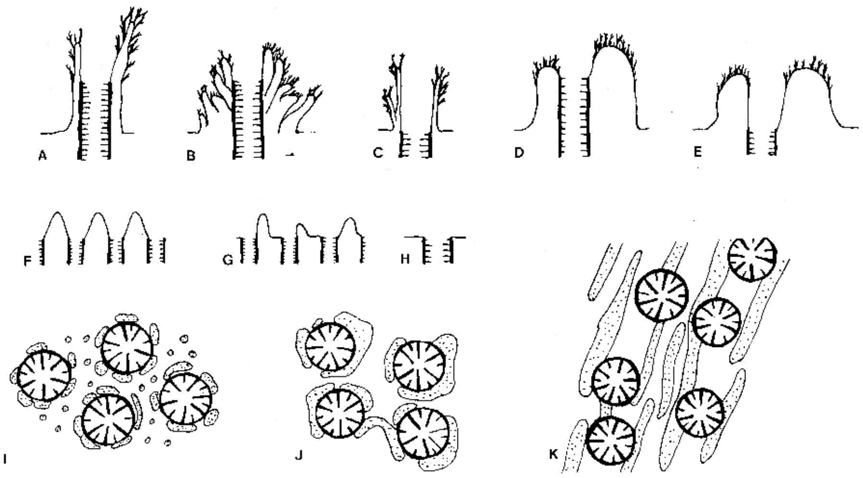


Fig. 15. Diagrammatic transverse (A-H) and surface (I-K) views of *Montipora* corallites and associated coenostial structures. (A) simple papillae with exsert corallite, (B) compound papillae with exsert corallite, (C) simple papillae with immersed corallite, (D) tuberculae with exsert corallite, (E) tuberculae with immersed corallite, (F-H) foveolate, tuberculate and glabrous corallites (respectively), (I) corallites with thecal and reticulum papillae, (J) corallites with thecal tuberculae, (K) corallites with reticulum tuberculae forming ridges(according to Veron, Wallace, 1984).

Tuberculae can be thought of as large papillae with sizes can be several times the diameter of the corallite. Tuberculae often merge in rows, ribs or can be thecal or reticular like papillae, i. e. they can surround corallites or be dispersed among them. Reticular tuberculae, having a dome-like shape and similar sizes, resemble the verrucae of *Pocillopora*. The tuberculae of *Montipora* differ from the verrucae of *Pocillopora*, where are covered with corallites.

Corallites of *Montipora* can be immersed or exsert above the coenosteum. They can have or lack thecal papillae or tuberculae. Immersed corallites can be deeply embedded in reticulum in such a way that the latter forms the upper corallite wall, which is usually funnel-shaped. Such corallites are termed foveolate. Corals without any additional structures in reticulum are termed glabrous.

Usually all coenosteal structures, forming a spongy matrix, are extensively covered by outward projecting trabecules, called spinules. The latter usually have elaborated tips, as a rule, typical for all acroporids.

Anacropora also have the same construction features as *Montipora*, but they form arborescent and subarborescent colonies with regularly located corallites on the branch surface. The coenosteum of these corals has similar construction for all species and consists of thin tall spinules with complexly branching top ends, without the formation of tuberculae. Despite good branching, *Anacropora* have no axial or specialized radial corallites. Corallites of *Anacropora* are immersed or protrude slightly from undifferentiated coenosteum.

The main feature which distinguishes *Acropora* from *Anacropora*, as well as from all the other scleractinians, is the formation of two types of corallites – axial and radial, which differ morphologically and functionally.

Axial corallites start growing from the base of a colony and grow upwards with different rates, diversely orienting in space according to the genetic ability of each species in certain environments. Growing fixed on branch ends in different directions, they form branched and branched-lamellar colonies, and never form massive colonies. Radial corallites bud from the lateral surface of axial corallites at different angles and with different spacings, and have different corallite shapes. Their growth in the aggregate forms that diversity of colony shapes which is typical for *Acropora*. The main shapes of *Acropora* colonies are termed arborescent, hispidose, corymbose, caespitose, digitate, and lamellate (Fig. 16).

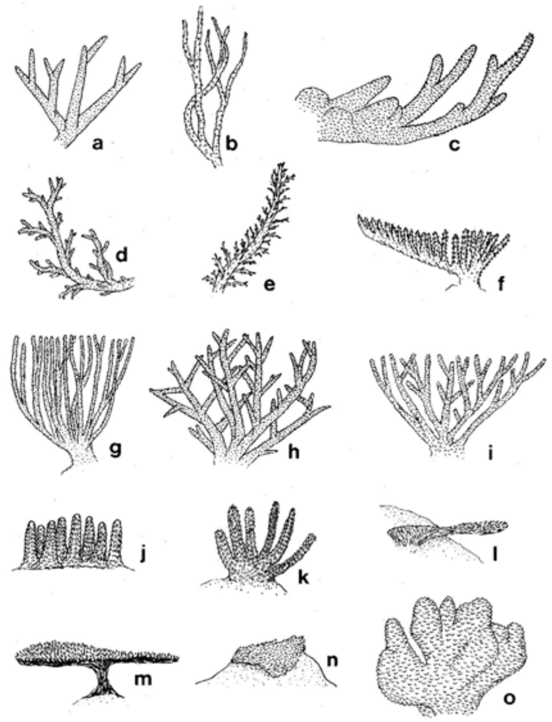


Fig. 16. Shapes of *Acropora* colonies a, b – arborescent, c – sub-arborescent, d, e – hispidose, f, g – corymbose, h - caespitose, i – caespito-corymbose, j - digitate, k – sub-digitate, l, m – plate-like, n – encrusting, o – branches plate-like to wedge-shaped (according to Veron, Wallace, 1984).

Radial corallites have a great morphological diversity. They can be short or long, they can diverge from an axial corallite at right angles or at other angles. Corallites can have a straight or oblique tubular shape; they may be nariform or resemble a bulging lip. They may be far from the surface of an axial corallite, may directly adjoin it or be immersed. Various corallite shapes and their terminology are given in Fig. 17.

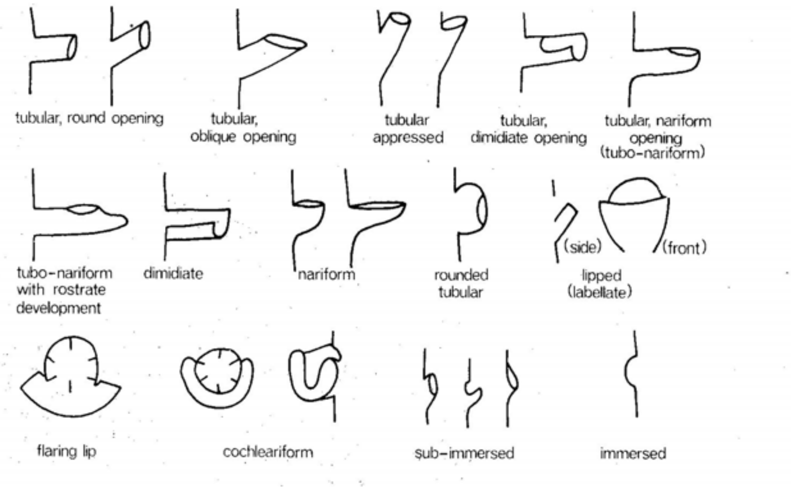


Fig. 17. Radial corallite shapes of Acropora and their nomenclature (according to Wallace, 1978).

Acropora skeleton structure is much simpler compared to other genera. They have no columellae or various septal reinforcements. A simple structure consisting of three septal cycles develops in the calices. Every element of these septal cycles is connected with trabecular lobes. Radial elements, passing through one or several concentric theca, form a row of trabecules, closely connected to synapticula.

Three complete septal sets develop in a small number of corallites. Usually one or both directive septa and several metasepta, located symmetrically to the main ones, are well developed. Septa are developed better, as a rule, in axial corallites.

When describing species, the following features are usually used: characteristics of axial corallites, corallite shapes, development of septal apparatus in calices, sizes of outer and inner diameters, wall thickness, morphology of main septa, septa of the first and second orders. That is why it is appropriate to provide a schematic illustration of axial and radial corallites with an indication of the main skeletal elements and the locations of measurements (Fig. 18).

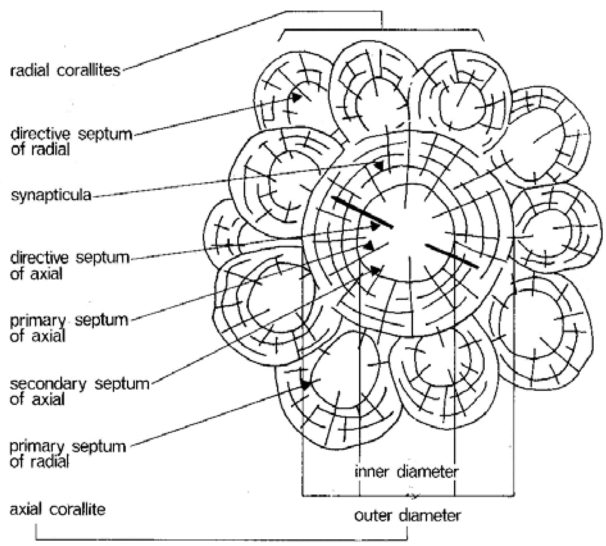


Fig. 18. Diagrammatic representation cross section of corallite indicating features used in the description of species (according to Wallace, 1978).

Morphologically *Astreopora* are distinguished among the other acroporids by the fact they they are found mainly as massive colonies with large numerous corallites and reticular coenosteum having a spiky surface. When describing and identifying the species, the sizes and shapes of corallites, their number per colony surface unit; sizes and degree of thickness of primary septa, the character of metasepta development; and the simplicity or complexity of the coenosteum spines split are used.

3.4.3. Family Acroporidae Verril, 1903

Massive and ramose colonies with extratentacular budding. Corallites are small, with synapticulatheca. Septa are of two cycles, rarely exsert over the calice, formed by simple needle-like trabeculae, rising inside and upwards from the wall. Columella is absent or it is weak and trabecular. Coenosteum is not distinct, weakly-reticulated, usually with spinous or striated surface. Genera *Montipora*, *Anacropora*, *Isopora*, *Acopora* and *Astreopora*.

Genus *Montipora* de Blainville,

Type species. *Montipora verrucosa* (Lamarck, 1816).

Diagnosis. Submassive, foliate, ramose or encrusting colonies without axial and radial corallites. Septa of the first cycle are always developed, columella is weak or absent. Coenosteum is reticular, with straight vertical trabeculae, as a rule with well developed papillae and tubercula, the surface is spinose.

Montipora monasteriata (Forskål, 1775)

Fig. 19-1, C24-3

Madrepora monastreriata Forskål, 1775.

Montipora capitata (Dana, 1846).

Montipora incrustans Bruggemaim 1877 (pars).

Montipora tuberoulos (Lamarck); Klunzinger (1879.).

Montipora lanuginosa Bernard, 1897; Yabe and Sugiyama (1935).

Montipora sinensis Bernard, 1897; Yabe and Sugiyama (1935).

Montipora fungiformis Bernard, 1897; Studer (1901).

Colonies are massive or thick-lamellar, which can be bifacial or have epitheca in the marginal parts.

Corallites are evenly distributed throughout the colony surface, and they have uniform sizes of 0.6-0.7 mm in diameter. Sometimes corallites can in groups of 4-7 in curving rows between tubercula. Septa of the first cycle are complete, up to 2/3 – 3/4 of a corallite radius, and consist of dentate laminae or a row of spines, which can be irregular. Second cycle septa rarely have a complete set, they do not exceed 1/3 of a corallite radius and are variable in size. The reticulum is coarse and regularly covered by papillae and tuberculae up to 0.4-1.6 mm in diameter. Tuberculae can merge and form rows, perpendicular to the marginal part of a lamellar colony. Papillae and tuberculae can be absent on bulging colony parts, and then corallites will be separated by a spongy reticulum. All papillae and tuberculae are covered by branching spinules.

Living colonies are brown.

Similar species *M. tuberculosa* has smaller corallites and smaller papillae.

Uncommon.

Location. The Gulf of Tonkin, Dao Chao Island.

Distribution. Widely distributed from the Red Sea to Hawaii.

Montipora tuberculosa (Lamarck, 1816)

Fig. !9-2, C2-5[1]

Porites tuberculosa Lamarck, 1816

Montipora tuberculosa (Bernard, 1897, pars), Hoffmeister (1925)

Montipora mammifera Bernard, 1897

Submassive colonies, encrusting or lamellar, with irregularly tubercular surface.

Corallites are 0.35-0.7 mm in diameter, and immersed. They are evenly distributed throughout the colony surface and surrounded by thecal papillae. In some colonies corallites can be surrounded by conical papillae or merge in an incomplete circle. Septa of the first cycle are complete, up to ¾ of a corallite radius. They are represented by rows of spines, sometimes flattened and merging into laminae, which project somewhat over the corallite. The directive septa, as a rule, are distinguished by their larger sizes. Septa of the second cycle can have a complete set, but are reduced and do not reach lengthwise more than 1/3 of a corallite radius. Reticulum is papillate. Papillae are covered by exsert spinules, with tips that are usually complexly branched.

Living colonies are brown and green.

Similar species *M monastreara* has tuberculae possible merge and form rows, perpendicular to the marginal part of a lamellar colony.

Common.

Location. Everywhere in Vietnam.

Distribution. Known throughout the entire Indo-Pacific.

Montipora hoffmeisteri Wells, 1954.

Fig. 19-4

Montipora hoffmeisteri Wells, 1954, Veron and Wallace (1984)

Submassive colonies, thick-lamellate, with tubercular surface, and epitheca on the lower surface. Corallites, reaching 0.9 mm diameter, are immersed with well-distinguished thecae. They are usually in groups of 7 between tuberculae, but they may be on their tops and on their lateral surfaces.

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[1] Color figures 2 -23

Septa of the first cycle are complete, up to 2/3 of a corallite radius. They are represented by rows of spinules not always forming laminae. Second cycle septa are not more than 1/3 of a corallite radius, they consist of rows of small spines. Complete sets are rare, or there may be no complete sets. Reticulum is uniform, of a moderate coarseness, is covered by conical tubercules of 2-4 mm diameter. Spinules tops are branched.

Living colonies are brown.

Similar species *Montipora floweri* has smaller corallites which are evenly distributed.

Relatively common.

Location. Re Islands, Con Dao, Khanh Hoa Province, Gulf of Siam.

Distribution. Vietnam, the Marshall Islands, western and eastern Australian coasts.

Montipora turgescens Bernard, 1897

Fig. 19-6, C19-1

Montipora caliculata (Dana): Vaughan (1917), not Dana (1816)

Montipora profunda Bernard, 1897

Colonies are massive or hemispherical, lamellate or columnar. Surface is sculptured, covered by bulging subcircular tubercules of 3.5-10 mm diameter.

Corallites, having 0.7-0.9 mm diameter calices, are evenly distributed between the tubercules. The thecal rim is usually quite distinct. Septa of both cycles reach ½ to 2/3 of a corallite diameter. Some of them can be flattened in the periphery. When forming regular rows of spinules, septa have similar sizes. Directive septa are larger. The reticulum is undifferentiated, spongy, with complexly branched spine tips.

Living colonies are usually brown.

Similar species *M. mollis* has smaller, more widely spaced corallites.

Common.

Location. Usually known on reefs from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Known from the western part of the Indian Ocean to Samoa Islands.

Montipora millepora Crossland, 1952

Fig. 19-3

Montipora millepora Crossland, 1952: Veron and Wallace (1984) cum syn.

Colonies are massive, cake-shaped, massive-encrusting. Their surface has considerable relief and covered by mastoid tubercules.

Corallites are small. They are regularly distributed throughout the colony surface, having calices not more than 0.6 mm diameter. The thecal rim is distinct. As a rule, septa of both cycles are present. Septa of the first cycle form a complete set. They are represented by rows of thick spines, often merging in dentate laminae, reaching 2/3 of a corallite radius. Second cycle septa can be complete or incomplete, sometimes they can be absent. Lengthwise they do not exceed half of a corallite radius. The directive septa are distinguished by their slightly larger sizes. The reticulum is spongy, moderately thin, with frequent thin and weakly branched spinules.

Living colonies are usually deep green.

Similar species *M. hoffmeisteri* has uniform reticulum of a moderate coarseness, which covered by conical tubercules.

Relatively rare.

Location. Re, Phu Quy, Tyaklon, Nam Su Islands.

Distribution. Vietnam, Ryukyu Islands, western and eastern coasts of Australia.

Montipora molis Bernard, 1897

Fig. 19-5

Montipora molis Bernard, 1897

Montipora saxea Berbard, 1897

Montipora turgescens Berbard; Vaughan 1918)

Montipora tertia Crossland, 1952

Montipora cristagalli Ehrenberg: Bernard 1897).

Colonies are lamellar, encrusting-lamellar, and often bilfacial. The surface is even along the colony margin and mainly uneven in its central part. Corallites regularly cover the entire colony surface. They have a clearly distinct theca with a calice diameter of 0.5-0.7 mm. In the colony periphery corallites can be in groups of 4-7 between the rows of reticular tubercules.

Septa of the first cycle are well developed. They are represented by flattened dentate laminae, which can weakly project near the upper calice edge, reaching ¾ of a corallite radius. Second cycle septa are represented by small spines, not exceeding lengthwise half of a corallite radius. They can be incomplete or absent. The directive septa are mainly by their larger sizes. The reticulum is spongy and consists of thin spinules. Low rows of conical reticular tubercules, sometimes branching, are formed along the margins of laminar colonies.

Living colonies are shades of brown.

Similar species. See *M. turgescens*.

Location. Con Dao Island.

Distribution. South Vietnam, Ryukyu Islands, western and eastern coasts of Australia.

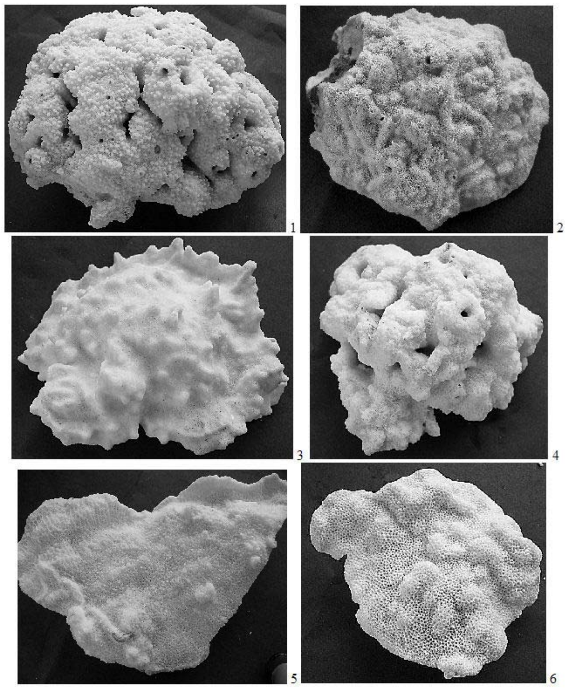


Figure 19. Appearance of colonies. *Montipora monasteriata*, spec. 1/9502, Namsu Island; 2 – *M. tuberculosa*, spec. 1/9503, Tho Chu Island; 3 – *M. millepora*, spec. 1/9504, Thu Island; 4 – *M. hoffmeisteri*, spec. 1/9505, Tyaklon Island; 5 – *M. mollis*, spec. 1/9506, Tyaklon Island; 6 – *M. turgescens*, spec. 1/9507, Thu Island

Montipora spumosa (Lamarck, 1816)

Fig. 20-1

Porites spumosa Lamarck, 1816

Montipora spumosa (Lamark): Vaughan (1918)

Montipora guppyi Bernard, 1897

Montipora coalita Nemenzo, 1967

Colonies are encrusting or irregular vertical laminae, protuberances or uneven columnar branchlets, rising from encrusting basis. The colony surface is hilly and highly divided.

Corallites are distributed non-uniformly, and as a rule are distant from each other. They are deeply immersed, without a theca. Calice diameters are 0.7-0.8 mm. Septa of the first cycle are well developed. They are always represented by a complete set, are distant from each other and irregularly distributed in the shape of flattened spines, reaching 2/3 of a corallite radius. Second cycle septa are incomplete or absent. They have the shape of small spines, reaching not more than half of a corallite radius. Directive primary septa are distinguished by their slightly larger sizes. The reticulum is weak with a regular surface structure. Irregular tubercules can form. Coenosteum spinules have flat highly divided tops.

Living colonies are cream, or brown with rose-tinted tops of vertical branchlets.

Similar species *M. spongodes* have a fine coenosteum.

Rare.

Location. The Gulfs of Tonkin and Siam.

Distribution. Known in the Central Indo-Pacific westwards to Fiji.

Montipora grisea Bernard, 1897

Fig. 22-1

Montipora grisea Bernard, 1897; Veron and Wallace (1984)

Colonies are massive, massive-encrusting or lamellar-encrusting, with tubercular surface.

Corallites are exsert or immersed. They are regularly distributed throughout the colony surface. Sometimes a theca can be present. Calice diameters are 0.6-0.8 mm. Septa of the first cycle always have a complete set of flattened spines, sometimes merging in a dentate lamina, which can reach ¾ of a corallite radius. They can be slightly exert. Second cycle septa, more often incomplete, are spike-shaped, not exceeding half of a corallite radius. Directive primary septa can be distinguished by their sizes. Corallites are surrounded by flattened thecal papillae, which are considerably taller than reticular papillae. All papillae are covered by weakly divided spinules. Thecal papillae can form cylindrical reinforcements around corallites.

Living colonies are shades of brown and green.

Similar species *M. nodosa* has larger corallites.

Usually common.

Location. Tho Chu, Nam Su Islands, reefs of Khanh Hoa Province.

Distribution. Vietnam, Ryukyu Islands, Australia, New Guinea, and Tonga Islands.

Montipora spongodes Bernard, 1897

Fig. 20-2

Montipora spongodes Bernard, 1897, Veron and Wallace (1984)

Colonies are encrusting or with a lamellar base, which can have rootlets extending downwards. The upper colony surface is covered by irregular branchlets, tubercules, columnar branching or anastomizing branches.

Corallites are immersed, regularly distributed throughout the colony surface at a distance which is 2-4 fold that of the corallite diameter of 0.7-0.8 mm. Septa of both cycles are represented by rows of round spinules. Septa of the first cycle rarely reach a half of a corallite radius. Second cycle septa are of equal or half that length. Reticulum is smooth and regularly covered by unsplitted spinules.

Living colonies are uniform brown, green or grey.

Similar species *M. mollis* has similar surface characters but does not form columns or verrucae.

Location. Batlongvy Archipelago, Re, Con Dao and Tho Chu Islands, reefs of Khanh Hoa Province, Spratly Islands.

Distribution. Seychelles and Maldives Islands, Vietnam, Philippines, Indonesia, Western and Eastern Australia.

Montipora undata Bernard, 1897

Fig. 20-3, C2-6

Montipora undata Bernard, 1897; Ma (1959), Veron and Wallace (1984)

Montipora colei Wells, 1954.

Colonies are formed from horizontal or vertical lamellae, which can resemble a tube or a whorl, or can form columnar branchlets, bending or branching. Colony surface is covered by verrucae, which usually merge in rows or ridges. On flat surfaces such ridges are perpendicular, rarely parallel to the margin of a colony. In columnar colonies verricular ridges form a flame-like pattern with directed towards each other.

Corallites are immersed and have rather uniform diameter sizes (0.5-0.6 mm). They can be regularly distributed throughout the colony surface or form rows between tubercular ridges. The theca is indistinct. Septa of the first cycle are represented by a row of spines of various lengths, up to a half or 2/3 of a corallite radius. Second cycle septa are rarely present as a complete set. The reticulum is covered by fine spinules, similarly on tubercular ridges and in striae between them. Coenosteum spines are similar to septal ones, the result of which is that a colony surface looks like it is continuous.

Living colonies are usually brown, pink is also observed, laminae edges are always lighter up to white.

Similar species *M. danae*, when large tuberculae are formed.

Common.

Location. Batlongvy Archipelago, Re, Con Dao and Tho Chu Islands, reefs of Khanh Hoa Province.

Distribution. Vietnam, Philippines, Indonesia, Western and Eastern Australia.

Montipora danae Edwards and Haime, 1851.

Fig. 20-5

?*Porites maeandrina* Ehrenberg, 1834

Manopora tuberculosa (Lamarok): Dana (1846)

Montipora rus (Forskål); Edwards and Haime (1851), Klunzinger (1879)

Montipora danae Edwards and Haime, 1851, Veron and Wallace (1984 cum syn.)

Montipora maeandrina (Ehrenberg): Bernard (1897)

?*Montipora crassireticulata* Bernard, 1897

?*Montipora brueggemani* Bernard, 1897.

Colonies are massive, submassive, columnar or lamellar. Their surface always has relief and is covered by verrucae of various shapes, which can merge into long ridges, perpendicular to the marginal edge of a colony. In laminate colonies longitudinal ridges of merged verrucae develop more often. On columnar colonies verrucae are more or less similar and form squamate rows, whereas in massive colonies tuberculae are curved or form reinforcements of various shapes.

Corallites are located between verrucae, as well as arranged in rows on lamellate colonies. They are always immersed, and have a various, though very porous theca. Calice diameters are 0.6-0.7 mm. Septa of the first cycle are represented by spines of similar length, and their length is, as a rule, less than ¾ of a corallite diameter. Second cycle septa are formed by shorter spinules, they usually have an incomplete set, and sometimes are minute. They rarely reach the length of half of a corallite radius. The reticulum is not coarse. Spines on tuberculae are thinner than in striae. In both cases they have divided tops.

Living colonies are shades of brown with lighter peripheral edges.

Similar species *M. verrucosa* has larger more open corallites.

Relatively rare.

Location. Culao Cham Island, Con Dao, Danang Cape.

Distribution. Known from the Red Sea to the southwestern part of the Pacific Ocean.

Montipora verrucosa (Lamarck, 1816)

Fig. 20-4

Porites verrucosa Lamarck, 1816.

pars. *Agaricia papillose* Lamarck, 1816.

Montipora papillosa (Lamarck): de Blainville (1834).

Montipora verrucosa (Veron and Wallace, 1984) cum syn.

Colonies are submassive or lamellar, their surface is covered by verrucae, uniform in size and shape and usually having a diameter of 2-3 mm. Epitheca is developed in lamellar colonies, whereas verrucae are slightly smaller and arranged in rows, perpendicular to the colony edge.

Corallites are immersed, forming funnel shaped calices. Corallites are regularly distributed among verrucae and have a diameter of 0.8-1.25 mm. A theca is distinct in rare corallites. Two cycles of septa are developed. They are represented by rows of spinules, merging into dentate laminae. Spines of first cycle septa are somewhat larger and merge more often. Septa of the first cycle reach half of a corallite radius, second cycle septa – 1/3 of a corallite radius. The reticulum is spongy. Verrucae and the space between them are covered by fine spines with moderately divided tops.

Living colonies are brown with blue or green spots that are polyps.

Similar species *M. danae*, which has smaller, less regular verrucae.

Common.

Location. Known everywhere, except for the northern part of the Gulf of Tokin.

Distribution. Distributed throughout the entire Indo-Pacific.

Montipora venosa (Ehrenberg, 1834)

Fig. C17-6

Poriters venosa Ehrenberg, 1834

Montipora venosa (Ehrenberg): Bernard (1897), Veron and Wallace (1984) cum syn.

Colonies are massive and submassive, with a slightly coarse surface.

Corallites are immersed or weakly exsert, the latter having tubular or funnel-shaped calices with a diameter of 0.7-0.9 mm, as a rule, with a common reticular wall. Septa of both cycles are developed. They are represented by vertical plate-like bars, thickening towards the axial space of a corallite without formation of a columella. Septal sizes are almost uniform, and they rarely reach half of a corallite radius. The reticulum is simple, made of plate-like thin spinules, slightly or moderately divided on their tops.

Living colonies are brown.

Similar species. This species is like a diminutive *M. foveolata*.

Rare.

Location. Con Dao Islands, Gulf of Siam.

Distribution. Found from the Red Sea to the Marshall Islands.

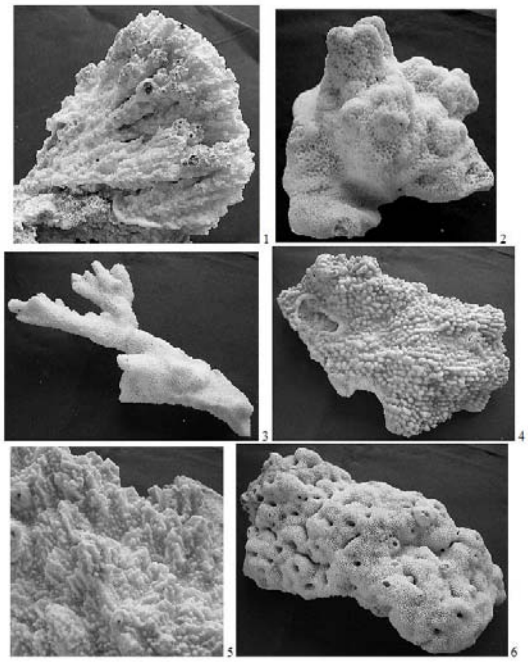


Figure 20. Appearance of colonies. *Montipora spumosa*, spec. 1/9508, Chuong Island; 2 – *M. spongodes*, spec. 1/9509, Phu Quoc Islands; 3 – *M.undata*, spec. 1/9510, Thu Island; 4 – *M. verrucosa*, spec. 1/9511, reef Gjang Bo; 5 – *M. danae*, spec. 1/9512, Thu Island; 6 – *M. caliculata*, spec. 1/9516, An Thoi Island

Montipora caliculata (Dana, 1846)

Fig. 20 - 6

Manopora caliculata Dana, 1846

Montipora caliculata (Dana): Quelch (1886), Veron and Wallace (1984) cum syn.

Colonies are massive and submassive, with porous surfaces.

Corallites are subfoveolate and immersed. The two forms are not well differentiated. Funnel-shaped calices have a diameter up to 1.5 mm, immersed ones – 0.7-0.8 mm. The theca is quite distinct. Septa of both cycles are represented by rows of lamellar spines. First cycle septa are deeply immersed to the corallite calice base, where septal spines, flattened near the axis, can form a likeness of a columella. Septa of the second cycle are arranged in a similar way, but they do not reach more than 1/3 of a corallite radius. The reticulum is coarse, and consists of unified placoid spines, very weakly divided.

Living colonies are brown, sometimes blue.

Similar species *M. venosa* has larger and more clearly funnel-shaped corallites.

Relatively common.

Location. Phu Quy, Con Dao and Hon Hay Islands, Gulfs of Siam and Tonkin.

Distribution. Vietnam, Western Pacific, Western and Eastern Australia.

Montipora angulata (Lamarck, 1816)

Fig. 21-1

Porites angulata Lamarck, 1816

Montipora angulata (Lamarck): Bernard (1897), Veron and Wallace (1984) cum syn.

Colonies have an encrusting base, from which unequal, differently curved columnar branches, flat on the sides, diverge. They can divide into several smaller branches at various angles, sometimes anastomizing. The colony surface is even.

Corallites are immersed, regularly distributed throughout the colony surface, and calices are sometimes funnel-shaped, with weakly developed theca. Corallite diameters are from 0.5 to 1.5 mm, and usually uniform within the same colony. Septa of the both cycles as a rule have complete sets. They are presented by rows of spines, not merging totally into laminae. Septa of the first cycle, going to a calice base, can form a bullet-like columella. First cycle septa reach ¾ of a corallite radius, second cycle septa, half. The directive primary septa are distinguished by their larger sizes. The reticulum is slightly coarse, with small simple spinules. Sometimes fine ridges are formed between corallites on colony tops, which create a weakly foveolate surface.

Living colonies are shades of brown.

Similar species *M. porites* has smaller corallites.

Rare.

Location. Re, Con Dao Islands, reefs of Khanh Hoa Province.

Distribution. From the Gulf of Mannar through the Central Pacific up to the Great Barrier Reef of Australia.

Montipora digitata (Dana, 1846)

Fig. 21-2, C2-3

Manopora digitata Dana, 1846

Manopora tortuosa Dana, 1846

Montipora digitata (Dana): Ortman (1888), Veron and Wallace (1984) cum syn.

Colonies are digitate, columnar-branched and arborescent. Branches can be short, straight, flat and widened upwards, as well as long, conical, and dichotomously branching. The surface is moderately coarse.

Corallites regularly cover all colony parts, being separated by noticeable reticular walls. They are immersed, and have a tubular calice with a diameter of 0.4-0.6 mm. Septa of the first cycle have a complete set. They are represented by irregular spines, not exceeding lengthwise half of a corallite radius. Septa of the second cycle are often incomplete and not longer than 1/3 of a corallite radius. The reticulum is simple, with simple spinules, flat toward their ends and moderately divided.

Veron and Wallace (1984), considering in detail synonymy of this species, and having studied all the type materials and their own large collection, produced a detailed description of the species, given below.

1. Coralla of the intertidal zone, exposed to strong wave action, have encrusted or compact branched colonies with short branches of uniform length. Corallites are small with a diameter of 0.3-0.5 mm. Septa of the first cycle usually have a complete set, reaching half of a corallite radius, and consist of irregular spinules. Septa of the second cycle are represented by single denticles. The reticulum is fine, with spinules having elaborated tips. Reticular ridges are weakly developed or absent.
2. Coralla from biotopes below the intertidal tide zone exposed to wave action have fine anastomizing cylindrical or flat branches, densely configured. Corallites are separated by reticulum ridges and distinct calices with diameters up to 0.8 mm. Septa are reduced to irregular rows of spines. The reticulum is relatively coarse, becoming flaky.
3. Coralla from reef slopes become arborescent with branches up to 16 mm diameter. Sometimes branches merge into laminae. Corallites are of similar shape and sizes. Septa of the first cycle are complete, up to 2/3 of a corallite radius, second cycle septa usually have an incomplete set and are smaller than 1/3 of a corallite radius.

Living colonies are shades of brown.

Similar species *M. porites* имеет has more dense and thin branches.

Usually common.

Location. Baikanh, Ba and Re Islands, Gulfs of Siam and Tonkin.

Distribution. Found from the western part of the Indian Ocean to Fiji.

Montipora porites Veron, 2000

Fig. C19-2

Colonies have encrusting bases and irregular branches which seldom fuse. Branching may be open or compact. Coenosteum ridges are very prominent and form a sinuous pattern over branch surfaces. Corallites are deeply embedded between the ridges. The skeletal structure of the corallites is *Porites*-like, with very elongate septa which occasionally fuse.

Living colonies are grey or green with pale coenosteum ridges.

Similar species: *Montipora setosa* and *M. vietnamensis*, both of which may have a similar growth-form but both have relatively superficial corallites without well developed coenosteum ridges. See also *M. malampaya*. Resembles the poritid *Porites negrosensis* underwater and corallites of skeletons are unusually *Porites*-like. Habitat: Shallow protected embayments (Veron, 2000)

Relatively rare.

Location. Batlongvi and Re Islands, Spratly Archipelago.

Distribution. Found from the south-west Pacific including Vietnam, Taiwan and the south of Japan.

Montipora hispida (Dana, 1846)

Fig. 21-3, C2-4

Manopora hispida Dana, 1846

Montipora hispida (Dana): Studer (1880), Veron and Wallace (1984) cum syn.

Colonies are massive and submassive, digitate and subarborescent, horizontally-lamellar, as well as variations of transitional forms of these.

Corallites are immersed or excert up to 2-3 mm above the colony surface. They are surrounded by 4-6 thecal papillae, which have synapticular junctions forming a synapticulotheca. Calice diameter is uniformly 0.6-0.7 mm. Septa of the first cycle reach ¾ of a corallite radius and are represented by rows of long spines. The directive septa are distinguished by their larger sizes. Second cycle septa do not always have a complete set and do not exceed a half of a corallite radius. The coenosteum has significant relief, formed by thecal and reticular papillae. Reticular papillae have smaller sizes than thecal papillae and are located farther from each other. All papillae are densely covered by divided spinules, and their tops are divided in a particularly complicated way. The reticulum is coarse between papillae, with separate spines of up to 0.2 mm diameter.

Living colonies are shades of brown with white edges in lamellar colonies. Branch tops also can have a light color.

Similar species *M. grisea* have similar corallites.

Common.

Location. Known everywhere from the Gulf of Siam to the Gulf of Tonkin.

Distribution. Can be found from the Seychelles to Hawaii.

Montipora australiensis Bernard, 1897

Fig. 21-4

Montipora australiensis Bernard, 1897: Veron and Wallace (1984) cum syn.

Colonies are thick-lamellar, bifacial in the paleriphery, digitate or columnar branchlets can be formed in the central part. Branches are of approximately similar length, up to 2 cm diameter. Colonies surface has high relief, and is hilly.

Corallites are immersed and noticeably exsert, with tubular calices of 0.6-0.8 mm diameter. There is no differentiation between corallites, in some colony parts they almost tightly adjoining each other, being separated only by thecal papillae. Septa of both cycles are developed. First cycle septa are represented by rows of thick spines reaching 2/3 of a corallite radius. The directive, and sometimes opposite primary septa as well, have larger sizes. Sometimes they are considerably larger near the corallite calice base. Septa of the second cycle are arranged in the same way, but they are shorter, they are rarely exceed half of a corallite radius. Corallites are so densely surrounded by thecal papillae that a thin-walled tubular calice is formed. The tops of spinules, covering papillae, are ornamented in a complicated way. Such ornamentation is finer in the colony periphery, and tops of denticles are more flat. The basal reticulum is covered by coarser spinules and looks rougher than separate papillae.

Living colonies are brown.

Similar species *M. hispida* exposed to wave action can have a similar appearance underwater.

Relatively rare.

Location. Con Dao, Tho Chu Islands.

Distribution. Known in Vietnam and from Western Australia to Tahiti.

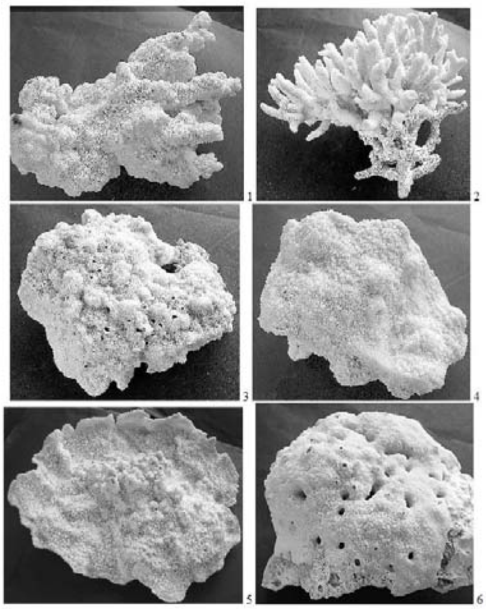


Figure 21. Appearance of colonies. 1 - *Montipora angulata*, spec. 1/9517, Namsu Islands; 2 – *M. digitata*, spec. 1/9518, Thu Island; 3 – *M. hispida*, spec. 1/9519, Bai Canh Bay, Khanh Hoa Province; 4 – *M. australiensis*, spec. 1/9520, Dao Chao Island, Bai Tu Long Archipelago; 5 – *M. efflorescens*, spec. 1/9521, Bai Canh Bay; 6 – *M. nodosa*, spec. 1/9522, Muong Island, An Thoi Archipelago

Montipora efflorescens Bernard, 1897

Fig. 21-5, C19-4

Montipora efflorescens Bernard, 1897, Veron and Wallace (1984) cum syn.

Colonies are massive to submassive, with a surface covered by spherical elevations up to 10-15 mm height and 8-12 mm width. The entire colony surface is covered by highly ornamented spinules, which is why it looks very rough and spiny.

Corallites are immersed and located at a distance of 2-4 calice diameters from each other. Their sizes are rather similar in all colonies and range within the limits of 0.5-0.7 mm. Septa of both cycles are represented by rows of a few spines of the same length, slightly flat laterally. First cycle septa are slightly thicker than small ones and sometimes have flattened axial ends. Septa of the first cycle are usually equal to 2/3 of a corallite radius, whereas septa of the second cycle – 1/3-1/4 of a corallite radius. The directive, and sometimes opposite primary septa are distinguished by their much larger sizes. Coenosteum is densely covered by papillae, which are weakly differentiated into thecal and reticular papillae, regularly covering the basal part of coenosteum. Spinules of all papillae are highly or very highly divided on their tops. In some colonies highly divided spinules of reticulum and papillae create a layer covering the entire colony by a spiky "fur-coat."

Living colonies are deep-green or brown.

Similar species *M. grisea* has more compact corallites without the formation of mounds.

Relatively rare.

Location. Gulf of Siam, Phu Quoc Islands.

Distribution. Widely distributed in the Pacific Ocean, known on the western coast of Australia, on Chagos Archipelago, and the Seychelles Islands.

Montipora nodosa (Dana, 1846)

Fig. 21-6, C19-3

Manopora nodosa Dana, 1846

Montipora nodosa (Dana): Verrill (1864), Veron and Wallace (1984) cum syn.

Colonies are massive or thick-lamellar, with well developed epitheca on the periphery, the surface is rough and spiky.

Corallites are immersed or exsert, regularly distributed throughout the entire surface and not differentiated. They are surrounded by flattened thecal papillae. A funnel-shaped calice of 0.6-1.2 mm diameter is often typical, as a rule, with similar sizes within the same colony. Septa of both cycles are developed. They are presented by rows of spines, which are somewhat thicker on first cycle septa. Septa of the first cycle reach 2/3 of a corallite diameter, small ones – not more than a half. The coenosteum has high relief, and is very rough. Thecal papillae densely surround corallites, usually 4-6 of them are larger and rise higher. Reticulum and papillae are covered by highly ornamented spinules.

Veron and Wallace, describing this species (1984), noted that it is close to two other species – *M. australiensis* and *M. hispida*. All three species have immersed and exsert corallites, similar septal features and well developed thecal papillae. At the same time, they point out substantial distinctions. *M. nodosa*, unlike *M. australiensis*, does not form columnar colony forms and has well developed epitheca, differs by well developed numerous papillae on the reticulum and does not form reticular ridges between corallites. *M. hispida* has a complicated colony form, laminae are always thinner and have no epitheca, and reticular papillae are better developed in the latter species.

Living colonies are pale yellow-brown.

Uncommon.

Location. Bai Kanh, Culao Cham Islands, Baitylong Archipelago, Gulf of Siam, Tho Chu Island.

Distribution. Known in the Western Pacific and Red Sea..

Montipora informis Bernard, 1897

Fig. 22-3

Montipora informis Bernard, 1897, Veron and Wallace (1984) cum syn.

Colonies are massive, submassive or thick-lamellar, encrusting. The surface is coarse, moderately spiky.

Corallites are exsert or immersed, regularly distributed throughout a colony, having calices of 0.5-0.76 mm diameter. Septa of the first cycle narrow to spines as they reach the axis, and reach ¾ of a corallite radius. Second cycle septa, arranged in the same way, not always have a complete set and rarely reach more than a half of a corallite radius. Directive septa can be larger. Coenosteum consists of thecal and reticular papillae. Thecal papillae surround corallites, and, as a rule, there are not less than 4-6 of them. They are thicker and higher than reticular papillae. All papillae are covered by moderately ornamented spinules.

Living colonies are brown.

Similar species. No other species has such an even cover of uniform papillae.

Rare.

Location. Tho Chu Island.

Distribution. Known in the Seychelles, western and eastern coasts of Australia, in the South Vietnam, New Guinea, and in Tonga.

Montipora stellata Bernard, 1897

Fig. 22-2

Montipora stellata Bernard, 1897, Veron and Wallace (1984) cum syn.

Colonies are subarborescent, with winding laminae along edges. Branches are mostly subcylindrical, flat, variously bending and anastomizing, rarely exceeding 20-25 cm lengthwise.

Corallites are immersed, usually have a diameter of 0.6-0.8 mm. Their sizes can be smaller in colonies with thin branches. Most corallites are surrounded by a very dense circle of papillae. Theca can be developed, but usually the wall is developed indistinctly. Septa of the first cycle are formed by a row of cylindrical spinules, reaching half of a corallite radius. Second cycle septa are incomplete, in a form of separate short spines. The directive primary septa can be larger. The reticulum is represented by small irregular papillae. In some places on a colony a reticular layer can be thin, spongy, similar to hoar-frost. Thecal papillae are numerous and densely surround corallites, sometime forming irregular rows or ridges.

Living colonies are cream and brown, with branch tops pure white.

Similar species *M. hirsuta* except that basal laminae are usually formed and coenosteum spinules form prominent ridges.

Rare.

Location. Tho Chu and Re Islands, Danang Cape.

Distribution. Vietnam, the Philippines, Solomon Islands, western and eastern coasts of Australia.

Montipora foliosa (Pallas, 1766)

Fig. 22-4

Madrepora foliosa Pallas, 1766

Montipora foliosa (Pallas): Brüggeman (1879), Veron and Wallace (1984) cum syn.

Encrusting-lamellar and lamellar colonies with several spiral tiers up to 2.5-3 m in diameter. In central parts of some colonies submassive or columnar areas can form. Most laminae have epitheca on the lower surface. The colony surface has complicated relief.

Corallites, having a diameter of 0.6-0.8 mm, are arranged in rows towards the periphery of laminae. They can be immersed, without thecal formations, or exsert with an upper parathecal wall. Septotheca can form in some corallites. Septa of the first cycle are represented by rows of separate cylindrical spines of less than ¾ of a corallite radius. Second cycle septa are arranged in the same way, but they are not always present in a complete set. The coenosteum is densely covered by papillae and tubercules, merging in a net of winding and parallel rows, often passing throughout the entire surface of a colony. Thin papillae form a wall around corallites. Ridges of merging papillae and tubercules project above the exert corallites. On non-lamellar and submassive colony sites, more rarely on columnar ones, tubercules form finger-like ridges. Tubercules and papillae are densely covered by spinules with complicated ornamentations.

Living colonies are cream and brown.

Similar species *M. aequituberculata* is primarily distinguished by its lack of coenosteum ridges

Usually common.

Location. Bai Kanh, Tho Chu Islands, reefs of Khanh Hoa Province.

Distribution. Can be found anywhere in the Indo-Pacific from the Red Sea to Fiji and New Hebrides.

Montipora aequituberculata Bernard, 1897

Fig. 22-5, C-1

Montipora aequituberculata Bernard, 1897, Veron and Wallace (1984) cum syn.

Colonies are thin-lamellar, foliose, with diversely bending and often multideck laminae. The underside of laminae can have epitheca, or disconnected tubercules can form, in which small corallites can be found.

Corallites (exsert or immersed) are surrounded by compact papillae, which can merge in long fine rows perpendicular to the margin part of laminae. Sometimes on the colony periphery papillae ridges form hoods above corallites, which are arranged in rows diverging in a radial way. Corallites have a diameter of 0.5-0.7 mm. Septa of both cycles are represented by rows of disconnected spines, sometimes merging into dentate laminae. Axial ends of some septa can be slightly flattened in a spindle-shaped fashion. The sizes of first cycle septa vary from 2/3 to 1/2 of a corallite diameter. Second cycle septa are arranged in the same way, they do not always have a complete set and rarely reach more than half of a corallite radius. Thecal papillae form a dense encirclement of brushes around corallites. Reticular papillae are thick, high, merging in short winding ridges. The upper spinulate ends have complicated ornamentations, sometimes they have very fine complexly divided denticles, which create a surface resembling hoarfrost.

Living colonies are shades of brown.

Similar species *M. crassituberculata* has larger corallites and more papillae.

Common.

Location. Con Dao, Tho Chu and Culao Cham Islands, reefs of Khanh Hoa Province, Danang Cape, Baitylong Archipelago.

Distribution. South China Sea, Central Pacific, the Great Barrier Reef of Australia, and the Red Sea.

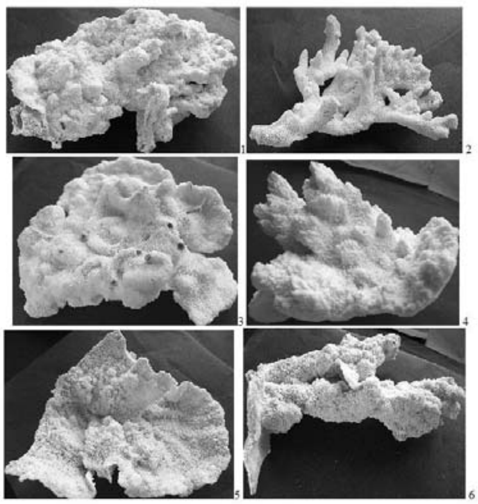


Figure 22. Appearance of colonies. 1 - *Montipora gricea*, spec. 1/9523, Namsu Islands; 2 – *M. stellata*, spec. 1/9524, Tho Chu Island; 3 – *M. informis*, spec. 1/9525, Hon Mung Island, Khanh Hoa Province; 4 – *M. foliosa*, spec. 1/9526, Muon Island; 5 – *M. aequituberculata*, spec. 1/9527, Hon Mung Island; 6 – M. *crassituberculata*, spec. 1/9528, Thu Island.

Montipora crassituberlata Bernard, 1897

Fig. 22-6, C2-2

Montipora crassituberlata Bernard, 1897, Veron and Wallace (1984) cum syn.

Colonies are encrusting or subencrusting, lamellar. They usually have regular circular edges of laminae with well-developed epitheca.

Corallites (exsert or immersed) have 0.7-0.9 mm diameter. Exsert corallites are surrounded by a dense circle of merging papillae with a conical shape. The theca is well developed. Differentiation of corallites is not observed. Septa of both cycles are developed. They are represented by disconnected subcylindrical spines of changeable length, sometimes merging in short dentate laminae. The primary septa can be distinguished by their large size. Septal length is variable, but usually less than 2/3 of a corallite radius. Small septa are somewhat thinner and shorter, but they always have a complete set. The coenosteum is densely covered by thecal and reticular papillae. Reticular papillae can merge in short slightly winding laminae. The entire papillae surface is covered by spinules with complicated ornamentation, which results in the very coarse appearance of the colony.

Living colonies are brown.

Similar species *M. aequituberculata* has smaller corallites and fewer papillae.

Common.

Location. Culao Cham, Re, Con Dao Islands.

Distribution. Vietnam, western and eastern coasts of Australia.

Montipora vietnamensis Veron, 2000

Fig. C2-7

Colonies have an encrusting or laminar base, with closely compacted short upright branches. Coenosteum ridges are mostly vertical but may be irregular. Corallites are large and immersed.

Living colonies are dark brown, usually with white coenosteum ridges and branch tips.

Similar species *M. confusa* has larger, more prominent coenosteum ridges and smaller corallites.

Uncommon but distinctive.

Location. Reefs of Khanh Hoa Province.

Distribution. Known South-West Pacific.

Montipora turtlensis Veron and Wallace, 1984

Fig. C2-8

Colonies are usually encrusting, submassive or form plates with nodular upgrowths at their center. Corallites are crowded and immersed. Thecal and coenosteum papillae are present although not as well developed as in other species of the group, and only on upgrowths.

Living colonies are dark brown, green or blue, sometimes with cream tips to nodules.

Similar species *M. grisea* has better developed thecal papillae.

Location. Reefs of Khanh Hoa Province.

Distribution. Known South-West Pacific.

Genus *Isopora* Studer, 1878

Madrepora (*Isopora*) Stader, 1878

Madrepora (*Isopora*): Brook (1893)

Acropora (*Isopora*) Studer, 1878: Veron and Wallace (1984)

Isopora Studer, 1878: Latypov (1992)

Type species. *Astrea palifera* Lamarck, 1816.

Diagnosis. Encrusting massive-lamellar colonies with columnar and palm-shaped vertical branching. Corallites are conical, exsert, regularly distributed throughout the colony surface without separation into axial and radial corallites. Septa are in two cycles; the directives are always distinguished by their larger size. Coenosteum consists of divided spinules, densely covering corallites and the space between them.

Remarks. Among the great diversity of *Acropora* a group of species can be selected, which have the following properties, distinguishing them from the other species of this genus:

1. Unlike in all the other *Acropora* species, transformation of the planula into the polyp in them takes place in the gastric cavity.
2. All corallites grow with an equal rate without subdivision into axial and radial corallites.
3. They never form branched colonies, have encrusting and encrusting-massive colonies with vertical columnar or palm-shaped branches.
4. Being distributed mainly in shallow waters of lagoons, inner reef-flat, backreef zone and the upper part of barrier reef slopes, they, as a rule, form vast monospecific colonies.

The main peculiarity of *Acropora* is the presence of axial corallites which, having larger sizes, are able to grow faster than the other corallites, and to form colony branches. Radial corallites, which is the other distinctive form of these corallites, bud from the top or lateral surface of axial corallites. The way of budding and shape of a corallite and its calice are noticeably different in every species. Growth and the relationship between axial and radial corallites provide the opportunity for *Acropora* species to form branched colonies especially well in this genus. Due to such properties they stand apart from the other genera and occupy the key position among the other scleractinians of a reef ecosystem.

Thus, a group of species, having a pronounced morphological status (absence of axial and radial corallites, inability to form branched colonies), peculiarities of reproduction (bearing planula up to a polyp state) and occupying specific ecological niches, should be distinguished taxonomically as well. That is why it is better to consider corals of subgenus *Madrepora* (*Isopora*) Studer (1878), synonyms Brook (1893), *Acropora* (*Isopora*) Veron and Wallace (1984), and subgroup *Isopora* (Nemenzo, 1967) within the independent genus *Isopora* Studer, 1878.

Isopora palifera (Lamarck, 1816)

Fig. 23-1, C4-7

Astrea palifera Lamarck, 1816

Madrepora labrosa Dana, 1846

Acropora palifera (Lamarck): Vaughan (1918)

Acropora (Isopora) palifera (Lamarck): Veron and Wallace (1984) cum syn.

Isopora palifera (Lamarck): Latypov (1992) cum syn.

Colonies are encrusting, lamellar, with vertical (lamellar, palm-shaped, tapered, columnar, etc.) branchlets, which sometimes can irregularly anastomize. Width, thickness and height of branches can highly vary even within the same biotope.

Corallites are conical, tubular, being 2-5 mm in height and 2.3-3.5 mm diameter, they densely cover a colony surface (from 15 to 25 per 1 sq. cm), sometimes they closely adjoin each other, grouped in 4-8 corallites. Calice diameters are 0.8-1.2 mm, but in some colonies they can be 1.5-2 times less. Septa are usually in two cycles, but more often in incomplete sets. They are presented by rows of spines, often merging in winding laminae, reaching half of a corallite radius. The directive septa are noticeably larger in size. In some corallites all 12 septa, having the shape of lanimae of different lengths, can be well developed, but not exceeding ¾ of a corallite radius. Coenosteum on corallites and in inter-corallite space is densely covered by anastomizing spinules with moderately divided and flattened tops.

Living colonies are shades of brown.

Similar species *I cuneata* has smaller, flatter branches and finer, more rounded, less elongate corallites.

Common.

Location. Re, Phu Quy, Con Dao, Hon Hay and An Thoi Islands, reefs of Khanh Hoa Province.

Distribution. Can be found everywhere on reefs from the western part of the Pacific Ocean to the Marshall Islands.

Isopora cuneata Dana, 1846

Fig. 23-2, C4-8

Madrepora cuneata Dana, 1846

Acropora cuneata (Dana): Wells (1954)

Acropora (*Isopora*) *cuneata* (Dana): Veron and Wallace (1984) cum syn.

Isopora cuneata (Dana): Latypov (1992)

Colonies are encrusting and horizontally lamellar with irregular horizontal and vertical branches of palm, column or belt shape. The surface is densely covered by corallites.

Corallites are conical and subcylindrical, being 1-3 mm in height and 1.8-2.5 mm in diameter. They often adjoin each other and are in groups of 6-11, reaching in a number of cases 30-

40 per 1 sq. cm. Calices are oblique, nariform and 0.8-1.25 mm diameter. The overwhelming majority of corallites adjoin to the "outer" complete side of a neighboring corallite by their oblique side, forming irregular rows. Septa of both cycles are represented by rows of spines and dentate fine laminae, which sometimes are granulated. First cycle septa can be slightly longer than half of a corallite radius. Both cycles of septa are not always well developed. The directive primary septum is always located on the oblique side of the calice and large. The opposite septum is shorter, but also well developed. The coenosteum, covering corallites and the space between them, is represented by dense anastomizing spinules with flat, moderately divided tops.

Living colonies are shades of yellow-brown.

Similar species *I. palifera* has larger corallites.

Common.

Location. Re, Phu Quy, Baikanhh, Hon Hay and Tho Chu Islands, reefs of Khanh Hoa Province.

Distribution. Can be found on reefs from the western part of the Indian Ocean to the central part of the Pacific Ocean.

Genus *Anacropora* Ridley, 1884

Type species. *Anacropora* forbesi Ridley, 1884

Diagnosis. *Anacropora* is like *Montipora* except that it has arborescent or sub-arborescent growth forms with no tendency to become encrusting or sub-massive. The coenosteum is uniform and is covered with fine, highly elaborated spinules without the development of tuberculae. There are no axial corallites in *Anacropora*; thus branch growth occurs from undifferentiated coenosteum in which corallites later develop. This is a fundamental difference between *Acropora* and *Anacropora*.

Anacropra forbesi Ridley, 1884

Fig. C6-1

Anacropora forbesi Ridley, 1884: Bernard (1897); Yabe & Sugiyama (1941), Pillai (1973), Veron and Vallace (1984) cum syn.

Colonies are arborescent, usually with dichotomous branching, branches being <] diameter and only slightly tapered, with rounded tips. Branches may be short with frel subdivisions, or up to 18cm long, giving colonies a lax appearance. The bases of bra| are dead, usually buried in mud. Corallites are uniformly spaced and uniform colonies. They are immersed or conical, or have a slightly protuberant lower lip. Calic rounded, 0.6-1.0mm diameter. Septa are usually in two complete cycles of 2/3R and some coralla, secondary septa are reduced or absent and primary septa are <1/3R. In other coralla, the first two cycles reach 3/4R and 1/2R and the rudiments of a third cycle may be developed. All septa consist of rows of straight spines. The coenosteum consists of compacted spinules which usually have elaborated tips. The latter may give a frosted appearance or may be fused into a near solid structure.

Living colonies are pale brown with white branch tips. Polyps may be extended during the day. More commonly than most species, colonies may be pure white as a result of expulsion of zooxanthellae.

Similar species. *Anacropora reticulata* by having smaller corallites, thinner, less curved branches and *A. puertogalerae* by its blunt branch tips.

Uncommon.

Location. Reefs of Khanh Hoa Provonce, Spratly Islands.

Distribution. Widespread in the tropical Indo-Pacific.

Genus *Acropora* Oken, 1815

Type species. *Millepora muricata* Linnaeus, 1758.

Diagnosis. Branched corals having on branch ends axial corallites, which grow faster than the more numerous radial corallites of tubular, porous or spongy shape which bud from the axial corallites. Septa of two cycles are developed, primary septa are larger and arranged in a vertical plane, perpendicular to the axial corallite. The coenosteum is reticular, spinous or pseudo-costate.

Acropora brueggemanni (Brook, 1893)

Fig. 23-3, C6-2

Madrepora brueggemanni Brook, 1891: Brook (1893)

Acropora brueggemanni (Brook): Crossland (1952), Latypov (1992)

Acropora (*Isopora*) *brueggemanni* (Brook): Veron and Vallace (1984) cum syn.

Colonies are branched, arborescent, with well spaced subcylindrical short branches 1.5-3 cm in diameter. Branch ends are obtuse, rounded, often branching dichotomously.

Axial corallites are irregular. They can be absent on some branches or there can be 2-3 on one branch tip. The wall is thick (up to 5-7 mm). Calices are, as a rule, funnel-shaped, being 0.6-1.2 mm in diameter, not very much larger than the calices of radial corallites. The latter have a tubular shape. They are closely crowded on a branch, rising as small hillocks. Septa of two cycles are developed, represented by short laminae, usually winding towards the calice periphery. The first cycle of septa reach ½ or ¾ of a corallite radius, second cycle septa not more than a half radius, and they can have an incomplete set of septa. The septa of axial corallites are better developed and more often have both sets complete. The coenosteum is represented by dense spinules, anastomizing, with flat or moderately divided tops. Spinules regularly cover corallites and the space between them.

Living colonies are hazel.

Similar species *A. cylindrica* has larger branches and less conspicuous radial corallites.

Uncommon.

Location. Con Dao, Tho Chu and Dan Chao Islands.

Distribution. Known in Indonesia, Malaysia, Vietnam, the Philippines, and on the Great Barrier Reef of Australia.

Acropora humilis (Dana, 1846)

Fig. 23-4, C5-4

Madrepora humilis Dana, 1846

Acropora humilis (Brook): Crossland (1952), Latypov (1992) cum syn.

Acropora (*Acropora*) *humilis* (Dana): Veron and Wallace (1984) cum syn.

Colonies are corymbose or caespito-corymbose. Branches are digitate, slightly narrowed towards the blunt round tip, which is often hemispherical. Branches reach 35-62 mm lengthwise and 15-25 mm in diameter.

Axial corallites are well developed, large, up to 6 mm in diameter, with well-developed septal apparatus. Calice diameter is 1-1.5 mm. Radial corallites are tubular, with oblique calices, 1.5-2 times smaller than the axial calice. They may be arranged in rows. The outer wall is thicker that the inner one. A few radial corallites of smaller sizes may be between rows. They are mainly immersed or have a thin slightly exsert wall. Septa of both cycles are represented by short slightly winding laminae. They are slightly longer with axial corallites, and the laminae themselves are more whole. The first cycle of septa have a complete set in all corallites, second cycle of septa in radial corallites can be incomplete. The length of septa of the first cycle in axial corallites reach ¾ of the calice radius, that of radial septa – 1/3 of a corallite radius. The second cycle of septa are half as long, sometimes they can have an incomplete set. The coenosteum on corallites and between them is reticular or ridged, with laterally flat spinules and slightly divided tips.

Living colonies are brown, blue or purple with blue or cream branch tips.

Similar species *A. gemmifera* has small axial corallites and radial corallites increasing in length down branches.

Common in various zone reef.

Location. Can be met everywhere up to the northern part of the Gulf of Tonkin.

Distribution. Widely distributed in the Indo-Pacific.

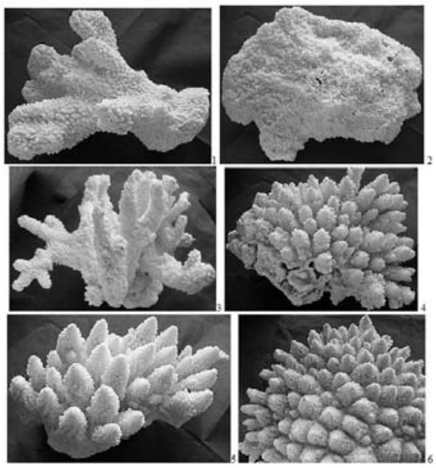


Fig. 23. Appearance of colonies. 1 – *Isopora palifera*, spec. 1/9529, Con Dao Island; 2 – *I. cuneata*, spec. 1/9531, An Thoi Islands; 3 - *Acropora brueggemani*, spec. 1/9532, Cham Island; 4 – *A. humilis*, spec. 1/9533, Khanh Hoa Province; 5 – *A. gemmifera*, spec. 1/9534, Re Island; 6 – *A. monticulosa*, spec. 1/9535, Con Dao Island

Acropora gemmifera (Brook, 1892)

Fig. 23-5, C3-7

Madrepora gemmifera Brook, 1892

Acropora gemmifera (Brook): Vaughan (1918)

Acropora (*Acropora*) *gemmifera* (Brook): Veron and Wallace (1984) cum syn.

Colonies are corymbose, plate-shaped, digitate, with a wide base, with conical and subcylindrical branches, which tips are pointed or slightly rounded. Branch length is 25-55 mm, width – 12-20 mm.

Axial corallites are cylindrical, exsert above a branch tip for about 2 mm. They are 2-3 mm diameter, with a calice diameter of about 1 mm. Radial corallites are of two sizes. Larger corallites are arranged in longitudinal rows, other corallites are smaller and mainly located between those arranged in rows, surrounding them from all sides. Larger corallites are tubular, with oblique calices and flattened walls. Small corallites are mainly immersed or nariform. The total number of corallites varies from 34 to 61 per sq. cm. The septa of axial corallites are in two cycles in complete sets, reaching 1/3 to 2/3 of a corallite radius. Septa of the first cycle of radial corallites always have a complete set, while second cycle septa usually have an incomplete set. In larger radial corallites the directive primay septa are clearly distinct, in a biradial arrangement of the septa. The coenosteum on corallites is covered by fine spinules or ridged. In intercorallite space it is slightly coarser.

Living colonies are brown or blue with blue or white branch tips.

Similar species *A. monticulosa* has radial corallites of uniform length down the sides of branches.

Common.

Location. Culao Cham, Re, Baikanhhh, Tiaklon, Tho Chu, An Thoi and Hon Hay Islands, reefs of Khanh Hoa Province.

Distribution. Widely distributed in the Indo-Pacific.

Acropora monticulosa (Brüggemann, 1879)

Fig. 23-6, C-4

Madrepora monticulosa Brüggemann, 1879

Acropora (*Acropora*) *monticulosa* (Brüggemann): Veron and Wallace (1984)

Large corymbose thick colonies with short (15-20 mm) branches of conical and pyramidal shape, reaching 20-30 mm in diameter. On the colony periphery branches can be finger-shaped and branch a little.

Axial corallites, slightly exsert above branch tip, have a diameter of 2-3 mm. Radial corallites are represented by two types – larger ones (1.8-2 mm diameter), tubular and nariform, arranged in vertical rows, and small ones (0.8-1.2 mm diameter), irregularly located among the larger corallites from the middle to the base of branches. Small corallites are mainly tubular with thin walls. The total number of corallites ranges from 39 to 50 per sq. cm. Septa of both cycles are represented by rows of spines or by short dentate laminae, rarely reaching half of a corallite radius. The directive primary septa of the axial corallite are distinguished by their larger size. The coenosteum is covered by fine spinules, sometimes merging into rows. Spinules between corallites are somewhat larger and more coarse.

Living colonies are shades of brown with light or blue branch tips.

Similar species. See *A. humilis* and *A. gemmifera*.

Rare.

Location. Re, Con Dao Islands.

Distribution. Rodriguez Island (Mascarene Islands), Vietnam, and the Great Barrier Reef of Australia.

Acropora digitifera (Dana, 1846)

Fig. 24-1, C3-4

Madrepora digitifera Dana, 1846

Acropora digitifera (Dana): Verrill (1902)

Acropora (*Acropora*) *digitifera* (Dana): Veron and Wallace (1984) cum syn.

Corymbose or caespito-corymbose colonies, as a rule, with wide massive base. Branches are finger-like, up to 40 mm lengthwise and 10-15 mm in diameter. On colony edges, rarer in the central parts, branches can branch dichotomously or have two symmetrical branchlets. Tips of the primary branches and lateral branches are round.

Axial corallites do not project, being 2-4 mm diameter with calices of 0.8-1.5 mm diameter. Radial corallites are nariform, with flattened lower walls, and have a diameter of 1.3-2 mm and a calice diameter of 0.9-1.2 mm. They are arranged in compact vertical rows. Septa of two cycles, represented by straight laminae of different length are developed in axial and radial corallites. They are longer with axial corallites, up to ¾ of a corallite radius, and in radial corallites they rarely exceed 2/3 of a corallite radius. The directive septa are well developed within all corallites. The coenosteum on corallites and in intercorallite space is dense and has a reticular structure with clearly developed fine ridges.

Living colonies are brown with blue or cream branch tips.

Similar species. See *A. humilis, A. gemmifera*, and *A. monticulosa*, all of which have substantially larger branches.

Common.

Location. Known everywhere up to the northern part of the Gulf of Tonkin.

Distribution. Widely distributed in the Indo-Pacific from Madagascar to Samoa.

Acopora squamata Latypov, 1992

Fig. 24-2

Acropora squamata sp. nov.: Latypov, 1992

Holotype: spec. # 1/9577, Gulf of Siam, Tho Chu Island, depth 7 m, organogenic detritus, dead coral debris, sand patches, *Acropora nobilis* facies; paratypes: spec. # 3/9577, the same Location spec. # 2/9577, An Thoi Archipelago, Thom Island, depth 2 m, large rubble, rock lumps, fine detritus, sand, and *Porites lutea* facies.

Colonies are digitate, subdigitate and subarborescent, up to 300-400 mm in diameter. Branches are short (not longer than 50-70 mm), round, widening on tips up to 1.5-2 fold due to dichotomous branching or formation of 3-4 short branchlets. Branches on the periphery are more often digitate, slightly curved in the same plane. Axial corallites project upwards by 2 mm, and are surrounded by aureole of 5-7 radial corallites. They are round, elongated along the line of symmetry, 2.5-3 mm diameter and with a wall 0.4 mm thick. Almost all branches have more than two axial corallites. Sometimes they can hardly be distinguished because of development of a great number of radial corallites, which resemble tubercules with their variously arranged scaly walls. Radial corallites densely cover branches. They are closely apressed to branches and have an outer strongly exsert scaly or nariform wall, which form the shape of an opened fir cone on branch tips. The height of the exsert wall can be up to 4-5 mm, with a corallite diameter of 1.8-2 mm. All corallites have well developed septa of the first cycle made of even plates, reaching ¾ of a corallite radius. The directive primary septa are always longer than the other septa. On axial corallites they can reach a corallite axis near the floor of the calice. Septa of the second cycle of radial corallites sometimes have an incomplete set; in addition to plates, they can be represented by rows of spines, and do not exceed half of a corallite radius.

Living colonies are brown with light branch tips.

The remark. From all species *Acropora* distinquished presence of two and more axial corallites and squamate radial corallites.

Rare.

Location. Gulf of Siam, Tho Chu and Thom Islands.

Distribution. South Vietnam, Gulf of Siam.

Acropora multiacuta Nemenzo, 1967

Fig. C4-5

Acropora multiacuta Nemenzo, 1967: Scheer and Pillai (1974), Wallace (1978), Veron and Walace (1984)

Coralla have encrusting bases from which extremely elongate primary axial corallites protrude, these corallites having incipient axial corallites towards their base. Primary axial corallites are up to 68mm exsert, up to 14mm diameter at their base and taper to 2.6-4.5mm diameter at their tip. Incipient axial corallites are much less exsert but are of similar shape. Septa are very variable, they may be absent, or the first cycle well developed (up to R) and the second cycle <1/2 R, or both cycles indistinguishable and their lengths irregular. Radial corallites are tubular or tubular appressed, with circular to oval openings. Septa are absent or consist of a few rows of spines. The coenosteum on and between corallites is smooth with a fine reticulate structure and few spinules. Fine costae are sometimes developed.

Living colonies are a pale blue or pink.

Similar species *A. suharsonoi* has more elongate corallites and forms larger, corymbose, colonies.

Rare.

Localites. Reefs of Khanh Hoa Province.

Distribution. Recorded from the Nicobar Islands, the Philippines and the Great Barrier Reef.

Acropora glauca (Brook, 1893)

Fig. 24-3

Madrepora glauca Brook, 1893

Acropora (*Acropora*) *glauca* (Brook): Veron and Wallace (1984)

Corymbose and caespito-corymbose colonies with branches, subhorizontally radiating out from the colony center. Branches can dichotomize or may have several lateral short projections in their upper parts; merging, branches form a strong laminar lattice-like colony.

Axial corallites, exsert for not more than 1 mm, have a diameter of up to 3.5 mm with a calice diameter of slightly more than 1 mm. Radial corallites are tubular, crowded, with straight, or more rarely oblique, calices. The lower part of the wall is flattened. Nariform corallites develop on the upper part of branches. Corallite sizes are 1.8-2.5 mm, and calices are about 1 mm diameter. Septa of the first cycle of axial and usually radial corallites are well developed and represented by regular laminae reaching ¾ of a corallite radius. The directive primary septa are always longer than other septa. Second cycle septa are arranged in the same way, in radial corallites they can be incomplete and do not reach half of a corallite radius. Spines of the third order septa can be met in some corallites. Coenosteum is reticular or finely costate. It has a similar structure on corallites and in intercorallite spaces, but in intercorallite areas it is less coarse.

Living colonies are deep-green.

Similar species *A. clathrata* has axial corallites are weakly exsert, cylindrical, with a straight deep calice and perforated wall. Radial corallites are characterized by a highly variable shape.

Realatively rare.

Location. Culao Cham Island, Baitylong Archipelago.

Distribution. Central and Northern Vietnam, eastern and western coasts of Australia.

Acropora abrotonoides (Lamarck, 1816)

Fig. 24-5, C3-8

Madrepora abrotonoides Lamarck, 1816

Acropora abrotonides (Lamarck): Vaughan (1918)

Acropora (*Acropora*) *danai* (Edwards and Haime): Veron and Wallace (1984) cum syn.

Acropora danai (Edwards and Haime): Latypov (1992) cum syn.

Colonies are clumps of prostrate branches with fused central branches and upwardly projecting peripheral branches. Branches may be conical to elongate, with or without pointed ends. Branches may have one to several axial corallites. Radial corallites are elongate.

Corallites are changeable in different colonies, but rather stable in size (1.8-2 mm) and calice shape within the same colony. They have a tubular and nariform calice shape, mainly 3-5 mm exert from the branch surface. Immersed corallites are present. Axial corallites noticeably project, they are tubular, of a round shape. They have a diameter of 2-2.5 mm, and a calice diameter of 0.8-1.2 mm. Septa of two complete sets are not always developed even in axial corallites. They are presented by rows of spines, dentate or regular laminae. In axial corallites septa can reach 2/3 of a corallite radius, in radial corallites not more than 1/3. Second cycle septa mainly form an incomplete set or are absent. Coenosteum is spongy, with irregular obtuse or slightly split spinules. Corallites are covered by distinct ribbing with short obtuse spines.

Living colonies are brown or green.

Similar species *A. robusta* has similar corallites, but is readily distinguished by the presence of thick encrusting bases.

Usually common.

Location. Culao Cham, Re, Con Dao, Tho Chu and Hon Hay Islands, reefs of Khanh Hoa Province and the Gulf of Siam.

Distribution. Widely distributed in the tropical Indo-Pacific.

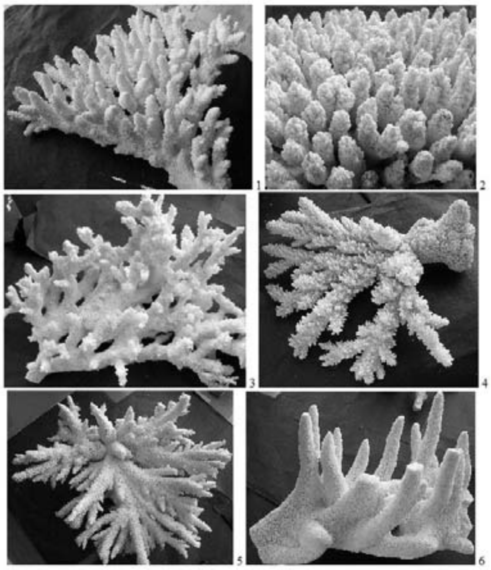


Fig. 24. Appearance of colonies. 1 – *Acropora digitifera*, spec. 1/9536, Re Island; 2 - *A. squamata*, spec. 1/9577, Tho Chu Island; 3 – *A. glauca*, spec. 1/9538, Bai Tu Long Archipelago; 4 – *A. robusta*, spec. 1/9538, Cape Danang; 5 – *A. danai*, spec. 1/9540, Tyaklon Island; 6 – *A. palmerae*, spec. 1/9541, Re Island

Acropora abrolhosensis Veron, 1985

Fig. C19-5

Colonies are arborescent with straight cylindrical branches. These may form stands over 10 metres across and 2 metres high. Branches are either widely separated or compact, depending on space availability. Axial corallites are large and exsert. Radial corallites are outward facing, appressed to tubular, with circular openings. One or more tentacles per polyp are usually extended during the day.

Living colonies are brown, blue or pink with pale branch tips.

Similar species: *Acropora formosa*, which does not have very large axial corallites but otherwise is similar. See also the larger *A. microphthalma*, the smaller *A. loisetteae* and *A. copiosa*, which has radial corallites of different sizes. Habitat: Lagoons or reef slopes protected from strong wave action.

Rare

Location. Batlongvi and Re Islands, Spratly Archipelago.

Distribution. Sout-west Pacific up to the south of Japan.

Acropora robusta (Dana, 1846)

Fig. 24-4, C16-7

Madrepora robusta Dana, 1846

Acropora robusta (Dana): Nemenzo (1967), Wallace (1978)

Acropora (Acropora) *robusta* (Dana): Veron and Wallace (!984) cum syn.

Subarborescent colonies of irregular shape, with thick (20-30 mm) anastomizing branches on the colony periphery. Short vertical or slightly inclined conical or bumpy branches are formed, as a rule, in the central part of a colony.

Axial corallites project above the branch tip for not more than 2 mm, mainly on the peripheral parts of a colony, having a diameter of up to 3 mm and a calice of not more than 1 mm diameter. Different types of radial corallites are distinguished by their variable sizes, wall height and calice shape. They can be immersed or exsert up to 3-4 mm. Calice shapes are mostly nariform, with a flattened lower wall, but corallites can be often have a very thin, lip-shaped lower wall, and there are also dimidiate corallites with thin porous walls. Only axial corallites have two complete sets of septa, reaching half of a corallite radius. All septa are represented by rows of spines, merging in dentate laminae. Septa of the second cycle more often have the shape of denticles and spines reaching not more than ¼ of a corallite radius. In radial corallites they are mostly incomplete. The directive septa are elongated. The directive septum in some corallites can reach the axis near the calice basis. All radial corallites are clearly costate, which, intersecting synapticula, form a lattice structure on thin-walled corallites. Coenosteum between corallites consists of irregularly flattened simple spinules, usually forming a spongy or reticular surface. Living colonies are shades of green and brown.

Similar species. See *Acropora palmerae* and *A. abrotanoides.*

Common, especially reef margins exposed to strong wave action.

Location. Everywhere in the Central and South Vietnam, Baitylong Archipelago.

Distribution. Widely distributed in the tropical Indo-Pacific.

Acropora palmerae Wells, 1954

Fig. 24-6

Acropora palmerae Wells, 1954

Acropora (*Acropora*) *palmerae* Wells: Veron and Wallace (1984)

Colonies are lamellar-encrusting with single short vertical branches, with tips that anastomose.

Axial corallites are slightly exsert, with 2-2.5 mm diameter and calice diameter of 0.8-1.2 mm. Radial corallites are nariform with fine lattice walls or are immersed. On branch tips they often have a tubular shape with a cylindrical calice. Corallite diameter is about 1.5 mm, and calice diameter is not greater than 1 mm. Corallites are nariform, and not oriented, as a rule, except on branches. Usually there are not two complete sets of septa. They are represented by separate spines, rows of spines and more rarely by laminae. Their length, even with axial corallites, rarely exceeds half of a corallite radius. The primary septa are usually clearly distinct. The coenosteum is spongy and rough, and corallites are costate with a synapticular lattice.

Living colonies are brown.

Similar species *A. robusta* does not form large branches.

Rare.

Location. Con Dao Islands, Re Island, Gulf of Siam.

Distribution. The Seychelles Islands, South Vietnam, the Great Barrier Reef of Australia, and Eniwetok Atoll (Marshall Islands).

Acropora nobilis (Dana, 1846)

Fig. 25-1, C4-6

Madrepora nobilis Dana, 1846

Acropora (*Acropora*) *nobilis* (Dana): Veron and Wallace (1984) part cum syn.

Colonies are arborescent with numerous strong anastomosing branches. This species often forms large thickets.

Axial corallites are clearly distinct on branch tips, having a diameter of about 3.5 mm and a calice diameter of 0.8-1.2 mm. Radial corallites are exsert or immersed, and have variable sizes and shapes. They can be tubular, dimidiate or nariform, with uniform or mainly flattened walls on one side of the calice. Most corallites are arranged in longitudinal rows. Septa of both cycles, as a rule, are developed in all corallites. They are represented by rows of spines or dentate laminae of 1/4-3/4 of a corallite radius. The septa of axial corallites are less dentate. The directive septum of most corallites is distinguished by its increased size. Corallites are covered by distinct smooth costae with a synapticular lattice. Coenosteum between corallites is reticular or spongy, with rare spinules. Living colonies have diverse colors. Shades of yellow, brown and green with light or blue branch tips are the most common colors.

Similar species *A. abrotanoides* has different growth-forms except in very shallow water.

Usually common.

Location. Known on the most reefs near the coast of Vietnam.

Distribution. Central and Southwestern Pacific.

Acropora listeri (Brook, 1893)

Fig. 25-2

Madrepora listeri Brook, 1893

Acropora listeri (Brook): Thiel (1932), Veron and Wallace (1984)

Colonies are thick lanimae, corymbose, without large vertical branchlets. Lateral branches are subhorizontal, thick, with numerous vertical short branchlets.

Corallites on thick branches are immersed. They differ noticeably by their shape from the corallites on branchlets. Axial corallites are tubular, exsert up to 3-4 mm. They have a round deep calice with a diameter of up to 1 mm. Radial corallites are of two shapes. They are irregularly situated on horizontal and vertical branches. Long tubular corallites steeply diverge from a branch and often there are additional nariform or lip-shaped short corallites, slightly exsert as a rule, by one side, with irregularly arranged calices. Usually there are not two complete sets of septa. In axial corallites, septa of the first cycle are complete or incomplete, composed of separate spines for not more than 1/3 of a corallite radius. The directive septa are composed of flattened and elongated spines. Corallites are costate, with costae made of dull spinules. The coenosteum between corallites is a lattice, composed of anastomosing spinules.

Living colonies are cream or brown.

Similar species *A. polystoma* has well defined axial corallites and less irregular radial corallites.

Relatively common.

Location. Con Dao, Re and Phu Quy Islands, reefs of Khanh Hoa Province.

Distribution. Kown in the tropical Pacific from Vietnam in the west to Samoa in the east.

Acropora grandis (Brook, 1892)

Fig. 25-3, C5-6

Madrepora grandis Brook, 1892

Acropora grandis (Brook): Crossland (1952)

Acropora (*Acropora*) *grandis* (Brook): Veron and Wallace (1984) cum syn.

Arborescent colonies with branches of 60-80 mm thickness and length up to 2 m. Branches are anastomosing, straight or curved.

Axial corallites project up to 3-4 mm, have a cylindrical shape, reaching 2-3 mm diameter. Radial corallites are irregularly situated on branches. They have different sizes and shapes. Most corallites are large (with a diameter of up to 2 mm), tubular, straight and with thick walls. Nariform corallites are also numerous. Small (1-1.5 mm) corallites, mainly immersed and nariform, are dispersed among large corallites. Not all corallites have complete sets of two cycles of septa. Septa are represented by spines and short dentate laminae. In axial corallites septa do not exceed 1/3 of a corallite radius. Second cycle septa do not exceed ¼ of a corallite radius, sometimes they are reduced. All corallites are covered by clear costae, which together with synapticulae creates a lattice structure. The coenosteum between corallites is a coarse lattice, with irregularly merging or lamellar spinules.

Living colonies are reddish-brown with light branches tips.

Similar species *A. formosa* has similar but smaller corallites, does not have elongate radial corallites near branch tips.

Common.

Location. Re, Con Dao, Tho Chu, Hon Hay, Phu Quy and An Thoi Islands, reefs of Khanh Hoa Province, Danang Cape.

Distribution. Vietnam, the Philippines, the Great Barrier Reef of Australia, and Samoa.

Acropora formosa (Dana, 1846)

Fig. 25-4, C3-6

Madrepora formosa Dana, 1846

Acropora formosa (Dana): Hoffmeister (1925)

Acropora (Acropora) *formosa* (Dana): Veron and Wallace (1984) cum sin.

Arborscent colonies with numerous, mainly straight branches with a diameter of 1-1.5 cm, often forming large shrubs and bushes. Branching is irregular, often intermittent.

Axial corallites are clearly protruding with a diameter of 2.5-3 mm, with a calice of a variable diameter (from 0.5 to 1.2 mm). Radial corallites are highly projecting, tubular, straight or slightly oblique. They densely cover a branch surface, often adjoining each other. Corallites are oriented in different directions. Small short corallites are distributed among exsert corallites, the former sometimes adjoing the walls of the latter. Septa of axial corallites are more weakly developed than those of the radials. Septa of the first cycle usually form a complete set, though they can be present only as spines. Second cycle septa are mainly incomplete. With radial corallites, septa of the first cycle are well developed, as distinct laminae up to 2/3 of a corallite radius. Second cycle septa are developed inconsistantly. Corallites are densely covered by fine costae of thin spinules with highly divided tips. Coenosteum between corallites is of a similar structure or finely reticular.

Living colonies are brown with light or blue branch tips.

Similar species *A. nobilis* has rasp-like radial corallites.

Common and can by a dominant species.

Location. Can be found from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely distributed on Indo-Pacific reefs.

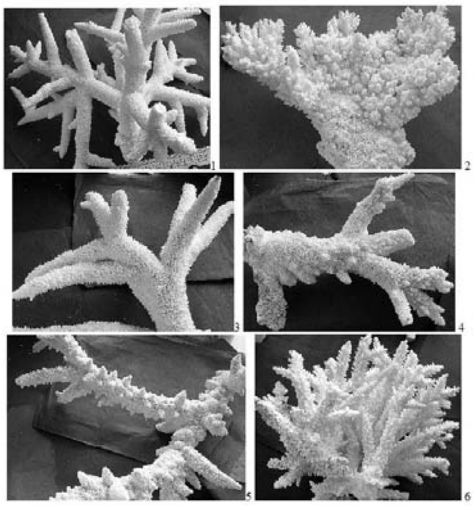


Fig. 25. Appearance of colonies. 1 – *Acropora nobilis*, spec. 1/9542, Con Dao Islands; 2 – *A. listeri*, spec. 1/9543, Con Dao Islands; 3 – *A. grandis*, spec. 1/9544, Nam Su Island; 4 – *A. formosa*, spec. 1/9545, Khanh Hoa Province; 5 – *A. accuminata*, spec. 1/9546, Khanh Hoa Province; 6 – *A. valenciennesi*, spec. 1/9547, Cham Island

Acropora acuminata (Verrill, 1864)

Fig. 25-5, C3-1

*Madrepora acuminata*Verrill, 1864

Acropora acuminata (Verrill): Verrill (1902), Wells (1954)

Acropora (*Acropora*) *acuminata* (Verrill): Veron and Wallace (1984) cum syn.

Caespito-corymbose colonies with horizontal branches, anastomosing and vertical, straight or slightly curved, subcylindrical, gradually narrowing upwards and having no branchlets.

Axial corallites are noticeably developed, 1.5-2.5 mm in diameter. Radial corallites are of two shapes. Larger corallites are arranged in rows, appressed, steeply diverging upwards, tubular, and nariform. Smaller corallites are situated between rows, sometimes oriented, often irregular, arranged perpendicular to the axis or somewhat downwardly inclined. As a rule, septa of both cycles are developed in complete sets. They are represented by spines and laminae of various length (1/3-2/3 of a corallite radius), ornamented by small denticles to a considerable degree. The directive primary septa are clearly distinct. Corallites are covered by distinct costae, forming a lattice structure together with synapticulae. Coenosteum between corallites is coarse, with irregular merging spinules or costate.

Living colonies are shades of brown.

Similar species *A. abrotanoides* has larger branches and rasp-like radial corallites and *A. valenciennesi*, which has large proximal branches.

Relatively common.

Location. Culao Cham, Con Dao and An Thoi Islands, Baitylong Archipelago.

Distribution. South China Sea, the Great Barrier Reef of Australia, Pacific Ocean – Marshall and Gilbert Islands.

Acropora valenciennesi (Edwards and Haime, 1860)

Fig. 25-6, C19-8

Madrepora valenciennesi Edawards and Haime, 1860

Acropora (*Acropora*) *valenciennes*i (Edwards and Haime): Veron and Wallace (1984) cum syn.

Colonies are corymbose, having a diameter of 2-3 m. Branches anastomose, with curved or caespito-corymbose upper edges, sometimes forming an irregular lattice framework.

Axial corallites are excert with round upper edges a and diameter of up to 1.5 mm. Radial corallites are noticeably excert. They are perpendicular to branches or are slightly inclined, have a tubular shape with a straight or oblique (up to a nariform) opening. The lower wall, as a rule, is more flattened. Septa are represented by short spines or by rows of spines. Septa of the first cycle, which are not longer than 1/3 of a corallite radius, have, as a rule, a complete set. Second cycle septa are often weakly developed, sometimes they are not visible at all. Corallites are costate with a lattice structure. Coenosteum between corallites is coarse, reticular, formed by spines and flat lamellar spinules.

Living colonies are brown.

Similar species *A. acuminata* has smaller, more compact branches and smaller corallites.

Usually common.

Location. Con Dao, Tho Chu, An Thoi Islands, Baitylong Archipelago, reefs of Khanh Hoa Province.

Distribution. Sri Lanka, Vietnam, the Philippines, Fiji, Palau, and the Great Barrier Reef of Australia.

Acopora microphthalma (Verrill, 1869)

Fig. 26-1, C5-3

Madrepora microphthalma Verrill, 1869

Acropora microphthalma (Dana): Wells (1954)

Acropora (*Acropora*) *microphthalma* (Verrill): Veron and Wallace (1984) cum syn.

Arborescent colonies with straight subcylindrical branches, which can widely ramify in different directions, forming open colonies, or can grow out from the base of one branch, radiating and forming dense caespito-corymbose constructions.

Axial corallites are exert for up to 2 mm. They have a cylindrical shape and a diameter of 1.8-2 mm. Radial corallites are short, crowded on the branch surface, with a straight round or nariform opening with a calice diameter of 0.5-0.6 mm. Radial corallites can be immersed on the branch tips of some corals. Septa of the first cycle have a complete set in all corallites. In axial corallites they are longer than ¾ of a corallite radius. Second cycle septa are rarely longer than half of a corallite radius, sometimes they are absent. Septa of the first cycle are presented by laminae, slightly flattened in the margins. Second cycle septa are spines or a row of spines, more rarely lamellar. The directive primary septa are well distinguished by their larger size. Corallites are covered by dense rows of spines, merging into winding costae, with spine tips divided in complicated ways. The intercorallite coenosteum is spongy or similar to that on corallites. Living colonies are shades of pale-yellow and brown.

Similar species *A. copiosa* and sturdy forms of *A. parilis*, the latter being distinguished by having widely spaced, elongate radial corallites.

Relatively common.

Location. Culao Cham, Con Dao, Tho Chu and Phu Quy Islands, Danang Cape.

Distribution. Widely distributed in the Indo-Pacific from Socotra and Madagascar to the Marshall and Ryukyu Islands.

Acropora horrida (Dana, 1846)

Fig. 26-2

Madrepora horrida Dana, 1846

Acropora horrida (Dana): Wells (1954), Wallace (1978)

Acropora (*Acropora*) *horrida* (Dana): Veron and Wallace (1984) cum syn.

Arborescent colonies with subcylindrical branches, which sometimes form small bushes of caespito-corymbose form.

Axial corallites are exert, tubular, with thick walls. Radial corallites are excert or immersed, crowded, and with a straight, tubular shape. There are strongly exert corallites (up to 5 mm), which have a structure and size similar to that of axials. The calice diameter of all corallites is approximately the same and is from 0.6 to 0.9 mm. Septa of the first cycle are developed in all corallites. Second cycle septa can be incomplete or absent. Septa are represented by lamellar spines and rows of spines. First cycle septa reach 1/2-2/3 of the corallite radius, minor ones – not greater than half. Corallites are covered by costae with numerous simple spines. Coenosteum between corallites is reticular, porous, with large spinules.

Living colonies are shades of fawn.

Similar species *A. vaughani* has widely spaced corallites and a smooth coenosteum.

Rare.

Location. Tho Chu Island.

Distribution. Widely distributed on Indo-Pacific reefs.

Acropora vaughani Wells, 1954

Fig. 26-3, C24-6

Acropra vaughani Wells, 1954, Wallace (1978)

Acropora (*Acropora*) *vaughani* Wells: Veron and Wallace (1984)

Colonies are arborescent, with long thin branches, gradually narrowing to the tip. Numerous lateral branchlets give a caespitose shape to the colonies.

Axial corallites, exert 1.5-2 mm, have the same diameter. Radial corallites are separated from each other, being situated in staggered rows and slightly exsert along the branches. They are crowded, tubular, rounded and nariform, with a calice diameter of 0.3-0.8 mm. Radial corallites on the branch tips protrude somewhat more than in the middle and lower parts of branches. Septa are variable. Two complete cycles of septa can be developed, or they can be incomplete. Radial corallites more often have septa of the first cycle in a complete set, and, as a rule, second cycle septa form a complete set. Axial corallites have incompletely developed septa. Septa are presented by fine dentate laminae with a length of up to ¾ of a corallite radius, and by rows of spines merging into laminae with a length of 1/3-1/2 of a corallite radius. Coenosteum on corallites and in intercorallite spaces is similar and represented by thin dense spinules with considerably divided tips.

Living colonies are brown.

Similar species *A.austera* has a similar colony shape but has larger, more compact radial corallites.

Relatively common

Locaton. Cape of Danag, Khanh Hoa Province, Phu Quy Island, Con Dao and Namsu Islands.

Distribution. South Vietnam, western and eastern coasts of Australia, and the Marshall and Caroline Islands.

Acropora austera (Dana, 1846)

Fig. 26-4

Madrepora austera Dana, 1846

Acropora austera (Dana): Verrill (1902)

Acropora (Acropora) *austera* (Dana): Veron and Wallace (1984) cum syn.

Colonies are of various shapes: from arborescent to caespitous. Arborescent colonies have branches 30-40 mm thick, rarely anastomizing.

Axial corallites are thick-walled and slightly exsert. They have a diameter of up to 3 mm and a calice diameter of 1-1.5 mm. Radial corallites are tubular, crowded, with straight or oblique nariform openings. The walls are thick, the outer wall is more flattened. Corallites are situated irregularly, but sometimes they are arranged in rows. Septa of axial corallites are mainly complete, of both cycles. They are represented by thin laminae, slightly tapered, dentate in the axial space. Large septa reach 2/3 of a corallite radius, Small ones ½. The directive septum is clearly distinct. In radial corallites, first cycle septa are usually present, which reach no more than half of a corallite radius. Second cycle septa are short, spiny, usually incomplete, or they can be absent. All septa of radial corallites are highly dentate. Corallite surfaces are weakly costate, covered by fine lamellar spinules, with slightly divided tips. Intercorallite coenosteum is of similar structure, with reticular areas, sometimes spongy.

Living colonies are yellow, brown and green; axial corallites can have a purple color.

Similar species. *A. austera* does not closely resemble any other species but its wide range of growth-forms sometimes makes it difficult to identify.

Usually uncommon.

Location. Con Dao, An Thoi Islands, Baitylong Archipelago.

Distribution. Widely distributed in the tropical Indo-Pacific.

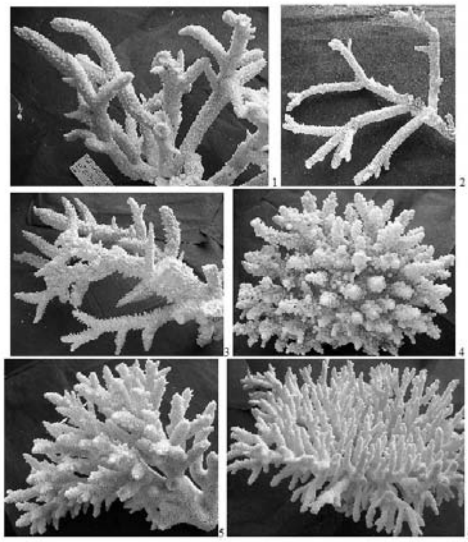


Fig. 26. Appearance of colonies. 1 – *Acropora microphthalma*, spec. 1/9548, Dao Chao Island; 2 – *A. horrida*, spec. 1/9549, reef Gjang Bo; 3 – *A. vaughani*, spec. 1/9550, Hon Mjeu, Khanh Hoa Province; 4 – *A. austera*, spec. 1/9551, reef Gjang Bo; 5 – *A. aspera*, spec. 1/9552, An Thoi Islands; 6 – *A. pulchra*, spec. 1/9553, Hon Mjeu

Acropora aspera (Dana, 1846)

Fig. 26-6

Madrepora aspera Dana, 1846

Acropora aspera (Dana): Faustino (1927), Crossland (1952), Nemenzo (1967)

Acropora (*Acropora*) *aspera* (Dana): Veron and Wallace (1984) cum syn.

Colonies are arborescent and subcorymbose, with short (60-80 mm) subcylindrical branches, up to 1.5 cm diameter. They, as a rule, anastomose highly, but finger-like branches with small additional branchlets can also be found.

Axial corallites are exsert, thick-walled, up to 4 mm diameter with a calice diameter of about 1.5 mm. Radial corallites very densely cover branches in staggered rows. They have calices with immersed lips. Septa of axial corallites are in two complete cycles up to 1/3 corallite radius. Septa of radial corallites are thick, short, highly dentate, not more than 1/3 corallite radius. Second cycle septa are presented by spines, rows of spines or can be incomplete. Corallites have distinct costae. Intercorallite coenosteum is represented by thick merging spinules with obtuse tips.

Living colonies are cream and green.

Remarks. Veron and Wallace (1984) considered this species to be highly polymorphic, and when describing it they provided characteristics of three ecomorphic groups from different biotopes.

1. *A. aspera* from the reef-front zone. Corals are subcorymbose, with strong subcylindrical, narrowing upwards, short and thick highly anastomosing branches. Radial corallites are densely grouped, of similar sizes, with immersed lip-shaped calices, with noticeable rows of septa. Corallites have a diameter of up to 4 mm, with a calice of 0.8-1.2 mm diameter. Septa are thick, highly dentate, almost equal, with a length of 1/3 of a corallite radius. Axial corallites are exert, smaller than 3 mm, have an outer diameter of less than 4.7 mm, with a calice diameter of 1-1.8

mm. Septa are in two complete sets, reaching from 1/4 to 1/3 of a corallite diameter. Coenosteum on corallites and between them consists of thick obtuse highly fused spinules.

2. *A. aspera* from shallow water protected biotopes. Such corals especially prevail on a reef-flat and in shallow lagoons where *Acropora* diversity is low. “Micro-atoll” forms or arborescent colonies with strong branches 10-15 mm thick, which rarely anastomose, are typical for such biotopes. Radial corallites are crowded, though less crowded than in exposed biotopes, and have two sizes. Greater ones have up to 4 mm diameter, with a round lip-shaped calice of 0.7-1.2 mm diameter. Septa form two complete sets, dentate, up to half of a corallite radius. Small corallites are more immersed, except for corallites on branch tips, and are usually less than 2 mm in diameter. Axial corallites are less than 4 mm diameter, with a calice diameter of 1.4-1.6 mm. Two cycles of septa with dentate edges reach 2/3 of a corallite radius. Corals are less calcified than those described above, and with thinner walls and more open reticular coenosteum.

3. *A. aspera* from protected biotopes and poor illumination. Corals from reef-slope or from turbid lagoons have arborescent colonies with relatively thin (8-11 mm) branches, with smaller, distant corallites, which can be of two sizes, though small corallites are often completely absent. Large corallites are 2 mm in diameter, as a rule, and they are dimidiate, sometimes with pointed lower lips. They usually have one cycle of simple septa reaching less than 1/4 of a corallite radius. Axial corallites are 3-5 mm in diameter, with calice diameters of 0.8-1.2 mm, and have two sets of septa with dentate edges, reaching not more than 1/3 of a corallite radius. All corallites are weakly calcified, with highly perforated walls. The coenosteum consists of fine nastomosed spinules.

Location. Known from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Cocos-Keeling Islands, Vietnam, western and eastern coasts of Australia, Fiji and the Central Indo-Pacific.

Acropora pulchra (Brook, 1891)

Fig. 26-6

Madrepora pulchra Brook, 1891

Acropora pulchra (Brook): Vaughan (1918), Wallace (1978)

Acropora (*Acropora*) *pulchra* (Brook): Veron and Wallace (1984) cum syn.

Colonies are arborescent and open, with well spaced, thin, and as a rule, long (150-250 mm) branches.

Axial corallites, excert 1-2 mm, have a straight, cylindrical form with a calice of 0.6-1 mm in diameter. Radial corallites are round-dimidiate or with lip-shaped lower walls. Septa of two cycles are developed, represented by flattened laminae with uneven or dentate edges. In radial corallites septa can be composed of rows of spines. In axial corallites primary septa are well developed, and the directive septa are notably distinct. Second cycle septa are rows of spines or incomplete. Septa of radial corallites are mainly spiny, only the directives almost always take the form of tapered laminae. No septa exceed 1/3 of a corallite radius. Corallites are covered by fine costae. Intercorallite coenosteum consists of loosely anastomosing flattened spinules, and is very porous.

Living colonies are brown.

Similar species *A. aspera* has similar radial corallites but these are much larger and more scale-like.

Relatively common.

Location. Everywhere in Central and South Vietnam, Dao Chao Island.

Distribution. Cocos-Keeling Islands, Western Australia, Vietnam, and the islands of the Central Pacific.

Acropora millepora (Ehrenberg, 1834)

Fig. 27-1, C4 - 3

Heteropora millepora Ehrenberg, 1834

Acropora millepora (Ehrenberg): Verrill (1902), Nemenzo (1967), Wallace (1978)

Acropora (*Acropora*) *millepora* (Ehrenberg): Veron and Wallace (1984) cum syn.

Colonies are mainly lamellar-corymbose, more rarely subarborescent or bushy. Branches are situated close to each other, vertical in the center and slightly curved on the periphery; branching is irregular.

Axial corallites are slightly exert, thick-walled (up to 1.5-2 mm thick), cylindrical and straight, with a distinct theca. The outer diameter is from 2.5 to 3.8 mm. Radial corallites are densely situated in staggered rows, and have no upper wall. The lower wall is thick, round, in the shape of a immersed lip. Septa of both cycles are present in axial corallites. First cycle septa reach ½ of a corallite radius, whereas second cycle septa reach ¼. Septa of the first cycle are more often lamellar, second cycle septa are lamellar and spinous, sometimes barely noticeable. Primary septa in radial corallites are well developed. They reach 2/3 of a corallite radius, and are represented by dentate laminae. Second cycle septa can be absent or incomplete. Corallites are costate with short irregular denticles. Intercorallite space, if any, is of a similar structure.

Living colonies are shades of red, or green with variously colored branch tips.

Similar species *A. aspera* has similar radial corallites but these are of two mixed size corallites.

Usually common.

Location. Known from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Can be anywhere in the Indo-Pacific.

Acropora tenuis (Dana, 1846)

Fig. 27 - 3

Madrepora tenuis Dana, 1846

Acropora tenuis (Dana): Faustino (1927), Wallace (1978)

Acropora (*Acropora*) *tenuis* (Dana): Veron and Wallace (1984) cum syn.

Colonies form thick corymbose laminae with regularly ramifying, numeous, thin, refined branches with lateral branchlets, which have few sub- branchlets.

Axial corallites, 5-6 mm exert, have a porous wall of a moderate thickness, with a calice of about 1mm diameter. Radial corallites, arranged in rows, have a round shape with a nariform opening, and are crowded on the branch surface. Skeletal elements of proximal corallites are developed more distinctly. The two cycles of septa do not always have complete sets. The septa of axial corallites are mainly represented by two cycles of approximately similar laminae, not more than a half of a corallite radius. Septa of distal radial corallites have a distinct plumose arrangement with distinct directive primary septa. Second cycle septa are incomplete. All septa are usually rows of spines. Septa of the first cycle of proximal corallites in a complete set reach 2/3 of a corallite radius, second cyle septa are shorter, and not always complete. The directive primary septa are distinct. All corallites have fine costae, sometimes winding, with disconnected spine tips. Coenosteum between corallites is also costate, with some reinforcement of spinules towards the axial part of a colony.

Living colonies are cream or pale-yellow.

Similar species *A. selago* has scale-like radial corallites not arranged in a rosette.

Usually common.

Location. Reefs of Khanh Hoa Province, Con Dao, An Thoi, Tho Chu, Hon Hay Islands.

Distribution. Widely known in the Indo-Pacific from the Mascarene to Marshall Islands.

Acropora selago (Studer, 1878)

Fig. 27-4

Madrepora selago Studer, 1878

Acropora (*Acropora*) *selago* (Studer): Veron and Wallace (1984) cum syn.

Caespito-corymbose colonies, forming lamellar structures. Branching is frequent and regular. Branches are thin, 3-5 mm in diameter. Additional branching is irregular, sometimes anastomosing.

Axial corallites are exert for up to 3 mm. Radial corallites are scale-shaped and steeply crowded. They are arranged in staggered rows. Septa of the first cycle are short dentate laminae, rows of spines and separate denticles; spines are most common. In axial corallites, first cycle septa reach no more than half of a corallite radius. Second cycle septa are absent or incomplete, and have a length of no more than 1/3 of a corallite radius. In radial corallites even septa of the first cycle can be incomplete, and second cycle septa are always incomplete; they do not exceed ¼ of a corallite radius. The directive primary septa are always distinguishable. Corallites have fine costae with divided lamellar spinules. The intercorallite coenosteum is also costate, and more dense on primary branches.

Living colonies are brown.

Similar species *A. tenuis* has thicker branchlets and radial corallites arranged in a rosette.

Uncommon.

Location. Dao Chao, Culao Cham, Con Dao, Tho Chu and An Thoi Islands.

Distribution. Known on the reefs of Vietnam, in the Central and Western Pacific, and on the Marshall and Solomon Islands.

Acropora donei Veron and Wallace, 1984

Fig. 27-2

Caespito-corymbose colonies, forming large corymbose laminae or plates. Branches are highly anastomosing, with numerous horizontal and subhorizontal sub-branchlets.

Axial corallites are immersed, with moderate, thin walls. Radial corallites are weakly exert, crowded, arranged in vertical rows. They have nariform or dimidiate calices, often immersed on the periphery. Septa are weakly developed. The cyclic nature of septa cannot always be distinguished. Septa can be represented by bilaterally symmetrical rows of spines. Directive primary septa are always present. Axial corallites can have two septal cycles of dentate short laminae or merging rows of spines. The length of septa of axial corallites does not exceed 2/3 of a corallite radius, and that of radial septa no more than a half. Corallites are covered by costae with a lattice structure. Coenosteum between corallites is very coarse, with anastomosing spinules, with split tips.

Living colonies are brown.

Similar species *A. yongei* has similar corallites but does not have upturned branches.

Rare.

Location. Re Island.

Distribution. South Vietnam and the Great Barrier Reef of Australia.

Acropora dendrum (Bassett-Smith, 1890)

Fig. C3-3

Madrepora dendrum Basset-Smith, 1890

Acropora (*Acropora*) *dendrum* (Bassett-Smith): Veron and Wallace (1984) cum syn.

Colonies form corymbose plates up to l m across, usually characterised by tapering branchlets and sub-immersed corallites. Branchlets are smooth or have incipient axial corallites and sub-branchlets developed near their tips. Where incipient axial corallites are prolific, the remaining radial corallites are tubular appressed, usually with nariform openings near branch tips and are sub-immersed elsewhere. They have calice diameters of 0.5-0.9 mm. Septa are thick, irregularly fused and very irregular in shape and number, so that separate cycles can not be distinguished. Two directive septa can usually be distinguished (especially in nariform corallites), with the remaining first cycle reaching up ¼ R to 2/3 R. Second cycle septa are sub-equal to absent. They are all strongly dentate. Axial corallites are similar in size and structure to radial corallites, except that septa are usually better developed and more clearly arranged in two cycles, the first up to 2/3 R, the second smaller and incomplete. The coenosteum in between corallites is uniform and consists of fused blunt spinules. Living colonies are brown.

Similar species *A. microclados* has tubular radial corallites and incipient axial corallites.

Rare.

Location. Reefs of Khan Hoa Province.

Distribution. South Vietnam and the central Indo-Pacific, depth 5-20 m.

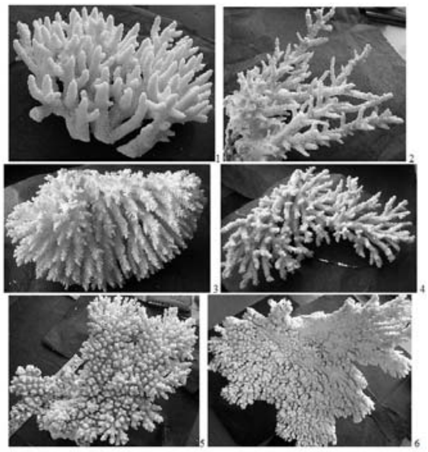


Fig. 27. Appearance of colonies. 1 – *Acropora millepora*, spec. 1/9554, Namsu Island; 2 – *A. donei*, spec. 1/9557, Namsu Island 3 – *A. tenuis*, spec. 1/9555, Tho Chu Island; 4 – *A. selago*, spec. 1/9556, Khanh Hoa Province; - *A. cytherea*, spec. 1/9558, Khanh Hoa Province; 6 - *A. microcladas*, spec. 1/9559, Re Island

Acropora cytherea (Dana, 1846)

Fig. 27-5, C3-2

Madrepora cytherea Dana, 1846

Acropora cytherea (Dana): Hoffmeister (1929), Crossland (1952), Wallace (1978)

Acropora (*Acropora*) *cytherea* (Dana): Veron and Wallace (1984) cum syn.

Caespito-corymbose lamellar or plate-like round colonies, often multilayered. Radial thin branches are usually highly anastomosed, with numerous short additional branchlets, with one or more exert axial corallites.

Axial corallites are exert for up to 5 mm, and have a diameter not more than 2.5 mm. Radial corallites are crowded, tubular, with nariform or dimidiate openings, often lip-shaped, with slight widening downwards. Septa are weakly developed in many corallites. Axial corallites have a complete set of septa of the first cycle with a length of up to 2/3 of a corallite radius. Second cycle

septa are rare, incomplete, and made of spines. Radial corallites on primary branches do not always have well developed septa even of the first cycle. They are mainly represented by reduced spines. Corallite surfaces are covered by costae, often consisting of whole long ridges, which form a lattice structure together with synapticulae. This framework continues into intercorallite space, where it has an incoherent texture.
Living colonies are pale-yellow, brown, and more rarely blue.

Similar species *A. hyacinthus* has branchlets without exserting axial corallites and radial corallites arranged in a rosette.

Common.

Location. Distributed from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely known in the Indo-Pacific from Madagascar to Hawaii.

Acropora microclados (Ehrenberg, 1834)

Fig. 27-6

Acropora (*Acropora*) *microclados* (Ehernberg): Veron and Wallace (1984) cum syn.

Corymbose colonies, symmetrically forming round lamellar structures from the place of attachment. Radial thin branches are usually highly anstomosed, with frequent additional branchlets, arranged vertically, with excert axial and radial corallites.

Axial corallites are exert up to 5-7 mm, tubular, having a diameter of not more than 2 mm. Radial corallites are long and immersed, or short and crowded. They have a tubular shape with labellate or nariform openings, and calices are 0.6-1.2 mm diameter. Most corallites are arranged in rows. Not all corallites have septa developed. Septa are represented by irregular large and small spines, and more rarely by short laminae. In axial corallites septa can be of two cycles, as a rule, not longer than ½ of a corallite radius. The second cycle of septa is incomplete. Radial corallites do not always have septa of the first cycle in a complete set, and they are no more than 1/3 of a corallite radius. The second cycle of septa is absent or incomplete, and is no longer than ¼ of a corallite radius. Directive septa can be found in some corallites. Corallites are covered by fine costae consisting of lamina and spinules. Coenosteum on branches is costate, with irregular spinules.
Living colonies are shades of brown.

Similar species *A. macrostoma* does not have nariform corallite openings.

Rare

Location. Nam Su and Re Islands.

Distribution. South Vietnam, Indonesia, and the Great Barrier Reef of Australia.

Acropora paniculata Verrill, 1902

Fig. 28-1

Acropora paniculata Verrill, 1902

Acropora (*Acropora*) *paniculata* Verrill: Veron and Wallace (1984) cum syn.

Lamellar or plate-like colonies with marginal attachment. Sometimes laminae can be rounded and funnel-shaped. Branches are thin, radial, with numerous additional branching, which can be vertical in the central part of a colony. Long axial and radial corallites diverge irregularly from small branchlets.

Axial corallites are exert for up to 7 mm, thin-walled, cylindrical, with a very deep calices. Radial corallites are variable in shape, size and their connection with branches, from which they bud. They can be long (up to 5-6 mm), tubular, with straight or oblique openings and diverging from a branch at right angle, or short, tubular, slightly bent, with an oblique calice, or crowded nariform and lip-shaped, or almost immersed, with slightly immersed porous walls and a straight opening. Corallite diameters are almost uniform and do not exceed 2 mm. Septa in all corallites are weakly developed. Axial corallites and long radials have a incomplete sets of septa in the first cycle, represented by perforated, very short laminae or rows of spines. Small septa composed of single spines are observed in some corallites. In radial corallites septa of the first cycle are incomplete and are needle-like denticles. A complete set of septa of the first cycle is present in subimmersed corallites with directive primary septa, which can reach ¾ of a corallite radius. Corallites are covered by fine costae, and have a porous wall. Intercorallite coenosteum has a similar structure, highly porous, with irregular squamates.

Living colonies are is cream or blue.

Similar species *A. cytherea* has thinner plates and branchlets which do not terminate in masses of tubular corallites.

Rare.

Location. Con Dao, Phu Quy Islands.

Distribution. South Vietnam, the Great Barrier Reef of Australia, Fiji, and Hawaii.

Acropora hyacinthus (Dana, 1846)

Fig. 28-2, C5-6

Madrepora hyacinthus Dana, 1846

Acropora hyacinthus (Dana): Hoffmeister (1925), Wells (1954), Wallace (1978)

Acropora (*Acropora*) *hyacinthus* (Dana): Veron and Wallace (1984) cum syn.

Caespito-corymbose lamellar or plate-like round colonies with marginal attachment. They often form multilayer spiral forms or bent funnel-shapes. Radial branches are compactly arranged, they are highly anastomosed, and have many short branchlets.

Axial corallites are exert for not more than 2 mm, have a cylindrical shape with a deep calice of 0.6-1 mm diameter. Radial corallites are situated around an axial and a branch, forming a rosette. They are highly crowded, of a labellate form, with a dimidiate or nariform opening. Corallites of the primary horizontal branches are cylindrical or immersed. Septa in different colonies or in similar corallites can be well developed or reduced to single spines, with poorly differentiated cycles. The most completely developed septa are in axial corallites with directive primary septa with the length of up to ¾ of a corallite radius. First cycle septa in such corallites can be complete, or minor and incomplete, or reduced to separate spines or absent. Radial corallites more often have only several septa on the lower side of the calice, and one directive is larger. Corallite walls have distinct costae, which intersects synapticulae, forming a lattice structure. Intercorallite coenosteum, if any, is costate, consists of short irregular spinules, and can be porous and scaly in some parts of the colony.

Living colonies color are cream, brown or green with light or blue peripheral margins.

Similar species. See *Acropora cytherea* and *A. spicifera*.

Usually common.

Location. Everywhere up to the northern part of the Gulf of Tonkin.

Distribution. Known on Indo-Pacific reefs from the Mascarene Islands to Tahiti.

Acropora anthocercis (Brook, 1893)

Fig. 28-3, C5-8

Madrepora anthocercis Brook, 1893

Acropora (*Acropora*) *anthocercis* (Brook): Veron and Wallace (1984) cum syn.

Colonies are thick-lamellar, with side or central attachment, often having a subcorymbose shape. Branching is mostly vertical or slightly inclined. Branches are short, anastomose, with a great number of small branchlets, and branchlets may have several axial corallites.

Axial corallites are exert for 5-7 mm, of slightly conical shape, with a diameter of 2-2.5 mm. Radial corallites are crowded, nariform, often labellate, with a thick lower wall and a calice diameter of about 1 mm. Corallites on the primary branches are immersed or rounded. In axial corallites septa of the first cycle are developed, usually complete, more than ½ of a corallite radius, and second cycle septa are reduced, not more than ¼ of a corallite radius. Radial corallites have weakly developed first cycle septa and second cycle septa composed of separate spines. All septa are irregular and represented by denticles and spines. Coenosteum on corallites and between them is presented by dense rows of thin flat spinules.

Colony color is pale-yellow, blue-green.

Similar species *A. hyacinthus* has smaller and less appressed radial corallites.

Relatively rare.

Location. Con Dao, An Thoi Islands.

Distribution. Known on Indo-Pacific reefs from the Red Sea to the Great Barrier Reef of Australia.

Acropora latistella (Brook, 1892)

Fig. C4-1

Madrepora latistella Brook, 1892

Acropora latistella (Brook): Hoffmeister (1925)

Acropora (Acropora) *latistella* (Brook): Veron and Wallace (1984) cum syn.

Colonies are corymbose, corymbose plates or caespitose. Branches are 5-9 mm thick and are relatively straight in corymbose and caespitose colonies or curved in corymbose plate colonies. Sub-branches form at acute angles but do not anastomose.

Radial corallites are regularly arranged, usually in rows along branches, and are tubular appressed, with open rounded to slightly dimidiate calices. Radials towards the proximal ends of branches become immersed. Axial corallites are 2-3 mm diameter and < 2 mm exsert. Both axial and radial corallites have calices 0.6-0.9 mm diameter and septa which slope steeply. Septa of axial corallites are in two cycles, usually incomplete, up to 3/4 R and ½ R but usually less. Septa are dentate, especially those of the second cycle. Radial corallites have two incomplete cycles, up to ½ R and ¼ R, but are usually much less, so that most have sub-equal septa of < ¼ R. One or two directive septa can usually be distinguished. The coenosteum on radial corallites is costate or broken costate, usually with lines of simple to elaborate spinules. Between corallites, the spinules are still present, sometimes with a dense infilling between them.

Living colonies are usually a uniform pale cream, grey or brown, sometimes green or purple. Branch ends sometimes have yellow tips.

Similar species *A. valida* and *A. nana* have longer radial corallites which are completely appressed.

Relatively rare.

Location. Known on Re Island and Khanh Hoa Province, 3-10 m deep.

Distribution. Common except in the central and western Indian Ocean where it is only known from a few records.

Acropora aculeus (Dana, 1846)

Fig. 28-4

Acropora aculeus (Dana): Faustino (1927), Nemenzo (1967), Wallace (1978)

Acropora (*Acropora*) *aculeus* (Dana): Veron and Wallace (1984) cum syn.

Colonies are corymbose or corymbose-lamellar. Lamellar colonies, as a rule, have a thick attachment side with horizontal branches, rarely anastomosed. Branchlets more often are symmetrical. Axial corallites on branch tips dichotomize.

Axial corallites project for 2-4 mm, are cylindrical, with a deep calice and a distinct theca. Radial corallites are crowded, tubular, with a round scale-like calice. They are located at a distance of 3-4 mm from each other along the branches. Septa are well developed. Axial corallites have a complete set of first cycle septa with well developed directive primary septa up to 2/3 of a corallite radius. The second cycle of septa are not more than 1/3 of a corallite radius, and can be incomplete. First cycle septa of radial corallites are short tapered dentate laminae or rows of spines, which are not more than a half of a corallite radius. Second cycle septa are often incomplete and are represented by rows of flat and tapered spines, merging into noncontinuous laminae. They are reduced in many corallites. Corallite surfaces are covered by rows of flat spinules. Coenosteum between corallites is similar, and includes slightly split spinules.

Colony color is brown.

Similar species *A. latistella* and *A. subulata* are readily differentiated by colony shape, clearly formed axial corallites, and tubular and appressed radial corallites.

Rare.

Location. Con Dao Islands.

Distribution. Sri Lanka, South Vietnam, Samoa, the Marshall Islands and the Great Barrier Reef of Australia.

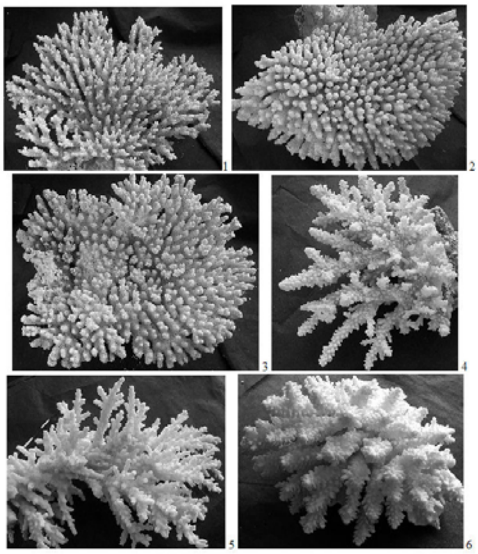


Fig. 28. Appearance of colonies. 1 – *Acropora paniculata*, spec. 1/9560, Thu Island; 2 – *A. hyacinthus*, spec. 1/9561, Bai Kanh Bay; 3 – *A. antocercis*, spec. 1/9562, Con Dao Islands; 4 – *A. aculeus*, spec. 1/9563, Khanh Hoa Province; 5 – *A. cerealis*, spec. 1/9564, Con Dao Islands; 6 – *A. nasuta*, spec. 1/9565, Tho Chu Island

Acropora cerealis (Dana, 1846)

Fig. 28-5

Madrepora cerealis Dana, 1846

Acropora cerealis (Dana): Faustino (1927), Nemenzo (1967), Wallace (1978)

Acropora (*Acropora) cerealis* (Dana): Veron and Wallace (1984) cum syn.

Caespito-corymbose colonies, forming corymbose laminae with short highly anastomosed branches, diverging regularly.

Axial corallites are 1-2 mm exsert, round and tubular, straight, with moderately thick walls. Radial corallites are crowded and nariform. They become more elongated towards the branch tips, and openings become more oblique. Corallite diameter varies from 1 to 1.8 mm with a calice diameter of 0.6-0.8 mm. Septa of axial corallites can be complete or incomplete. They are represented by rows of spines or by dentate laminae with a length of ¼-3/4 of a corallite radius. In radial corallites only septa of the first cycle may be complete, represented by rows of spines and more rarely by short dentate laminae. The directive primary septa are mainly lamellar and larger than other septa. Second cycle septa are weakly developed or absent. The coenosteum on radial corallites is costate, formed by slightly or moderately divided spinules. Costae can be clear and quite unexpessed nearer the upper edge of a corallite. In intercorallite space spinules are uniform, and coenosteum is reticular and sometimes porous.

Living colonies are pale-yellow, brown.

Similar species *A. nasuta* has nariform radial corallites but is corymbose.

Usually common.

Location. Culao Cham, Re, An Thoi, Con Dao and Hon Hay Islands, Turan Cape, reefs of Khanh Hoa Province.

Distribution. Known from the reefs of Vietnam, the Philippines, Indonesia, Tonga, the Marshall Islands and the Great Barrier Reef of Australia.

Acropora nasuta (Dana, 1846)

Fig. 28-6, C5-7

Madrepora nasuta Dana, 1846

Acropora nasuta (Dana): Hoffmeister (1929), Wells (1954), Nemenzo (1967), Wallace (1978)

Acropora (*Acropora*) *nasuta* (Dana): Veron and Wallace (1984) cum syn.

Colonies are corymbose or small comorymbose laminae with short branches, often without secondary branching, densely covered by vertically arranged corallites.

Axial corallites are 1-2 mm exert. They have a straight cylindrical shape with a diameter of 0.5-1 mm. Radial corallites form distinct dense rows. Corallites are tubular-nariform, sometimes digitate in the middle and lower parts of branches. Corallites often project nearly at right angles to the branch. Subimmersed corallites of somewhat smaller sizes are distributed in the lower parts of branches. First cycle septa are present in almost all corallites. They are represented by slightly tapered laminae, dentate to various degrees, and reaching ¾ of a corallite radius in axial corallites. The directive primary septa are clearly distinguished by their larger size. Second cycle septa can be complete, especially in radial corallites, or they can be rows of spines or separate spines, or can be completely absent. As a rule, they do not reach more than ¼ of a corallite radius. Radial corallites are covered by dense rows of moderately divided spinules or spiny costae. Coenusteum between corallites is reticular, with uniform spinules.

Living colonies are pale-yellow with purple or blue tips.

Similar species *A. cerealis* has interlocking branches and radial corallites with flaring lips.

Common.

Location. Known everywhere from Turan Cape to the Gulf of Siam.

Distribution. Can be found from the Red Sea to Tahiti.

Acropora valida (Dana, 1846)

Fig. 29-1, C16-8

Madrepora valida Dana, 1846

Acropora valida (Dana): Verrill (1902)

Acropora (*Acropora*) *valida* (Dana): Veron and Wallace (1984) cum syn.

Colonies are corymbose or caespitose- corymbose, forming a number of shapes from compact bushes to laminae with attachment on one side. Branches are short and anastomosed, with frequent additional branching closer to the upper surface of the colony.

Axial corallites are exert up to 2 mm. They have a slightly conical shape and rather thick wall (up to 1 mm). Radial corallites are subimmersed or exsert, moderately or highly crowded, and tubular. A calicular openings are round, sometimes nariform. The diameter of corallites (1.6-2 mm) can be uniform within a colony or can vary. Calice diameters are 0.4-0.7 mm, and are uniform for the same coral. Septa of both cycles are developed, as a rule, most corallites. They are represented by even, slightly tapered, short laminae or by rows of spines, merging into dentate laminae. Axial corallites have two complete sets of septa, reaching ½ of a corallite radius. The directive primary septa are distinguished by their larger sizes. In radial corallites first cycle septa are complete, in the form of laminae reaching 2/3 of a corallite radius. The second cycle of septa is more often are complete than incomplete, but the septa are shorter than the first cycle of septa. The second cycle of septa in small subimmersed corallites is incomplete. The directive primary septa are clearly distinguished. Corallites are covered by costae, which can have the tips of spinules moderately divided or not divided. Intercorallite coenosteum is spongy and coarse.
Living colonies are shades of yellow-brown.

Similar species *A. variabilis* and *A. nasuta* are similar but the strongly appressed radial corallites of *A. valida* are distinctive.

Relatively common.

Location. Reefs of Khanh Hoa Province, the Gulf of Siam, Hon Hay Island.

Distribution. Found from the Red Sea to Hawaii.

Acropora secale (Studer, 1878)

Fig. 29-2

Madrepora secale Studer, 1878

Acropora secale (Studer): Verrill (1902)

Acropora (*Acropora*) *secale* (Studer): Veron and Wallace (1984) cum syn.

Colonies are corymbose or corymbose plates with marginal attachment. Branches are short, narrowing towards the tip. There can be a dense arrangement of single sub-branches.

Axial corallites are exert up to 2.5 mm. They are rounded and subcylindrical with a diameter of 2.5-3 mm diameter. Radial corallites are exert, rarely crowded, and as a rule, are arranged in vertical rows. Corallites with circular or oval openings have walls that are uniformly flattened, and corallites that have tubular-nariform openings are flattened on one side. Subimmersed and immersed corallites are situated between exsert corallites and the same or slightly smaller sizes. Complete sets of both cycles of septa are developed only in axial corallites. Septa project as rows of spines or short slightly tapered laminae, rarely reaching more than a half of the corallite radius. Second cycle septa reach no more than 1/3 of a corallite radius. Radial corallites have a complete first cycle of septa and single small distinct septa. Directive primary septa in all corals are clearly distinguished by their larger size. Corallite surfaces are densely covered by pointed or flat spinules, weakly divided and sometimes forming costae. Intercorallite coenosteum is similar, but less dense.

Living colonies are yellow-brown or blue-green.

Similar species *A. valida* has smaller radial corallites.

Relatively rare.

Location. Reefs of Khanh Hoa Province, Con Dao and An Thoi Islands.

Distribution. Widely distributed on Indo-Pacific reefs.

Acropora lutkeni Crossland, 1952

Fig. 29-3

Acropora lutkeni Crossland, 1952

Acropora (*Acropora*) *lutkeni* Crossland: Veron and Wallace (1984) cum syn.

Colonies are corymbose, caespito-corymbose and hispidose. The main branches are short and straight, with round tips, and may be digitate. In hispidose colonies branches are subhorizontal, thick (30-40 mm), straight or slightly bent. Further branching is rare in all colonies.

Axial corallites are almost non-exsert, round, with thick walls (up to 2.5 mm thick). Radial corallites are exsert and crowded, tubular and nariform. Their diameter varies from 0.8 to 2 mm. Corallite walls are uniformly thick or flattened on one side. In branched colonies corallite walls sometimes can be thin on branch ends. First cycle septa form rows of spines or short, dentate laminae in most corallites. First order septa in axial corallites reach 2/3 of the corallite radius, and second cycle septa are weakly developed or absent. In axial corallites of some colonies septa of both cycles can be developed which do not exceed 1/3 of a corallite radius. Radial corallites have weakly developed septa, consisting of two cycles of septa. The second cycle of septa is more often incomplete, and, as a rule, does not exceed 1/3 of a corallite radius. The directive septa are distinguished by their larger size. Corallite surfaces are densely covered by flat spinules with moderately divided tips. Intercorallite coenosteum is similar and reticular.

Living colonies are green or brown.

Similar species *A. austera* has twisted branches.

Uncommon.

Location. An Thoi, Hon Hay Islands and Baitylong Archipelago.

Distribution. Vietnam, the western and eastern coasts of Australia.

Acropora clathrata (Brook, 1891)

Fig. 29-5, C5-2

Madrepora clathrata Brook, 1891

Acropora clathrata (Brook): Wallace (1978)

Acropora (*Acropora*) *clathrata* (Brook): Veron and Wallace (1984) cum syn.

Branched-lamellar, lamellar colonies with irregularly anastomosing branches. Branches 8-10 mm thick can almost merge with each other up to formation of round thin plates, or can be located at various distances from each other, forming perforated plates up to subarborescent colonies.

Axial corallites are weakly exsert, cylindrical, with a straight deep calice and perforated wall. Radial corallites are characterized by a highly variable shape. They can be exsert or immersed, diverging far from a branch at various angles and crowded. Tubular, round, dimidiate, tubular-nariform and nariform corallites can be found within the same colony. They do not form regular vertical rows, but a tend to form scaly-irregular rows, which results in a coarse and barbed appearance of a colony. Septa are represented mainly by first cycle septa as rows of spines or short, dentate laminae. In axial corallites, first cycle septa do not exceed 1/3 of a corallite radius. Radial corallites have first cycle septa reaching ½ of a corallite radius, or ¾ of a corallite radius in long tubular exsert corallites. Second cycle septa in all corallites are weakly developed or absent. Directive primary septa are clearly distinguished by their larger sizes. Corallites are covered by distinct costae, which sometimes split into a series of separate flat plates. Intercorallite coenosteum is reticular.

Living colonies are brown or green.

Similar species *A. glauca* may have a very similar growth-form.

Uncommon.

Location. Culao Cham, Re, Tho Chu Islands.

Distribution. Widely known in the Indo-Pacific from La Reunion Island in the Indian Ocean to the Tuamotu Archipelago in the Pacific.

Acropora divaricata (Dana, 1846)

Fig. 29-4

Madrepora divaricata Dana, 1846

Acropora divaricata (Dana): Wallace (1978)

Acropora (*Acropora*) *divaricata* (Dana): Veron and Wallace (1984) cum syn.

Corymbose colonies with central or lateral attachment, sometimes lamellar. Branching is caespitose; in lamellar colonies branches are subhorizontal, merging with each other.

Axial corallites on tips can be free of radial corallites. They have a straight, tubular shape. In lamellar colonies axial corallites are weakly exsert and conical. Axial corallite diameter is 2.5-3 mm, calice diameter up to 1 mm. Radial corallites are distinguished by their variable shape. They can be highly exsert (up to 3 mm) on branch tips or crowded and scale-shaped. Exsert corallites diverge from branches at various angles – from 45 to 90º. Corallites are tubular, nariform-tubular, nariform or beak-shaped. Septa are also highly variable. Septa can be of two well-developed cycles or only one rudimentary cycle. They are represented by thin laminae, rows of spines or separate spines. The directive primary septa are distinguished by their larger sizes. The length of the first cycle septa does not exceed half of a corallite radius. Second cycle septa, if any, are not more than ¼ of a corallite radius. Corallites are covered by vertical rows of flat spinules with slightly divided tips. Intercorallite coenosteum is spongy.
Living colonies are brown or green-brown.

Similar species. See *A. nasuta.*

Common.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam.
Distribution. Found in the Indo-Pacific from the Seychelles to Fiji.

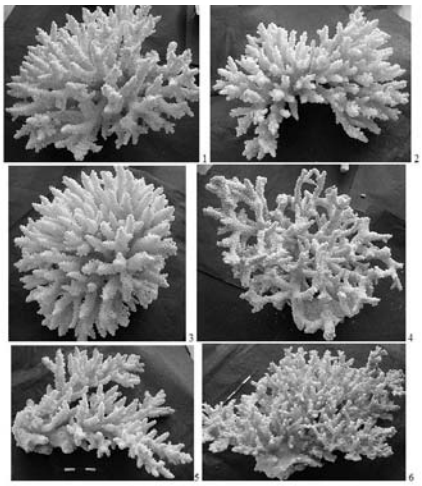


Fig. 29. Appearance of colonies. 1 – *Acropora valida*, spec. 1/9566, Re Island; 2 – *A. secale*, spec. 1/9568, Phu Quoc Island; 3 – *A. lutkeni*, spec. 1/9567, Khanh 4 – *A. divaricata*; 5 – *A. clatrata*, spec. 1/9569, Cham Island; 6 – *A. subglabra*, spec. 1/9571, Namsu Islands

Acropora subglabra (Brook, 1891)

Fig. 29-6

Madrepora subglabra Brook, 1891

Acropora subglabra (Brook): Thiel (1933), Nemenzo (1967), Wallace (1978)

Acropora (*Acropora*) *subglabra* (Brook): Veron and Wallace (1984) cum syn.

Colonies are hispidose, with irregular lateral branching, covered by dense short branchlets with highly exert axial corallites.

Axial corallites project 4-5 mm and have a diameter of 1.5 mm. They are tubular, straight, and slightly conical, with a diameter of 0.5-0.6 mm. Radial corallites are tubular, crowded, sometimes subimmersed, with a straight or slightly oblique opening. Axial corallites on branchlets can protrude 5-7 mm. First cycle septa form short laminae or rows of flat spines, and are most complete in immersed and subimmersed corallites. In other corallites they are, as a rule, incomplete and do not exceed ¼ of a corallite radius. Second cycle septa are usually incomplete or absent. First cycle septa can be long particularly deep in the calice. Corallite surfaces are covered by fine dotted costae. Intercorallite coenosteum is reticular, represented by mixed irregularly flattened ridges and spinules.

Living colonies are brown with light branch tips.

Similar species *A. echinata* has much longer axial corallites.

Rare.

Location. Gulf of Siam, Thom and Rut Islands.

Distribution. Known in the Western Pacific from the Ryukyu Islands to the Great Barrier Reef of Australia.

Acropora elseyi (Brook, 1892)

Fig. 30-1, C19-6

Madrepora elseyi Brook, 1892

Acropora elseyi (Brook): Pillai and Scheer (1976), Wallace (1978)

Acropora (*Acropora*) *elseyi* (Brook): Veron and Wallace (1984) cum syn.

Bushy arborescent colonies with hispidose sub-branches. Branching can be consistently symmetrical or irregular, widening upwards in a shape of a bunch of flowers. Primary and secondary branches can differ slightly in length and branch diameters.

Axial corallites are numerous, 2 mm exsert. They are situated on the tips of primary and secondary branches can form short branchlets with several radial corallites among the primary and secondary branches. Corallite diameters vary from 1.5 to 3 mm, and walls are thick, up to 2 mm. Radial corallites are long or short, exsert, subimmersed, crowded, and tubular with with rounded edges. First cycle septa are well developed in axial and radial corallites, forming straight slightly tapered laminae up to ¾ of a corallite radius. Second order septa, not more than ¼ of a corallite radius, can be incomplete or completely absent. Directive primary septa are clearly distinguished by their slightly larger sizes. Corallite surfaces are densely covered by moderately divided spinules. Intercorallite coenosteum is similar.

Living colonies are shades of yellow-brown.

Similar species. See *A. longicyathus* and *A. subglabra*.

Relatively rare.

Location. Con Dao Islands, Gulf of Siam.

Distribution. Known in the Maldives, in South Vietnam, and on the eastern coast of Australia.

Acropora insignis Nemenzo, 1967

Fig. C24-5

Colonies form compact irregular corymbose clumps with distal branches much finer than proximal branches. . Primary and secondary branches can differ slightly in length and branch diameters.

Axial corallites are long and tubular. They are exert for up to 3 mm. Radial corallites are widely spaced, immersed on main branches, scale-like on distal branches.

Living colonies are with white branches with contrastingly coloured with brownish - green radial corallites and branches. This colour pattern is useful for identification.

Similar species: *A. selago*, which has a more regular branching pattern with larger and more closely spaced scale-like radial corallites not intermixed with immersed corallites.

Uncommon.

Location. Con Dao and Thocu Islands, Gulf of Siam, dept 6-15 m.

Distribution. Known in Known in the south-west Pacific.

Acropora longicyathus (Edwards and Haime, 1860)

Fig. 30-2, C4-2

Madrepora longicyathus Edwards and Haime, 1860

Acropora longicyathus (Edwards and Haime): Nemenzo (1967), Wallace (1978)

Acropora (*Acropora) longicyathus* (Edwards and Haime): Veron and Wallace (1984) cum syn.

Colonies from subarborescent to bottlebruch-branched, with upright primary and secondary branches, with numerous radially exsert long axial corallites. Colonies with relatively long lateral branching and exert corallites more often form bunch-like growth forms, hispidose colony forms are quite common.

Axial corallites are tubular, slightly conical, with round deep calices, with walls, as a rule, that have a thickness of not less than 1 mm. Radial corallites are crowded or partially crowded. They have a clear tubular shape with a regular round opening, sometimes slightly nariform on branch tips. Near the base of branches, radial corallites can form independent branching, exsert 7-10 mm from a branch base. First cycle septa are, as a rule, well developed. They are represented by straight, sometimes noncontinuous lamimae up to ¾ of a corallite radius. Second cycle septa are rarely present as a complete set. More often they are incomplete, or can be completely absent, and do not reach more than 1/4 of a corallite radius. Corallite surfaces are covered by laminar spinules, moderately divided, sometimes arranged in longitudinal rows. When intersecting septa and synapticulae they form a lattice structure. Intercorallite coenosteum is similar.

Living colonies are shades of brown.

Similar species *A. loripes* has radial crowded or subcrowded corallites, rarely exsert, with a straight or slightly oblique opening, sometimes nariform.

Relatively common.

Location. Re, Thu, Tho Chu, Con Dao and Spratly Islands.

Distribution. Known in South Vietnam, in the Philippines and the Great Barrier Reef of Australia.

Acropora loripes (Brook, 1892)

Fig. 30-3, C17-2

Madrepora loripes Brook, 1892

Acropora (*Acropora*) *loripes* (Brook): Veron and Wallace (1984) cum syn.

Colonies are hispidose, corymbose or lamellar, with central or marginal attachment. Lamellar colonies often have simple axial corallites with rare radial corallites or without radials. Groups of axial corallites develop on tips of primary and secondary branching.

Axial corallites are exert up to 3 mm, are tubular, and have thick walls. The upper surface of secondary axial corallites, formed on lower branches, can lack radial corallites. Radial corallites are crowded or subcrowded, rarely exsert, with a straight or slightly oblique opening, sometimes nariform. They are irregularly situated on primary and secondary branches. First cycle septa are well developed in all corallites. In the axials they reach ¾ of a corallite radius, and in radials, not more than half. Second cycle septa are most complete in axial and immersed radial corallites. In other corallites they are usually incomplete or absent. Corallite surfaces and intercorallite coenosteum consist of lamellar spinules, moderately divided, sometimes forming longitudinal rows. Living colonies are brown.

Similar species *A. granulosa* has more elongate axial corallites.

Usually uncommon.

Location. An Thoi, Con Dao, Hon Hay and Phu Quy Islands.

Distribution. South Vietnam, the Philippines and the Great Barrier Reef of Australia.

Acropora granulosa (Edwards and Haime, 1860)

Fig. 30-4

Madrepora granulosa Edwards and Haime, 1860

Acropora granulosa (Edwards and Haime): Wallace (1978)

Acropora (*Acropora*) *granulosa* (Edwars and Haime): Veron and Wallace (1984) cum syn.

Colonies are horizontal-lamellar, round or branched-bunch-like, with marginal attachment. The primary and secondary branching is irregular, with short amastomosed branches and frequent independently branching axial corallites.

Axial corallites are 15 mm exert, 3-3.5 mm in diameter, with a calice, as a rule, smaller than 1 mm diameter. Radial corallites are of two shapes: long, 10-12 mm exsert, tubular, and short, crowded, tubular or nariform, sometimes subimmersed. First cycle septa are developed in all corallites. They are represented by dentate laminae, reaching ¾ corallite radius. Directive septa are usually distinguished by their larger sizes. Second cycle septa usually have an incomplete set, and sometimes are absent. In axial corallites they can reach 1/3 corallite radius. Corallite surfaces are densely covered by moderately divided spinules, sometimes arranged in longitudinal rows. Intercorallite coenosteum is similar.

Living colonies are cream or green.

Similar species *A. caroliniana* has larger, usually more tapered axial corallites.

Relatively common.

Location. Can be found from Danang Cape to the Gulf of Siam.

Distribution. Widely distributed in the Indo-Pacific from Réunion Island to Tahiti.

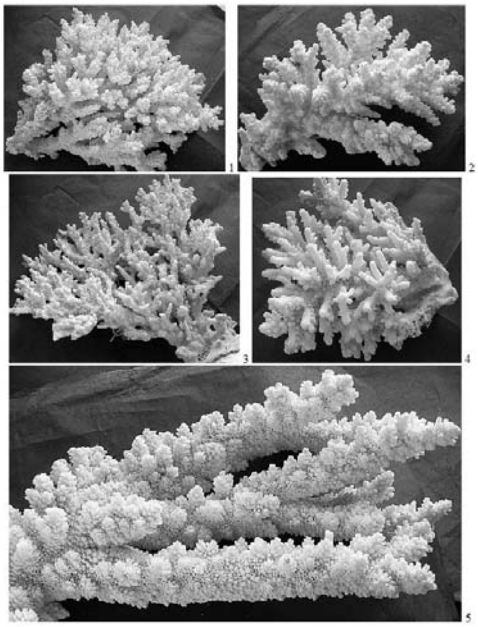


Fig. 30. Appearance of colonies. 1 – *Acropora elseyi*, spec. 1/9572, Con Dao Islands; 2 – *A. longicyathus*, spec. 1/9573, Tho Chu Island; 3 – *A. loripes*, spec. 1/9574, Namsu Islands; 4 – *A. granulosa*, spec. 1/9575, Tho chu Island; 5 – *A. florida*, spec. 1/9576, Namsu Islands

Acropora florida (Dana, 1864)

Fig. 30-5, C3-5

Madrepora florida Dana, 1864

Acropora florida (Dana): Wallace (1978)

Acropora (*Acropora*) *florida* (Dana): Veron and Wallace (1984) cum syn.

Colonies are hispidose, with anastomosing subhorizontal thick branches, covered by numerous short branchlets.

Axial corallites are exert not more than 2 mm. They are tubular with thick walls and a straight vertical opening. Axials are 2-3 mm diameter, with a calice diameter of 0.8-1.5 mm. Radial corallites are tubular and crowded, with a straight round or oblique openings. Corallite walls are thickened evenly or from some lower side. Radial corallites on the main branches are subimmersed or immersed. Septa are irregularly developed. First cycle septa are always present in all corallites. Their length is variable, sometimes the septa of radial corallites can be longer those of axials, but they do not reach more than 2/3 corallite radius. Second cycle septa can be complete in radial corallites and incomplete in axials. In axials they usually are better developed and reach half of a corallite radius. Corallite surfaces are costate, with perforated walls. Intercorallite coenosteum is costate or reticular, with slightly divided spinules.

Living colonies are shades of brown, and sometimes green.

Similar species *A. sarmentosa* has large axial corallites and smaller branches forming digitate colonies.

Usually common. Can form big colonies.

Location. Can be found everywhere, except the northern part of the Gulf of Tonkin.

Distribution. Widely distributed in the Indo-Pacific from the Seychelles to the Marshall Islands.

Acropora parilis (Quelch, 1886)

Fig. C25-1

Colonies are compact bushes with delicate upright branches forming thickets. Numerous branches form at acute angles and densely disposed.

Axial corallites are long and tubular. Radial corallites are numerous tubular with nariform apertura. They are long near branch tips, shorter towards branch bases. They sa rule are directed by arow along of branches.

Living colonies are commonly green or brown with blonde or blue tips.

Similar species *Acropora exquisita*, which has thicker branches, branches at obtuse angles, and has radial corallites of mixed sizes and shapes.

Sometimes common and may be a dominant species.

Location. Thu and Thocu islands, dept 4-15 m.

Distribution. Distributed in the south-west Pacific.

Acropora sarmentosa (Brook, 1892)

Fig. 31-1, C17-5

Madrepora sarmentosa Brook, 1892

Acropora sarmentosa (Brook): Nemenzo (1967), Wallace (1978)

Acropora (*Acropora) sarmentosa* (Brook): Veron and Wallace (1984) cum syn.

Colonies are hispidose, with a tendency to form small lamellar shapes. The main branches are widely spaced, subhorizontal, anastomose, can branch dichotomously on the ends. Lateral branchlets are vertical and subvertical, short, and numerous.

Axial corallites are slightly exert, and have a thick porous wall up to 2 mm thick. Radial corallites are crowded, tubular, more rarely nariform. Corallite walls can be evenly thick, thin or thickened from one side. Radial corallites on the main branches are mostly immersed. As a rule, two cycles of septa are developed. First cycle septa in axial corallites can reach ¾ of a corallite radius, whereas in radials they are no larger than 2/3 R. Small septa usually do not have a complete set and do not reach more than half of a corallite radius. Corallite surfaces are costate, porous, with flat, slightly divided spinules. Intercorallite coenosteum is similar.

Living colonies are shades of green-brown with light or pink branch tips.

Similar species *A. samoensis* has shorter branches and distinctive axial corallites.

Usually common.

Location. Culao Cham, Re, Con Dao and An Thoi Islands and reefs of Khanh Hoa Province.

Distribution. Known from Vietnam, the Philippines, the Great Barrier Reef of Australia and Fiji, depth 5-20 m.

Acropora speciosa (Quelch, 1886)

Fig. C17-1

Madrepora speciosa Quelch, 1886

Acropora speciosa (Quelch): Veron, 1986

Colonies form thick cushions and bottlebrush branches. Axial and incipient axial corallites are large and elongate and only slightly taper. Radial corallites intergrade with axial corallites, but most are small, appressed and tubular or pocket-like. Each branchlet is composed of one or more axial corallites, which may be only arbitrarily distinguished from incipient axial corallites. Axial corallites are tubular, up to 15mm exsert, 1.2-3.5mm diameter, with calices usually <lmm diameter. First cycle septa are up to 3/4R, the second cycle varies from 1/3R to absent. There are two sorts of radial corallites on the branchlets; the first are incipient axial corallites, the second are tubular appressed or nariform. Corallites on main branches are mostly sub-immersed. They have primary septa up to 3/4R, usually with conspicuous directives and a reduced or absent secondary cycle. Septa are usually unperforated and have blunt, regular dentations. Most elongate corallites occupying radial positions with respect to an axial corallite develop secondary radial corallites and may then become incipient axial corallites. The colony surface is thus dominated by these tubular corallites. The coenosteum is primarily composed of very fine costae ornamented with fine, regularly spaced spinules.

Living colonies have a very wide range of colours. Uniform cream, grey or pale blue are the most common.

Similar species *A. echinata* has smaller corallites and does not form compact cushions.

Usually uncommon.

Location. Reefs of Khanh Hoa Province.

Distribution. Known from Vietnam, the Philippines, Indonesia, the Great Barrier Reef of Australia and Fiji, depth 5-20 m.

Acropora solitariensis Veron and Wallace, 1984

Fig. C20-1

Acropora solitariensis n.sp.Veron and Wallace, 1984

Acropora solitariensis Veron and Wallace: Veron, 1986

Colonies have an *A. divaricata*-like branching pattern, with a strong tendency for basal branches to become fused into a perforated or solid plate. The amount of fusion may vary greatly within biotopes and there is also considerable regional variation. Radial corallites are tubular appressed on branchlets, becoming immersed on basal branches. Calices are circular to nariform in shape and 1.0-1.3mm diameter. Septal development varies greatly within coralla. Both cycles may be present, up to 2/3R and 1/3R, but secondary septa are usually incomplete to absent. Primary septa may be of irregular lengths and directive septa are usually distinguishable or may be prominent. Axial corallites are up to 3mm exsert, 3.4mm diameter and have calices 0.7-1.0mm diameter. Septa are usually in complete cycles of 1/2R and 1/4R. All septa are thin plates, which may be irregularly dentate. The coenosteum is usually the same on and between corallites and is covered with rows of fine spinules, which may develop into distinct costae.

Living colonies are dark brown or green in colour.

Similar species. *Acropora natalensis* and *A. branchi*. See also *A. glauca*, which has a similar growth-form but has rounded peripheral corallites and indistinct axial corallites.

Usually uncommon.

Location. Reefs of Khanh Hoa Province.

Distribution. Common at subtropical locations, rare elsewhere.

Acropora samoensis (Brook, 1891)

Fig. C19-7

Madrepora samoensis Brook, 1891

Acropora samoensis (Brook): Veron and Wallace, 1984 cum syn.

Colonies are digitate, corymbose or prostrate, with curved branches which only slightly taper. Colonies may be over one metre across. The larger corallites are tubular or tubular appressed, thick-walled and have oval openings. They are < 2.8mm diameter, with calices 0.7-1.3mm diameter. They may be aligned in rows but are mostly irregularly spaced, being separated by the smaller corallites which are irregularly oriented and are tubular appressed to sub-immersed with rounded openings. All radial corallites have a poorly-developed septation, the first cycle consisting of two directive septa and the remainder <1/3R or absent and the second cycle <1/4R, incomplete or absent. Axial corallites are uniform in size and appearance, approximately 2mm exsert, 3-4.5mm diameter, with calices 1.2-1.4mm diameter. Septa are in two complete cycles up to 2/3R and 1/3R. The coenosteum on and between corallites is reticulate.

Living colonies are usually purple, blue (which may photograph pink) or cream.

Similar species: *Acropora sarmentosa* and *A. humilis*. See also *A. torresiana*, which has radial corallites of uniform size.

Usually uncommon

Location. Reefs of Khanh Hoa Province.

Distribution. Are known at tropical locations of Indo-Pacific.

Acropora fasciculare Latypov, 1992

Fig. 31-3

Acropora fasciculare sp. nov.: Latypov, 1992

Holotype: spec. 1/9578, Danang Cape, depth 3 m, coral and rubble beds.

Colonies are flat and round, with subdigitate and hispidose short branching (not longer than 20-30 mm), covered by very short dense lateral branching, forming clusters of up to 5 axial corallites on branch tips. The width of terminal branches rarely exceeds 15 mm.

Axial corallites are not exert. They are 4 mm in diameter with thick walls about 1 mm thick. Radial corallites are tubular, crowded, situated along branches in staggered rows, having a diameter of 1.8-2 mm and a calice diameter of 1.2-1.5 mm. Corallite walls are slightly thickened on the opposite side. Septa are well developed, represented by long laminae with wavy or dentate edges. The directive primary septa reach the corallite axis. In axial corallites first cycle septa of the first cycle reach 4/5 of a corallite radius, sometimes they reach the axis. In radial corallites are no larger than ¾ corallite radius, and usually they are dentate. Second cycle septa are similar and have a length of ½ - ¾ corallite radius. Corallite surfaces are covered by fine costae, formed by merged lamellar spinules, with dentate divided tips. The theca and synapticular rows are well developed. Intercorallite coenosteum is similar to that on corallites.

Living colonies are fawn colored.

Comparison. It differs from *A. sarmentosa* by well developed septa, formed by long septa of two cycles, and by the ability to form clusters of axial corallites on branch tips.

Rare.

Location. Danang Cape, depth 3-10 m.

Distribution. South China Sea and Central Vietnam.

Acropora papillare Latypov, 1992

Fig. 31-2

Acropora papillare sp. nov.: Latypov, 1992

Acropora indiana Wallace, 1994

Holotype: spec. 1/9579, Con Dao Islands, Ba Island, depth 1.5 m, organic detritus; paratype: spec. 1/9579, the same location.

Corymbose colonies with a wide and massive base. Branches are mammiform or icicle-shaped, slightly bent in a crescent, with round tips. Branch width is 20-40 mm, their length is 15-20 to 50-100 mm and diameter - 10-20 mm. They are regularly distributed on a colony surface, mostly adjoining each other in groups of 2-4 branches. Axial corallites are not exsert. They have a diameter of 2-3 mm, with a calice diameter of 1-1.25 mm. Radial corallites are immersed, with slightly flattened lip-shaped lower walls. Radials are small, not larger than 0.8-1 mm, they densely cover branch surfaces with little space between them, reaching numbers of 85-100 per sq. cm of branch surface. Both cycles of septa are developed only in axial corallites. First cycle septa protrude are thin laminae, reaching not more than ½ of a corallite radius. Second cycle septa reach not more than ¾ of the length of first cycle septa. Directive primary septa are clearly distinguished by their larger sizes. In radial corallites complete septal sets were not observed. Usually only one directive septa is present in radial corallites. They are represented by short spines, rarely merging with each other. The septa of radial corallites are better developed near branch bases. Directive primary septa can merge in laminae and reach the axis near the calice base. The rest of the septa of the first and second cycles are represented by separate spines or short noncontinuous laminae, not forming a complete set of septa. The entire surface of branches and small space between the branches is covered by radial corallites, which have distinct costae.

Living colonies are green-brown.

Comparison. *Acropora papillare* differs from all other known species of *Acropora* by not having exert axial corallites, by having only one type of radial corallites, and by the longitudinal arrangement of radial corallites.

Rare.

Location. Con Dao Islands.

Distribution. South Vietnam and the south-west Pacific.

Genus *Astreopora* Blainville, 1830

Type species: *Astraea myriophthalma* Lamarck, 1816

Diagnosis. Massive, encrusting-massive and subramose colonies without axial corallites. Corallites are large, with a distinct solid wall. Two cycles of septa are normally present, the third cycle is incomplete. Coenosteum is reticular, with a barbed spiny surface.

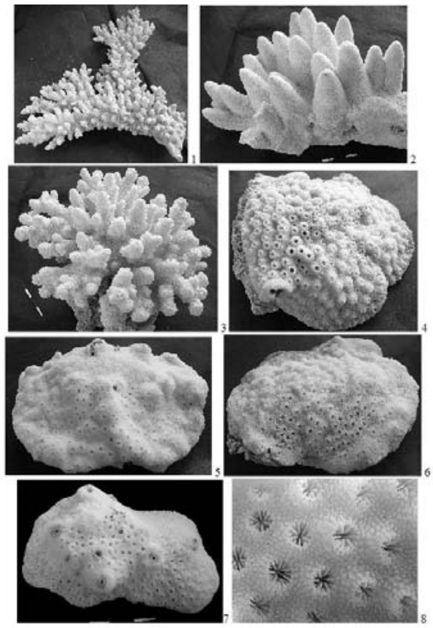


Fig. 31. Appearance of colonies. 1 – *Acropora sarmentosa*, spec. 1/9530, An Thoi Islands; 2 – *A. papillare*, spec. 1/9579, Con Dao Islands; 3 – *A. fasciculare*, spec. 1/9578, Cape Danang; 4 – *Astreopora miryophthalma*, spec. 1/9581, Mjeu Island; 5 – *As. listeri*, spec. 1/9582, Tho Chu Island; 6 – *As. ocellata*, spec. 1/9584, Tho Chu Island; 7-8 – *A. longiseptata* sp.nov, spec. 1/9585, Cham Island, corallites focused in lines and long septa of two cycles are distinctly visible.

Astreopora myriophthalma (Lamarck, 1816)

Fig. 31-4, C6-4

Astraea myriophthalma Lamarck, 1816

Astreopora myriophthalma (Lamarck): Edwards and Haime (1860), Veron and Wallace (1984) cum syn.

Colonies are massive, hemispherical or flattened, as a rule, with an even surface, covered by uniform corallites.

Corallites are exsert, slightly conical, adjoining each other, sometimes being arranged in rows parallel to the colony edges. Calices are cylindrical, deep, with vertical well-formed walls and 2-2.5 mm diameter. Immersed corallites of somewhat smaller sizes can be located between exsert corallites. In some colonies they form groups of up to 7-11 corallites. First cycle septa are short, reaching 2/3 of a corallite radius only at the floor of the calice, where they sometimes merge near the axis. Second cycle septa are low ridges along the calice wall. Septa of the third cycle are solitary and extend as small segments of ridge in the upper part of the calice. Coenosteum is covered by short flat spinules with moderately divided tips. On corallites they can be arranged in rows, corresponding to septa.

Living colonies are cream, brown or yellow.

Similar species *A. listeri* is distinguished by its smooth coenosteum and immersed corallites.

Common.

Location. Can be found everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely distributed in the Indo-Pacific from the Red Sea to the southern islands of the Pacific Ocean.

Astreopora listeri Bernard, 1896

Fig. 31-5

Astreopora listeri Bernard, 1896: Wells (1954), Veron and Wallace (1984) cum syn.

Massive, encrusting-massive and encrusting colonies, with well-developed epitheca. The surface is smooth or slightly wavy, with well spaced corallites.

Corallites are immersed or slightly exert as small hills. They rarely adjoin each other, usually they are separated from each other at a distance of up to 7 mm. Rows of corallites are sometimes observed along the growing edges of a colony. Calices are vertical, deep, slightly conical, with well-formed walls, 1.5-2.1 mm in diameter. First cycle septa are well developed. They extend as thin dentate lamellae from medium depths in a calice, reaching ¾ of a corallite radius towards the calice base, often merging or getting entangled near the axis. Second cycle septa are short, extending as ridges on calice walls. Third cycle septa usually are not developed. The coenosteum is coarse, and has short moderately or slightly divided spinules. Along the calice edges septa extend as spinules.

Living colonies are shades of fawn.

Similar species A. *myriophthalma* has oenosteum covered by flat spinules with moderately divided tips.

Usually uncommon.

Location. Re, Tho Chu, Con Dao and Hon Hay Islands.

Distribution. Widely distributed in the Indo-Pacific from the Nicobar Islands to the Marshall Islands.

Astreopora cuculata Lamberts, 1980

Fig. 50 - 3

Astreopora cuculata Lamberts, 1980: Veron and Wallace (1984)

Massive, hemispheric, or massive-encrusting colonies with well-developed epitheca. The surface is densely covered by large corallites.

Corallites are bulging, conical and hill-shaped, adjoin each other and point irregularly in various directions. Corallites have only a slight tendency to form rows. Calices are deep, vertical and cylindrical, with porous walls. Their diameter ranges from 1.5 to 2.8 mm. On concave surfaces of a colony and on its periphery corallites are immersed and are somewhat smaller. First and second cycle septa are uniformly developed. In the upper part of a calice they project as ridges or very short laminae, increasing up to 2/3 of a corallite radius towards the calice floor and usually merging near its axis. Third cycle septa are single; they can be observed more frequently in large bulging corallites and are mostly developed along the upper calice edge. The coenosteum is densely covered by large flattened spinules with highly elaborated tips.

Colonies color is pink or of brown tints.

Similar species *Astreopora scabra*.

Rare.

Location. Tho Chu, Con Dao Islands.

Distribution. South Vietnam, the Great Barrier Reef of Australia, the Marshall Islands, and Samoa.

Astreopora ocellata Bernard, 1896

Fig. 31 - 6, C20 - 4

Astreopora ocellata Bernard, 1896: Vaughan (1918), Yabe and Sugiyama (1941), Wells (1954), Veron and Wallace (1984)

Colonies are massive, dome-shaped or flattened and encrusting. The surface is smooth or finely uneven, with numerous corallites.

Corallites are mostly bulging in the shape of hillocks, adjoining each other or separated from each other at a distance of up to 10 mm. Rows of corallites, arranged along the edges of colony growth, can be observed. Calices are deep, with vertical walls, slightly conical, with a diameter of up to 3.5 mm. First cycle septa protrude as thin wavy laminae from the upper calice edge, reaching ¾ of a corallite diameter at the floor of the calice and merging near the axis with the formation of a rudimentary columella. Second cycle septa are short spines, sometimes merging into laminae in the lower part of the calice. Third cycle septa are single, they protrude in a shape of excrescences or separate spines only in the upper part of the calice. The coenosteum is coarse, covered by short broad spinules with highly divided tips. Spinules along the edge are less divided, but longer. Living colonies are cream or pale brown.

Similar species. Corallites are substantially larger than those of other *Astreopora*.

Common.

Location. Found everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Vietnam, Caroline Islands, the Marshall Islands, Palau and the Great Barrier Reef of Australia.

Astreopora longiseptata sp. nov.

Fig. 31-7, 8

Astreopora sp. 1: Latypov (1992)

Golotype specimen 1/9585, Museum of Institute of Marine Biology, Vladivostok, Russia, Culao Cham Island, reef slope 12 m.

Massive uneven colonies, with well-developed epitheca. Colony surface is regularly covered by corallites, arranged in clear equal rows.

Corallites are immersed or slightly exsert, located a uniform distance from each other. Calices are deep, vertical, cylindrical, with a uniform diameter of 1.8-2 mm. First and second cycle septa are well developed. First cycle septa diverge from the upper part of the calice, reaching 3/5-4/5 of a corallite radius, often merging at the axis at the calice base. Second cycle septa also

diverge from the upper calice edge, but they are half as long and do not merge at the axis. Their laminae are less uniform in length and more dentate along the axis edge. Third cycle septa can be complete or incomplete, their length does not exceed the length of the second cycle septa, and they are often represented only by rows of spines. The coenosteum is covered by short, widely spaced spinules with wide highly divided tips. On corallites the spines are arranged in rows aligned with the septa. On the most exerted edge of corallites the peripheral ends of septa merge and form thickened a wall with thickened and dismembered spinules.
Living colonies are fawn colored.

Remarks. So far only one sample of this coral species has been found. It differs from the other *Astreopora* species by corallites located a uniform distance from each other, which are arranged in distinct isomeric rows, by well developed septa in three cycles, and by especially long first and second cycle septa.

Etymology. Longus (Latin) – long, septum (Latin) - septum
Location. Culao Cham Island.
Distribution. South China Sea and Central Vietnam.

3.5. Faviidae and Fungiidae

Corals of Faviidae and Fungiidae families are perhaps the most diverse scleractinians taxonomically. Including about 30 genera, they often make up more than 1/3 of the generic and more than ¼ of the species composition of coral fauna of many Indo-Pacific reefs. In terms of the number of species (from 80 to 100, depending on the region and the degree of its study) they are only slightly inferior to Acroporidae.

Faviidae form mainly massive and massive-encrusting colonies from a small palm-sized encrustation to huge massive hemispherical colonies up to 7-9 m in diameter. Fungiidae are mainly isolated unattached round corals, which form mushroom-shaped skeletons, ranging from 2-3 cm to more than half a meter discs. Representatives of species of both families occupy all ecological niches on reefs from the tidal zone to the maximal depths of a reef-slope. Faviidae can form monospecific patches, occupying vast areas of a reef plateau. In the highest horizon of the intertidal zone some Faviidae can form microatolls, extending for hundreds of square meters. Some Faviidae can survive in extreme conditions and even dominate in shallow areas, especially surf zones of Indo-Pacific reefs. Fungiidae are able to grow on firm or soft bottoms that have no attached scleractinians, covering the substrate in several layers, as if the bottom was paved by living discs, in different reef zones.

Inhabiting practically every reef and all its biotopes, Faviidae and Fungiidae serve as a good object for biogeographical investigations. Large corallites of representatives of both families, especially of mushroom-shaped corals, allow us to investigate polyp biology and especially morphological features of its skeleton, the corallite. At the same time, having mainly only a massive colony form and actually only two kinds of corallite forms – round and polygonal, Faviidae with their extraordinary variation represent, on one hand, the most laborious taxonomic group of corals, and on the other hand – the most interesting pattern for clarifying the methods of identification and peculiarities of systematization of not only Faviidae, but of all corals.

In Vietnam both Faviidae and Fungiidae are known on all reefs from the most northern islands of the Gulf of Tonkin, where water temperature drops to 16ºC in winter, to the reefs of the turbid and silty shallow waters of the Gulf of Siam. They are distributed from small littoral basins with the size of small shallow dishes to the maximal depths of the Spratly Islands reef-slopes, and include more than 90 species, which is slightly less than 1/3 of all scleractinian corals of Vietnam, as well as Indonesia and the Great Barrier Reef of Australia. In the dry zone of a reef-flat some Faviidae form monospecific stands with microatolls. Fungiidae form accumulations with one or several layers (up to 45 species/sq. m) on reef-flats and on reef-slopes, often dominated by one species.

3.5.1. Taxonomic history

The Faviidae is one of the most important families of hermatypic corals, having after Acroporidae the most number of genera and species among all scleractinians. Due to their abundance in the majority of reef biotopes throughout the entire Indo-Pacific they are present from the 18th century on in the most of taxonomically important collections. In one of the earliest taxonomic publications (Forskål, 1775) 23 scleractinian coral species from the Red Sea were described, of which 8 species were attributed to Faviidae.

The taxonomic history of this coral group has never been simple and it still has many controversial points and ill-defined issues. The abundance and diversity of Faviidae, as well as the broad variability of the morphology of these scleractinians and their skeletal structures, facilitated the appearance of a great number of nominal species with extremely numerous, not always clear or well explained synonymies.

The subdivision of the Scleractinian genus *Madrepora*, as well as many others, was initiated by Lamarck (1801, 1806), who introduced the following genera: *Echinopores, Explanaires, Monticularies, Astrees, Meandrines*, belonging at present to the family Faviidae.

The first subdivisions of Faviidae, as it was not difficult to understand from their names, were based mainly on growth form of colonies and corallites. *Ehinopores* and *Explanaires* had mainly lamellar or folio forms of colonies with well-delineated corallites. Massive and ramose colonies with stellate corallite cones are typical for *Monticulaires*. Representatives of *Astrees* have massive colonies with distinct polygonal or round corallites, whereas *Meandrines* included all corals with corallites, arranged in meandering grooves similar to convolutions of the brain.

Based on the interpretation of Lamarck, two well-defined genera were distinguished later, which were not almost changed afterwards. *Echinopora* (Dana, 1846) and *Monticulaires*, later named *Hydnophora* by Woldheim (1807) were distinguished on the basis of *Echinopores* and *Explanaires*. Later on Blainville (1830, 1834) and Dana (1846) followed the same line, and the latter added two genera to Faviidae: *Caulastrea* and *Manicina*.

The next important step in the development of Faviidae classification was made by Edwards and Haime (1857). Their subdivision of *Astrees* and *Meandrines* genera (distinguished by Lamarck) into 8-10 independent genera in many respects anticipated and determined modern views on taxonomy and the number of genera in the Faviidae family. At the same time, they distinguished several groups of related species, attributed to the genus Favites by modern taxonomists, into the independent genera *Aphrastraea, Prinastraea* and *Metastraea*. In the opinion of Veron and his co-authors, such intraspecific subdivisions became possible only due to the fact that they were based on a small number of skeletal characteristics of corals, which have been found to be highly variable only recently.

Nevertheless, one of the most important achievements of the Edwards and Haime classification was subdivision of their subfamily Astraeidae into a group of genera, reproducing by gemmation (*Agele* and *Astracees*), and into another group, reproducing by polyp fission ("*Faviaceas*" and *Lithophylliacees*" *Agele*). As a result of this subdivision, peculiarities of Faviidae reproduction – intra-corallite or intratentacular division and inter-corallite gemmation or extratentacular division – began to be used as a taxonomic criterion. This point of view was supported by Dunkan in his revision (1884). However, in both these works species with meandroid corallites were separated from astreides with distinct corallites.

Most of the following investigators took into account the peculiarities of extratentacular division, but they attributed a variety of meanings to this feature. Mattai (1914, 1918) and Crossland (1952) did not consider the nomenclatural status of species groups described by them, but at the same time, they supported differences between species with meandroid and non-meandroidal corallites.

Vaughan (1918) held a different view: he raised every of these coral groups up to the family level – Orbicelliidae and Faviidae. Later on Yabe and his co-authors followed Vaughan (Yabe et al. 1936).

In the 1940's Vaughan together with Wells proposed an intermediate point of view. They gave the status of Montastreinae (integrating *Ehinopora, Leptastrea, Cyphastrea, Montastrea* genera) and Faviidae (*Plesiastrea, Favia, Favites, Goniastrea, Hydnophora, Platygyra, Leptoria, Oulophyllia, Caulastrea, Moseleya, Trachyphyllia* genera) subfamilies to two groups of Faviidae (genera with extratentacular and genera with intratentacular division in the sense of Edwards and Haime). This statement was widely supported by many researchers: Wells (1956), Nemenzo

(1959), Eguchi (1968), Pillai (1972, Wijsman-Best (1972), Pillai and Scheer (1974), and Sheer and Pillai (1974). But Chevalier (1971) came out with an opposite point of view. Vaughan did not distinguish subfamilies within the Faviidae, based on the fact that corals of these genera, reproducing by polyp fission (especially species of *Favia* genus), exhibit both intra- and extra-tentacular reproduction. Veron and his co-authors (1977) supported this point of view, pointing out that many genera and species have both reproduction modes, one of which usually prevails in one or the other species. Supporting Chevalier's opinion that the division of the family into of two separate subfamilies was groundless, they list certain species as an example (*Favia* taxa, *Favites pentagona,* and *Montastrea valenciennesi*). They all formally belong to the Faviinae subfamily (i. e. reproduce by intra-corallite division), whereas extratentacular division is also typical for them.

Considering interrelations of taxa within Faviidae, Veron with co-authors (1977) noted that a number of genera did not have well-defined limits because of their variation, leaving little or no gap between genera. Generic distinctions are especially difficult in the group of species *Favia-Favites-Goniastrea*. Discrimination between *Favia* and *Favites* is made on the basis of colony morphology, which is placoid for *Favia* and cerioid for *Favites*. However, some *Favites* species (they cite *F. rotundata* and *F. complanata* as examples) often display placoid-cerioid colony forms. They write that this fact served as grounds for Matthai (1914, 1918) to unite *Favia* and *Favites* under the common name of *Favia*. Matthai went further. Understanding the content of *Favia* genus in a broad sense, he included the species *F. solida* and *F. versipora* in it (not taking into account the predominance of extratentacular budding (gemmation). Now these species are attributed to different genera: *Montastrea* and *Plesiastrea*, respectively. In the opinion of Veron and his co-authors, such example can serve as a good illustration of the need to posses several stable skeletal characteristics of corals when identifying lower taxons.

Further, developing the idea of the wide variability and transition of many features from one genus to the other one, these authors point out the clearness of distinctions between *Favites* and *Goniastrea*. *Goniastrea* form multitrabecular polymorphic lobes, arranged in one or several fan-shaped systems, differing from such systems of their septa, while *Favites* usually have no internal septal lobes. In some species such systems are not distinct. Thus, *Goniastrea palauensis* was described as *Favia* (Yabe et al. 1936), then it was preliminarily attributed to *Goniastrea* (Chevalier, 1971), and finally it was positioned with *Favites* (Wijsman-Best, 1972). It should be noted that in the same species structural variation of internal septal lobes can vary from simple high monotrabecular spikes to real pali.

Within the group of Faviidae species one can also observe a similarity between the species of *Goniastrea* and *Oulophyllia*. Such similarity is represented by variations of growth form in a continuous series of colony forms, which can be traced in a succession, represented in Table 1 (Veron et al. 1977).

The other groups of Faviidae species, in the opinion of Veron and his co-authors, can be subdivided comparatively easily. These are *Leptoria, Diploastrea, Cyphastrea, Leptastrea,* and *Echinopora*. On the other hand, they consider that *Montastrea* and *Plesiastrea* genera are in the center of this taxonomic debate. One of the reasons for this is the fact that *Montastrea* has a complicated taxonomic history, including generic names of *Orbicella* Dana, *Heliastrea* Edwards and Haime, and *Favia* Oken together with some species belonging to them. The other reason was the denial by Vaughan and Wells (1943, Wells, 1956) of the existence of *Montastrea* species in Indo-Pacific. As a result of this there was confusion not only between these genera, but also between their species, for a long time. It continued until Chevalier (1971) elucidated this problem, explaining that *Plesiastrea* have real pali, consisting of multitrabecules of an independent diverging structure, and that they together with the obvious absence of direct mesenteries with *Plesiastrea* polyps serve as important evidence of the difference between the genera *Montastrea* and *Plesiastrea*.

When describing Australian Faviidae, Veron and his co-authors (Veron et al. 1977) actually revised all known Faviidae. They re-studied all type material of the valid species, including synonyms, published in taxonomically important works of the 20th century. Following Chevalier (1971), they showed that Faviidae should be united in one Faviidae family without subdivision into taxons of a lower rank.

These authors' point of view on the taxonomy of all Faviidae was partially presented above, but in addition, when describing corals, they expressed their opinion about classification of the most disputed and difficult genera, *Favia, Favites, Platygyra, Echinopora*, which will be analyzed in detail below.

Admitting that *Favites* are similar to *Favia* in many respects, but have cerioid colonies usually with septo-thecal septa, they underlined that these distinctions were recognized and taken into account by many researchers, but they were not sufficiently discussed. Based on their material, they show that the species *Favites rotunda* and *F. complanata* often have cerioid-placoid corallites. And on the contrary, *Favita pallida* and *F. rotumana* can be entirely cerioid. This emphasizes that generic attribution of some species of *Favia* and *Favites* remains complicated, and the nature of the majority of essential distinctions lies in the strategy of budding, which is almost the same or the same for all *Favia* (axial division) and *Favites* (peripheral budding).

The same can be true for *Goniastrea*, which differ from *Favites* and *Favia*, first, by a tendency for corallites to form meandering series, and secondly, purely cerioid corallites have the same calicular structures as meandering ones. There are the primary septa with fine regular denticulation and paliform lobes, forming a prominent crown. At the same time *Favites* are characterized by the presence of paliform lobes, whereas septa are presented by a uniform fan-shaped system (Chevalier, 1971). Wells (1956) adds that uniform monocentric corallites and weak columellae cannot be applied as distinctive features for several *Favia* species. In other words, species, having a tendency for subplacoid colony formation, are attributed to *Favia*, whereas species, having no *Goniastrea*-like structure, are attributed to *Favites*. Such division is not always clear and unequivocal (simple), which can be seen in the numerous synonymies. The generic status of *Goniastrea, Favites*, and *Favia* species have been repeatedly changed by modern researchers. Taxonomic instability within *Favites* can be explained, first, by arbitrariness of distinctive features of the genus itself in relation to closely-related genera, *Goniastrea* and *Favia* in particular, and, secondly, by division of species, in intricate synonymy, especially the series of *abdita-halicora-virens-vasta-flexuosa*. Veron and his co-authors reduced all of the existing nominal species of *Favites* and other genera, attributed to this genus earlier, to seven names (Veron et al., 1977).

Over-devotion to the obsolete nomenclature hierarchy, on the one hand, and insufficient knowledge of variability, on the other hand, existed and still exists to some extent in the taxonomy of the genus *Platygyra*. Chevalier (1975) described 10 varieties of *P. daedalia*, 4 varieties of *P. sinensis*, and divided *P. pini*, described by him, into two varieties. Logical extension of this process in the presence of a large collection, in the opinion of Veron and his co-authors, will lead to creation of more and more variations, which will result in a situation, when an unlimited nomenclature complex will be created artificially with incomprehensible biological meaning.

These authors emphasize in their work that *Platygyra* consists of relatively few species. 34 nominal specific names were reduced to just four. It was emphasized that they have a broad genotypic and phenotypic variation, and visible variations of skeletal characteristics of corals are fixed within a given species, but their correlation with every other species is too general.

Although the majority of species in the genus *Oulophyllia* seem to be homogenous, relations of this genus with the other Faviidae are not specified well enough. Edwards and Haime (1848) mentioned the closeness of *Tridacophyllia* (= *Pectinia*), but it was not more than a superficial similarity. Closeness of *Oulophyllia* with *Platygyra* is the most evident. In the beginning of the 20th century the two genera were united without doubt in the single genus *Coeloria* (Gardiner, 1904). Soon afterwards their status was restored (Gravier, 1910), and this point of view was accepted by most authors. Nevertheless, Crossland (1952), affirming that he liked Gardiner's integration, described species of both *Oulophyllia* and *Coeloria* from the Great Barrier Reef of Australia.

Generic features of *Oulophyllia* were confused by the description of two obscure species: *Coeliria gigantea* Yabe and Sugiyama (1935) and *Coelogyra laevis* Nemenzo (1959). Wijsman-Best (1972) expressed the opinion that these species should be attributed to *Goniastrea australiensis*, whereas Chevalier (1975) considered *C. gigantea* to be quite specific to *Oulophyllia*. The type specimen of *Coeloria laevis* is not available, and nevertheless Nemenzo, describing corals from a location near to the type location, supposes that this species together with *C. gigantea* should be included in *Oulophyllia*.

Subscribing to the opinions of Chevalier and Wijsman-Best, Veron and his co-authors consider *Oulophyllia* to be a monospecific genus with the characteristics of *O. crispa*, including in the synonyms of *O. crispa* 14 species, previously placed in five genera: *Meandrina, Ulophyllia, Coeloria, Oulophyllia* and *Coelogyra*.

Within the so-called montastreans *Echinopora* is the closest to *Cyphastrea*. The principle distinctions between these two genera are the corallite size (larger for *Echinopora*), colony form (more massive for *Cyphastrea*), and the morphology of a corallite wall (better developed and unperforated for *Cyphastrea*). Ornamentation of the exotheca by spinular ridges is inherent in many scleractinians, that is why it is not a very reliable way to distinguish *Echinopora* from other similar genera. The situation at the species level within *Echinopora* remained confused until Matthai (1914) synonymized many species names. This point of view was widely supported by many more modern researchers. In addition, it was re-evalued in terms of the species problem (Umbgrove, 1939; Crossland, 1952; Chevalier, 1975). According to the opinion of Veron and his co-authors, all these problems were described and summarized best of all by Chevalier, who wrote: "I believe that there are four species: *gemmacea, lamellosa, hirsutissima*, and *horrida*; however, in every certain case I am not able to identify them with certainty." They consider that *Echinopora* clearly belongs to the Faviidae, and there are no reasons to isolate it in the Echinoporidae family (Verril, 1901), which was supposed to include *Oxyphyllia* (= *Echinophyllia*), *Mycedium* (Yabe et al. 1936) and *Tridacophyllia* (Umbgrove, 1939). In the opinion of these authors, in accordance with the hypothesis of Chevalier about the less rapid evolution of Melanesian *Echinopora* in comparison with that of the Indian Ocean, as a result, *Echinopora* of the South-Western Pacific are more distinct, but have greater intraspecific variability.

Unlike Faviidae, Fungiidae perhaps are the most safe scleractinian group from the taxonomic point of view. Due to the solitary unattached way of living, large corallites and some specific features peculiar to only these corals, Fungiidae are one of the very few groups which retained the taxonomic status of many subdivisions from the times of pre-Linnaen taxonomy.

Already in the beginning of the 20th century Fungiidae were subdivided by morphological features into six stable groups (Döderlein, 1902), which later became subgenera (Wells, 1966). Both for the family as a whole and for genera (subgenera) and species a number of phylogenetic cladograms have been elaborated (Wells, 1966; Cairns, 1984; Hoeksema, 1989).

Some disagreements exist in distinguishing some subgenera (*Danafungia, Ctenactis, Verrillofungia* and others), their generic identification or attributing some species to one or the other genera (Matthai, 1924; Boschma, 1929; Wells, 1966; Veron and Pichon, 1979). These problems were considered in more detail while describing Fungiidae of the Great Barrier Reef of Australia

(Veron and Pichon, 1979). These problems were considered especially in Hoeksema's monograph, in which , in addition to revision of all existing Fungiidae, the problems of their taxonomy, phylogeny and biogeography are elucidated in detail (Hoeksema, 1989). In this monograph, 40 species attributed to 11 genera, one of which – *Fungia* – subdivided into 7 subgenera, are described.

3.5.2. Morphology, terminology and taxonomic peculiarities

Most Faviidae have massive or dome-shaped colonies. Ramose or dendroid projections can be formed in some massive or encrusting-massive colonies. Not many Faviidae can form branched, lamellar or foliose colony shapes. Massive colonies may have polygonal (or angular) corallites, and are called cerioid. Whereas colonies with rounded-cylindrical, disconnected or adjoining corallites are named plocoid. Meandroid colonies, in which corallites are grouped in long winding series similar to the convolutions of the brain, can often be found among the Faviidae.

Presence of an intercorallite structure, formed in the zone of coenosarc-coenosteum, is typical for Faviidae. Coenosteum can be smooth or can consist of exothecal dissepiments, which is referred to as being vesicular. In most Faviidae coenosteum is covered by ribs (costae or coastal ribs) and needle-like spines (spinules), which in turn can be divided or ornamented by many tiny spines and denticles. Distinct development of costae on the exotheca of corallites is one of the most typical features of Faviidae. Costae may be in one and two cycles, equal or unequal, differentiated by size. Costae of neighboring corallites can merge (in such case they are called adjoining) or terminate near the base of the exotheca and be separated by an intercorallite boundary – a narrow crack or groove.

The septal apparatus of the Faviidae are formed by five cycles of septa, often forming a septotheca and, as a rule, differentiated by length into two sizes (orders) with prominent primay septa. Distal septal margins are always more or less dentate serrate with the formation of paliform lobes and pali. External peripheral septal margins are nearly always fan-like and protruding above the theca. The Favid columella is trabecular, more rarely agminate. It can be lax, consisting of several simple spinules or pinnacles, or very dense, consisting of numerous interlacing trabeculae, often winding spirally.

Faviidae have rather well developed horizontal skeletal elements: tabulae or dissepiments. Tabulae may be complete or incomplete, convex or concave, rarely with additional lamellae. Dissepiments formed inside the corallite between septa are called endothecal. They are formed by large (up to 5-7 mm), medium (3-5 mm) or small (less than 3 mm) laminae, bulging in various degrees forming vesicles. Dissepimental laminae can be variously oriented within the corallite cavity: with their convexity upwards towards the calice (horizontal), towards the axis (inclined), or towards the corallite axis (vertical) (Fig. 32).

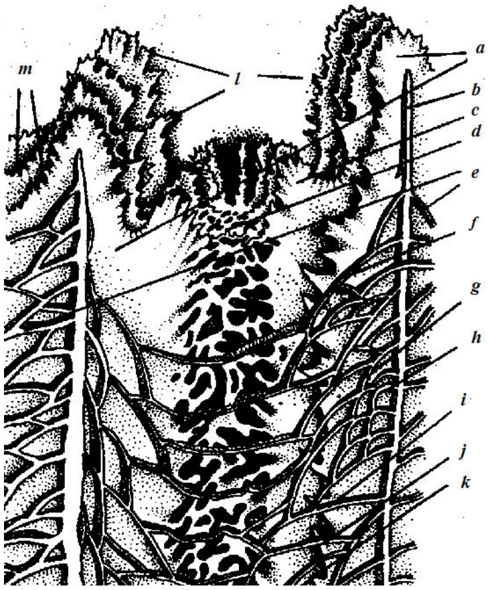


Fig. 32. Skeletal elements of corallites Faviidae. ***a*** – septae, ***b*** – wall, ***c*** – paliform lobes, ***d*** – columella, ***e*** – coenosteum (exothecal dissepiments), ***f-k*** – endothecal dissepiments, ***h*** – horseshoe, ***i*** – cystiphore, ***l*** – costae, ***m*** – septal dentation (part after Veron, 1986)

Dissepiments, separating neighboring corallites, often form a vertical row of horseshoe-shaped lamellae. Exothecal dissepiments are formed among (between) corallites and costae. Dissepimental laminae are laid frequently (15-20 per 1 cm of corallite length), moderately frequently (10-15) or rarely (less than 10). They can be thin (less than 0.2 mm) or thick (more than 0.3 mm). Several dissepimental rows, completely filling a corallite cavity from the wall to columella, are called a dissepimentarium.

One or several concentric circles, made of merging granulated septal ends, can be formed in a Favid calice. These circles are called pseudosynapticulae, and almost all of them have a distinct indentation – a depression above the columella.

Fungiidae or fungid corals are mainly unattached and have the largest corallites among all scleractinians, which is why we shall consider their morphology and terminology in more detail.

The majority of fungid corals have a single growth form with one mouth cavity – stomodeum (primary mouth or ostium), but some species are able to form numerous circumoral (around the mouth) and peripheral secondary stomatal centers (Fig. 33). That is why it is better to call Fungiid corals, having many of stomata, polystomatal (or polycentric), instead of colonial (Hoeksema, 1989). Corals with one stomodeum can be called solitary or monostomatal corals.

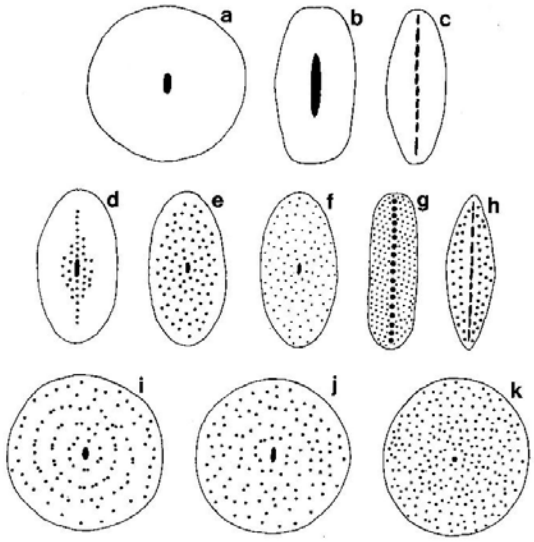


Fig. 33. Corallum outlines and stomatal distribution patterns of the Fungiidae. When intra-stomadaeal and circumoral budding dominate over peripheral budding, the stomata are distributed in an either aggregated or irrelar pattern. When peripheral budding dominates, the secondary stomata are more evenly arranged. Examples: (a) a round and monostomatous animal *(Fungia, Heliofungia);* (b) an oval animal with a long mouth *(Fungia);* (c) intrastomadaeal budding along the central axis in an elongate animal *(Ctenactis crassa);* (d) circumoral budding, predominantly along the long axis of an oval animal *{Sandalolitha dentata);* (e) evenly distributed secondary stomata developed by peripheral and circumoral budding in an oval animal *(Sandalolitha robusta);* (f) as the former, with smaller secondary stomata *(Zoopilus);* (g) an elongate animal with relatively large stomata arranged along the central axis, and smaller ones evenly distributed alongside it by peripheral and circumoral budding *(Polyphyllia);* (h) an elongate animal with large stomata developing along the central axis by intrastomadaeal budding, and in irregularly formed rows alongside the axis by circumoral and peripheral budding *(Herpolitha);* (i) a round animal with a large mouth at the centre of the polyp and secondary stomata spaced in an clustered pattern by circumoral and peripheral budding *(Halomitra);* (j) a round coral with small secondary stomata developing in a slightly irregular pattern by peripheral and circumoral budding *(Lithophylon);* (k) an animal with a slightly oval outline and secondary stomata developing in an evenly distributed pattern by peripheral and circumoral budding *(Podabacia)* (according to Hoeksema, 1989)

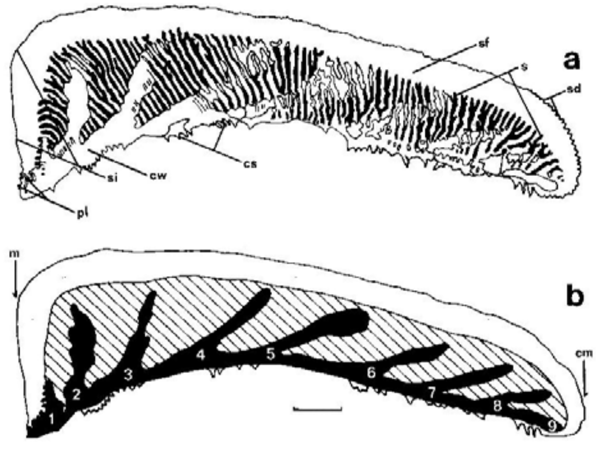
Secondary ostiums can be formed inside stomata, around them and along the coral periphery. Intrastomatal budding takes place by the way of division of the primary stomodeum due to the merging of two opposite primary septa. Each of the newly formed ostiums is divided in turn in the same way. In circumstomatal budding, new stomata are formed around the previously formed ones, appearing due to the invagination of septa. Peripheral budding occurs at successive invagination of septa on the coral periphery. Intracalice, circumoral and peripheral budding are different kinds of intratentacular budding. Another method of asexual reproduction – extratentacular budding – is not typical for Fungiidae on the way to coloniality.

Septa, forming new stomata by way of division, are not homologous to septocostae, present between corallites in coral colonies of other scleractinians. In Fungiidae costae are located on the under side of the coral. For the secondary septal structures it is preferable to use the term “interstomatal” septa (Hoeksema, 1989).

In addition to their unattached way of living, the main distinctive feature of fungid corals is a great number of septa. Hundreds of long thin septa of up to 15 or more cycles, always highly dentate and with numerous rows of synapticulae, are formed in the Fungiidae.

Septocostal ridges are lamellar structures, consisting of septa and costae, laterally joined to each other by complicated synapticulae and a coral wall. Septa and ribs of the first cycles are called lower cycles, and that of the last cycles – higher cycles (Bourne, 1887).

As a rule, Fungiidae septa are thin and straight, but sometimes they are wavy or with tear-shaped reinforced axial parts. When septa are reinforced and dense, synapticulae are poorly distinguished. Septa and costae of higher cycles are more reinforced and protrude upwards to a greater extent than the other septa (Fig. 34).



` Fig. 34. Lateral view of a septo-costal unit. a - Several structures displayed when a coral is broken cross-wise: si = inner edge of septum; pi = paliform lobes; cw = corallum wall in cross-section; cs = costal spines; s = compound synapticulae; sf = septal fringe; sd = septal dentations. b - Orientation of some parts of a septo-costal unit after several phases of growth; m = the present location of the mouth (in the living animal) or fossa (in the skeleton); cm = the present location of the corallum margin; 1-9 = successive locations of the corallum wall (black). Scale bar: lcm. (Modified after Gill, 1980).

Sizes and shapes of septal and costal dentation and ornamentation serve as the main morphological features of Fungiidae.

Septal ends can be very weakly notched and highly granulated, lobate or angular (angled, saw-shaped teeth). Lateral septal surfaces can be covered with grooves, ribs and other structures, oriented parallel or perpendicular to the septal margin. Costal ribs, projections (protuberances, spines) vary from fine granulated spinules to short (clavate) or long needle-like or clavate complexly divided spines.

Septa of the lower cycles are usually whole, but sometimes they can be perforated on the periphery. Septa of the higher cycles are almost always perforated. They can have relatively large perforations and in that case they are called fenestrate.

A distinct fossa is often formed in monostomatal Fungiidae, the length of which depends on the coral size. A distinct columella, consisting of trabecules and paliform lobes, projecting above the fossa bottom and from the inner septal margins, is present inside the fossa.

In Fungiidae the coralite wall is usualy dense and whole, but sometimes it can be perforated between costae, especially in the zones of successive stages of coral growth.

Fungiidae have rather diverse coral shapes. They can be round (circular), oval (elliptical), long tongue-shaped, etc. Damaged corals can be three or four-rayed. Disk, ellipse and other shapes of Fungiidae can be thin, thick, highly convex or concave, arc-shaped or cup-like.

In the light of the morphological features of Faviidae and Fungiidae discussed above, we shall briefly discuss the taxonomic peculiarities of these corals.

As can be seen from the review of Faviidae systematization history, taxonomic problems have existed at higher and lower taxonomic levels. There were different opinions and disputes about the integrity of the Faviidae family and on its value, and on the names of genera included in it. There was no less uncertainty in species identification, as well as at establishing their placement in one or the other genus. I think many researchers can repeat after Chevalier that they are not able to always identify four *Echinopora* species, and the same is true of other genera.

The problem is not much better with the four species of *Platygyra*. The larger a collection is, the more samples of one species at least from the same area are available, and the more uncertainty and doubts a taxonomist has, since the limits of extreme values of features become more and more extensive, and variability curves become more and more even and continuous.

In principle, this is all right. If these are specimens of the same species, a complex of values of features of all samples must fit in the limits, determined by the given feature, and constitute a complete series of transitive values of the feature. It is all correct, and will work only when the feature is clear and has a single meaning, no matter whether it is qualitative or quantitative.

If we limit ourselves to such a terse diagnosis as to say that *Favites* are similar to *Favia* but they are cerioid (Wells, 1956), then it will be necessary to follow the diagnosis strictly. *Favia* have only placoid colonies, and *Favites* – only cerioid ones, but not subplacoid or subcerioid, as we can often read in diagnoses and descriptions of Faviidae. Strictly speaking, all *Favia* have placoid colonies, especially if we mean type specimens. In other words, all these corals have massive colonies with corallites closely or distantly located from each other. I stress that these are detached corallites, mainly of a round shape, though this roundness can be close to a trigonal or irregularly polygonal form (*F. laxa, F. speciosa*).

The opinion about purely cerioid *Favia pallida* and *F. rotumana* (Veron et al. 1977) is not quite correct. Type specimens of these species are typically placoid. They have round corallites, slightly detached or adjoining. Every corallite has clearly developed endo- and exotheca. Adjoining corallites are necessarily separated by a distinct groove. The same can be said of the majority of cited pictures of these species (Hoffmeister, 1925; Wells, 1954; Chevalier, 1071; Scherr and Pillai, 1974, 1983; Veron, 1986; Nakamori, 1986; etc.). Even in supposedly subcerioid specimens (Veron et al. 1977, p. 34, Fig. 49-52; Fig. 62-63) endo- and exotheca (despite the irregular, almost polygonal form of corallites) and clearly detached corals with discrete costal ridges are clearly seen. As to the truly cerioid specimen of *F. pallida* (p. 34, Fig. 46, in the same work), its attribution to the genus *Favia* seems to me doubtful, as it has typically cerioid corallites with a common endotheca, here and there turning into septotheca, septa of the neighboring corallites are adjoining, and these are features typical for *Favites*.

Regarding cerioido-placoid forms of *Favites rotundata* and *Favites complanata* (Veron et al. 1977), it is necessary to note approximately the same circumstances as discussed above. First, *Favites rotundata* has now been placed in the genus *Favia* (Veron, 1977), secondly, the type specimen and cited pictures of *Favites rotundata* specimens have clearly polygonal (cerioid) corallites with a common septothecal wall and adjoining septa. A false boundary between corals can be formed at the expense of light removal towards adjoining septa at their transition to a neighboring corallite and replacement of an earlier cycle by a later one. And finally, the columella is formed by complexly divided anastomosing trabeculae, which cannot be in *Favia*.

In conclusion, we shall consider one more example, testifying to the necessity of a strict approach to the character of a "placoid coral". Wells described *Plesiastrea russelli* (1954), which is attributed to the genus *Favites* by Veron and his co-authors (1977). In this case, first of all, not only the purely placoid form of a colony and corallites alerts one to the problem, but also two cycles of highly projecting septa with a very well developed crown of pali. These features are more typical for the genus *Plesiastrea*. In addition, the total number of septa (the third cycle is always rudimentary) rarely exceeds 30. In the smallest representative of *Favia* the number of septa is 30-40 (the third and fourth cycles are always developed), and on the average they have 40-60 septa.

Thus, in many cases taxonomic problems in identification and systematization of Faviidae arise in the result of vagueness of definition of diagnostic classification characters or introduction of alien characters, not proper for the given genus. As a result of this process, an artificial extension of natural limits of species variability takes place, with species falling out through the boundaries fixed for each genus.

In support of the above-said, it is necessary to consider the similarity of growth forms of some species groups (*Caulastrea-Favia-Favites* and etc.), which was spoken about in the previous Chapter when discussing variability and the transition of many features from one genus to the other one.

Now we shall see to what extent a two-way transition of such features as "placoid", "cerioid" and meandroid" growth forms in the series *Caulastrea-Favia-Favites-Goniastrea-Platygyra* is real.

All *Caulastrea* have only phaceloid colonies, and however close to each other corallites may be located, every of them has epitheca and its colony has no coenosteum. And it must be so, proceeding from the definition of a phaceloid colony (Wells, 1956). In a placoid colony all corallites have a common coenosteum, and phaceloid colonies are not known among *Favia*. This means that in this case an indicator between *Caulastrea* and *Favia*, showing transition of features of colony forms, does not work in both directions. As was shown above, placoid colonies fundamentally differ from cerioid ones. The former have round discrete corallites with endo- and exotheca developed on a smooth or vesicular coenosteum. The latter are characterized by polygonal corallites with a common exotheca, adjoining septa and the absence of coenosteum. This is why a strict approach to the definitions of "placoid" and "cerioid," taking into account that all *Favia* are placoid, and all *Favites* are cerioid, goes a long way toward removing the problem of transition of these features from one genus to the other one.

Among *Favites* the species *F. bennettae*, having a tendency for corallites to form meanders, is now attributed to the genus *Oulophyllia* (Veron, 1986), thus, the transition of the feature "meandroid colonies" to the genus *Goniastrea* and back to *Favites* is removed.

For the remaining three genera the feature "meandroid colonies" is not really the most reliable character. They all have cerioid and meandroid corallites in some of their species. *Goniastrea* in most cases are cerioid, *Platygyra* are both, and *Oulophyllia* are meandroid with individual polygonal corallites. It means that this feature cannot serve as a diagnostic feature. But if a characteristic of cerioido-meandroid colonies were added that "well formed large pali, forming a crown, always projecting over the corallite indentation," then these features would be typical only for the genus *Goniastrea*. Neither *Platygyra* nor *Oulophyllia* have a distinctly developed crown. The spongy columella of *Platygyra* merges into one line, passing through all corallites within a valley. In *Oulophyllia* the columella always designates the centers of corallites. In addition, broad trough-shaped valleys or corallites of the *Oulophyllia* are 1.5 times wider than the funnel-shaped valleys of *Platygyra*.

The characteristics "massive placoid" and "massive-cerioid" are as insufficient for the identification of *Favia* and *Favites* without mentioning that they are *Faviidae* as the characteristic "massive cerioid-meandroid" is insufficient for identification of *Goniastrea, Platygyra* and *Oulophyllia*. As it is known from the principles of zoological systematization, a character or a sum of characters become taxonomic characters only in relation between two taxa. And when they are unambiguously limited qualitatively or quantitatively, then specimens of a species will be identified easier, and there will always have to be a gap in the values of one or more characters between different species, no matter whether the characters are morphological, ecological, biochemical or genetic.

Difficulties in identification, and especially in the separation of *Favia speciosa* from *F. pallida*, have been discussed repeatedly (Chevalier, 1971, 1975; Veron et al. 1977; Scheer and Pillai, 1989). Now we shall analyze a complex of characters of both species (Table 2). As can be seen, there are distinctions for every character. At the same time, many characters will overlap even though a sample of colonies of the two species is not large. But *F. pallida* has no highly prominent corallites, and *F. speciosa* has no corallites joined together. There are also characters with a larger gap. Horizontal skeletal elements of these species corals differ greatly. The difference in lamina size is not very great, but the rates that laminae are laid down in the process of corallite growth differ substantially. In *F. speciosa* dissepiments are laid 2-3 times more often than in *F. pallida*. It seems that this genetically determined character is functionally connected and morphologically developed in highly prominent corallites, which are absent in *F. pallida* corals, having different rates of vertical growth.

Table 2. Comparison of attributes two species Faviidae

Attributes	*F. speciosa*	*F. pallida*
The form of a corallite	Oval, strongly acting, separated, can merge	Oval wrong, weakly exert, frequently merge
Calixe	It is expressed distinctly	It is expressed seldom
Septa	Thin, lacerate and serrate dentated, general number 26-42	Thin, it is weak thik, Lacerate and spinulose dentated, general number 28-36
Paliform lobes	Can be distinct with a crown	Not always distinct
Coenostium	It is always well expressed, cystiphor	It is expressed not always distinctly, cystiphor
Endothecal dissepiments	Subhorizontal, large, with numerous additional dissepiments, on 1 sm of growth 20-24 plates were postponed	Abruptly inclined, the average sizes with individual additional dissepiments, on 1 sm of growth 8-10 plates it was postponed
Ecsothecal dissepiments	Numerous thin	Thick

Good examples of overlapping of values of skeletal characters of various species, and at the same time of their recognition, were cited for the genus *Platygyra* (Veron et al. 1977). Partially overlapping of characters values can be clearly seen, but on the other hand, in every species its inherent characters of wall width, corallite length and width dominate (Fig. 35). Such statistical comparisons and construction of diagrams and graphics based on the data give good results for any characters of all coral groups, both recent and fossil (Veron and Pichon, 1976; Tesakov, 1978; Latypov, 1984, 1990).

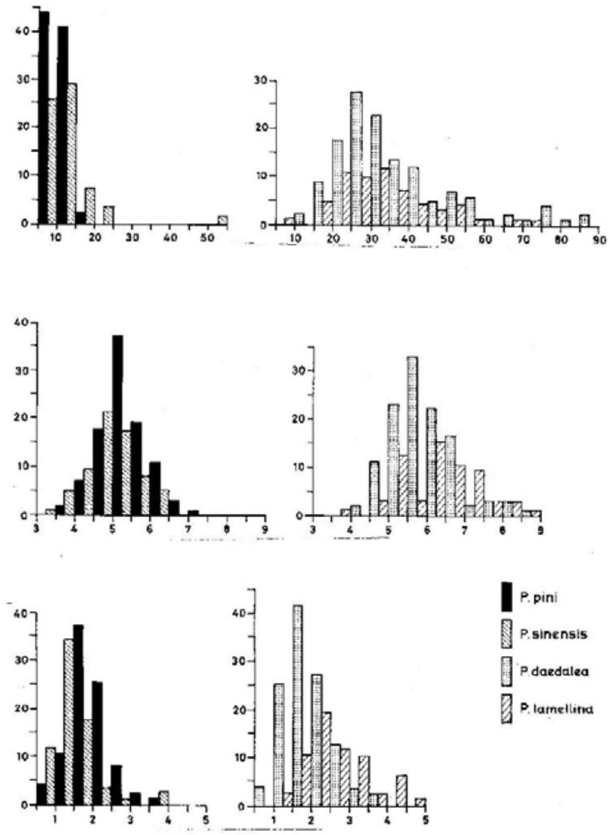


Fig. 35. Comparison of the mean valley length (top), mean valley width, and mean wall width per corallum of the *Platygyra* species indicated. All sizes in mm, on an axis of ordinates number of measurements (part after Veron et al., 1977)

All of the above can also be attributed to classification of the Fungiidae. It is necessary to add, however, that the shape of the Fungiidae can be a good generic taxonomic character, as well as circumoral or peripheral budding. The length of fossa, especially its ratio to the coral diameter, can be used as an identification (recognition) character for species. Perforation of septa in various degrees or its absence can be used both when distinguishing taxa at the generic level, and when distinguishing different species within the same genus. The arrangement of secondary stomata in one line or in concentric circles, or its absence is a generic level character. Shape and sizes of septal denticles in accordance with sizes and shape of costal spines serve as good interspecies distinction characters.

In conclusion it is necessary to say that both (ambiguity) of characters with many values (ambiguity) leads to an unnatural increase in their variability and the boundaries of taxa, and a clearly determined character very definitely limits its variability within a taxon and allows us to find gaps between taxa.

3.5.3. Family Faviidae Gregory, 1900

Genus *Caulastrea* Dana, 1846

Type species: *Caulastrea furcata* Dana, 1846.

Diagnosis. Phaceloid corals with short, thick, weakly diverging branches. Corallites are oval or oval-triangular with prominent septa of three to four cycles and distinct costae on the epitheca, monocentric or, more rarely, polycentric. Dissepiments are inclined and prominent.

Caulastrea furcata Dana, 1846

Fig. 36-1, C8-2

Caulastrea furcata Dana, 1846: Pillai and Scheer (1976), Veron et al. (1977) cum syn., Nakamori (1986), Veron (1986)

Phaceloid colonies with diverging branches, at a distance of up to 20 mm from each other. Corallites are oval, sometimes with a tendency to formation of round-triangular corallites having one flat side. Most corallites are monocentric, and have a diameter from 10 to 13 mm. Calices are not deep (rarely more than 8 mm) with thin walls.

Septa are thin, reinforced with spindle shapes, and half of them reach the columella. The upper septal margins distinctly project (for up to 2 mm) over the corallite wall. Axial septal margins, especially of the first and second cycles, form paliform laminae and form a well-developed round fossa over the columella. Inner septal margins are highly notched. In the upper part of the corallite they are serrated, in the lower part they are lacerate. The lateral surfaces of all septa are abundantly granulated with fine spines, often arranged in fans. The total number of septa is 34-42. The columella is dense and trabecular. Costae are distinct, of several cycles, covered with numerous serrated denticles. Dissepiments are vertical, steeply inclined, medium to small (up to 3 mm), thin, and prominent.

Living colonies are fawn colored.

Similar species *C. tumida* has a corallites, which can have one or two to three centers.

Uncommon.

Location. Reefs of Khanh Hoa Province, Con Dao, Tho Chu Islands.

Distribution. Known from the Seychelles Islands to Japan and the Great Barrier Reef of Australia, depth 10-40 m.

Caulastrea tumida Matthai, 1928

Fig. 36-2, C8-3

Caulastrea tumida Matthai, 1928: Veron et al. (1977) cum syn.

Phaceloid colonies with short thick branches. Corallites are oval and subtriangular with one reinforced side. They can have one or two to three centers, corallites diameters range from 8 to 13 mm. Calices are deep, not less than 10 mm, with thin to medium walls.

Septa are thin, but highly reinforced on the periphery, especially that of the first and second cycles. More than a half of septa merge with the columella. All septa project well over the corallite wall, and septa of the first two cycles project most of all. Axial septal margins are lacerate and

consist of numerous flat and triangular divided spikes. Lateral septal surfaces are covered by numerous fine spines, which can be arranged in fans in the projecting upper parts of the septum. The total number of septa is 30-48. The columella is trabecular and well developed. Costae are distinct, and in two cycles. They are densely covered by large spines, which increase in size towards the upper part of the corallite. Dissepiments are inclined, of medium to large sizes, and prominent. Sometimes there can be less than five laminae per 10 mm of coral growth.
Living colonies are brown with a green oral disk.

Similar species *C. furcata* has most corallites monocentric.

Uncommon.

Location. Reefs of Khanh Hoa Province, Culao Cham, Phu Quy Islands.

Distribution. Madagascar, the Seychelles, the Maldives, the Red Sea, Vietnam, Japan, the Great Barrier Reef of Australia, Bonin Islands, and New Caledonia, depth 5-42 m.

Genus *Barabattoia* Yabe and Sugiyama, 1941

Type species: *Barabattoia mirabilis* Yabe and Sugiyama, 1941.

Diagnosis. Massive-subramose corals with long cylindrical corallites, sometimes branching dichotomously. Highly notched costae correspond to septal insertions. The columella is compact and dense. Dissepiments are exo- and endothecal, forming one peripheral row of vertical swollen laminae.

Barabattoia amicorum (Milne-Edwards and Haime, 1850)

Fig. C8-1

Colonies are massive and usually small. Corallites are plocoid to tubular. Budding is primarily extratentacular. Costae are equal and well developed. Columellae are small and compact. Tentacles are extended only at night. Reef slope.
Usually yellow-brown, cream or green with pale oral discs.

Similar species *B. laddi* has longer corallites and alternating costae.

Usually common.

Location:Are known everywhere except for northern part of the Gulf of Tonkin, depth 4-15 m.

Distribution:Uncommon in the Central and South West Pacific.

Barabattoia mirabilis Yabe and Sugiyama, 1941

Fig. 36-3

Barabattoia mirabilis Yabe and Sugiyama, 1941: Veron et al. (1977) cum syn.

Massive-encrusting, massive with spherical and bumpy projections up to subramose, sometimes of dendroid form. Corallites are placoid, greatly projecting, up to several centimeters. Calices are 8-12 mm deep.

Septa of the first and second cycles are weakly distinguished by length and reach the columella. Septa of the third cycle can reach the columella or be less than a half of the corallite radius. Septa of the fourth cycle are always in an incomplete set, and present thin laminae or ridges on the corallite wall. The axial margins of all septa are moderately notched or highly lacerate. They bear 6-12 spines each, with highly divided tips. Lateral septal surfaces are moderately or weakly ornamented by fine spines and granules. The upper septal margins are fan-like, notched, and project well over the theca. The total number of septa is 26-38. The columella is compact, more often dense than spongy, and is located in what is usually a round cup-shaped fossa. Costae are coarse, of two distinct size orders, and intensively notched in the shape of a sawtooth and lacerate spines. Septal insertion can be clearly seen. The coenosteum is distinctly vesicular. Dissepiments are prominent, and fine to medium. A vertical row of smaller swollen laminae is formed on the periphery.

Living colonies are green, or brown.

Similar species *B. amicorum* has placoid corallites which are monocentric.

Realatively common.

Location. Reefs of Baitylong Archipelago, Khanh Hoa Province, Con Dao Islands, and Tho Chu Island.

Distribution. Known on the reefs of Vietnam, South China, Japan, New Caledonia, the Marshall Islands and the Great Barrier Reef of Australia, depth 3-20 m.

Genus *Favia* Oken, 1815

Type species: *Madrepora fragum* Esper, 1795.

Diagnosis. Massive, placoid corals with projecting corallites, with distinct costae, with wide or narrow coenosteum. The columella is trabecular, made of irregular spines; rarely it is dense. Dissepiments are endo- and exothecal. Septa are long, with pali, not always divided into cycles.

Favia stelligera (Dana, 1846)

Fig. 36-4

Orbicella stelligera Dana, 1846

Favia stelligera (Dana): Vaughan (1918), Veron et al. (1977) cum syn.

Massive hemispherical or dome-shaped colonies, sometimes collumnar. Corallites are separate, small, and round. They project above the colony surface, having a diameter of 2-3 mm.

First and second cycle septa merge with the columella in the depth of the calice (at 1/3 of its height). Third cycle septa project only as ridges in the upper part of the calice and on the exotheca. The structure of the septa is highly variable. Septa are not fixed in number (from 16 to 28), they can be dense and thin, and weakly or highly notched. The lateral surfaces of all septa are densely ornamented with fine spines, arranged in a fan-shaped pattern in the upper parts of the septa. All septa protrude over the theca. Pali are simple or complicated (compound), and often thick. The

columella is trabecular and loose. Costae and septocostal ridges are developed on most corallites. The coenosteum is vesicular. Dissepiments are slightly inclined up to subhorizontal, sometimes wavy. Additional laminae are rare, developed primarily in the axial zone.
Living colonies are shades of brown-green.

Similar species. Does not resemble other *Favia* and growth-form alone makes this species distinctive underwater.

Common.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam.
Distribution. Widely distributed throughout the entire Indo-Pacific from the Red Sea to Hawaii, depth 3-20 m.

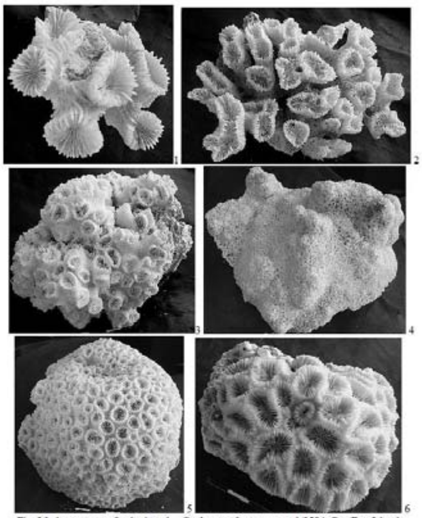


Fig. 36. Appearance of colonies. 1 – *Caulastrea furcata*, spec. 1/9594, Con Dao Islands; 2 – *C. tumida*, spec. 1/9593, Thu Island; 3 – *Barabattoia mirabilis*, spec. 1/9595, An Thoi Archipelago; 4 – *Favia stelligera*, spec. 1/9596, island Zyan, Namsu Islands; 5 – *F. speciosa*, spec. 1/9597, Island Moon, plocoid colony with well advanced exotheca; 6 – *F. favus*, spec. 1/95102 Bai Canh Bay, Khanh Hoa Province

Favia laxa (Klunzinger, 1879)

Fig. 37-1

Orbicella laxa Klunzinger, 1879

Favia laxa (Klunzinger): Matthai (1914), Veron et al. (1977) cum syn.

Massive to flat colonies with typically placoid corallites, slightly projecting and having a diameter of 8-12 mm. Calices of a medium depth or deep with vertical walls, reaching 6-8 mm diameter.

First cycle septa reach the columella. Most second cycle septa reach the columella and form well-developed paliform lobes, forming a distinct crown higher than the columella. Third cycle septa are developed mainly near the upper calice edge and plunge steeply downwards along the endotheca in a form of short ridges. All septa protrude over the corallite edge. Septa and pali are moderately serrated and notched, and their lateral surfaces are noticeably granulated. The total number of septa is 26-30. The columella is trabecular and compact. Costal ridges are long, thin, noticeably notched, and as a rule, in two distinct cycles. The coenosteum is strongly vesicular.

Dissepiments are steeply inclined, prominent to slightly prominent, large to medium, and numerous. They can form a dissepimentarium made of several rows of dissepiments.
Living colonies are a fawn color.

Similar species *F. helianthoides* has larger, less irregular corallites.

Uncommon.

Location. Dangho Islands (Gulf of Tonkin), Nam Su, reefs of Khanh Hoa Province.
Distribution. Widely distributed from the Red Sea to New Caledonia and the Great Barrier Reef of Australia, depth 5-40 m.

Favia favus (Forskål, 1775)

Fig. 36 - 6, C22 - 6

Madrepora favus Forskål, 1975

Favia favus (Forskål): Matthai (1914), Veron et al. (1977) cum syn.

Colonies are massive, hemispherical and dome-shaped. Corallites are placoid, conical, noticeably projecting over the colony surface, having a diameter of 14-18 mm. Calices are vertical, deep (up to 4 mm), funnel-shaped, often with a flat horizontal floor. Their diameter varies from 6 to 12 mm.

From 1/3 to ½ of all septa reach the columella with the formation of well- or weakly-developed paliform lobes. Primary septa are reinforced slightly more than the other septa, their axial ends do not merge with the other metasepta. All septa are noticeably reinforced on the periphery. Septal margins are lacerate, more rarely highly notched. The lateral surfaces of all septa are moderately ornamented. The total number of septa is 32-46. Paliform lobes are slightly above the small loose trabecular columella. Costae are long, thin, in two cycles, and regularly slightly notched. Rare intercostal ridges can be observed on many corals. The coenosteum is vesicular, sometimes with numerous highly swollen exothecal dissepiments. Dissepiments are frequent, slightly inclined, and bulging upward to cystiphorm.
Living colonies are brown or green.

Similar species *F. speciosa* has smaller, usually more compact corallites.

Usually common.

Location. Reefs of Khanh Hoa Province, Phu Quy, Con Dao, Tho Chu, Nam Su, An Thoi Islands.
Distribution. Widely distributed from the Red Sea to the Sea of Japan and the Marshall Islands, depth 1-55 m.

Favia truncatus Veron, 2000

Fig. 37 - 2

Part. *Favia amicorum* complex (Veron et al. (1977)

Massive, flat colonies with subplacoid prominent corallites of oval or irregular shape, with a diameter of 8-16 mm. Calices are deep (5-7 mm) with vertical, often thin walls, with a diameter of 6-14 mm.

First and second cycle septa are thin and slightly flattened near the axis and merge with columella. Third cycle septa almost reach columella. Fourth cycle septa are short, not more than half of a corallite radius. A complete fourth set is not found, as a rule. Axial ends of septa are mainly vertically upright. Margins of all septa are moderately lacerate, and lateral surfaces are weakly ornated. The total number of septa is 25-50. The columella is small, trabecular, spiny, and can be surrounded by an clearly crown made of paliform lobes. Costae are distinct and noticeably notched. The coenosteum is smooth or slightly vesicular. Dissepiments are frequent, prominent, and of small to medium sizes.

Living colonies are shades of fawn.

Similar species *Favia speciosa* and *F. pallida*, both of which have larger corallites with less exsert septo-costae. The inclined corallites, giving a hooded appearance, usually make colonies recognisable underwater.

Rare.

Location. Nam Su Islands, Gulf of Siam.

Distribution. The Red Sea, South Vietnam, Tonga Islands, New Caledonia, and the Great Barrier Reef of Australia, Depth 3-40 m.

Favia speciosa (Dana, 1846)

Fig. 36-5, C8-6

Astrea speciosa Dana, 1846

Favia speciosa (Dana): Vaughan (1918), Veron et al. (1977) cum syn.

Massive colonies of a dome-shaped to hemispherical form with placoid corallites, protruding over the colony for 2-3 mm with formation of a distinct paliform crown. Corallites, having a diameter of 8-17 mm, can adjoin neighboring walls or be at the distance of 3-6 mm from each other. Corallite shape varies from regular cylindrical to elliptical or triangular. Calices are deep (4-6 mm) with vertical walls and broad bottoms.

The first and second cycles of septa are thin (fine), slightly tapering and reinforced towards the periphery. They merge with the columella, from which axial septal edges, rising vertically, form a distinct oval depression (up to 2 mm deep). The third cycle septa, more often an incomplete set, reach ¾ of a corallite radius. Fourth cycle septa are rare; they are represented by short ridges (not more than 2 mm tall) on the calice wall. Septa of the higher cycles can fuse on axial edges to the lateral surface of lower cycles of septa. Inner septal margins are lacerate and notched bearing flat divided denticles. Lateral surfaces are moderately, or rarely highly, ornamented with simple spines. The upper projecting parts of the septa are notched in a fan-like fashion. The total number of septa is 26-42. The columella is trabecular, needle-shaped, and loose. Costal ridges are distinct, uniform, highly serrated with notches. The coenosteum is vesicular, more rarely smooth. Dissepiments are subhorizontal, large, and fine with frequent additional laminae. 20-24 laminae are laid per cm.

Living colonies are deep green or brown-green.

Similar species. See *Favia pallida* and *F. truncatus*.

Common.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Distributed throughout the entire Indo-Pacific from the Eastern coast of Africa to Japan and the Tuamotus, depth 3-45 m.

Favia pallida (Dana, 1846)

Fig. 37 - 3

Favia pallida (Dana): Vaughan (1918), Veron et al. (1977) cum syn., Head (1980), Nakamori (1986), Veron (1986)

Massive hemispherical, dome-shaped, more rarely encrusting-massive colonies with placoid, round, elliptical or polygonal corallites, having a diameter of 7-11 mm. Corallites can merge and protrude upwards together, or can be at the distance of up to 5 mm from each other, covered with distinct costae. Calices are conical with vertical walls, and deep.

First and second cycles of septa are thin (fine) and merge with the columella. Their axial edges, rising vertically, form pali, which more or less distinctly tower over columella. Third cycle septa sometimes reach the columella. They usually do not reach half of a corallite radius. The fourth cycle septa, rarely in a complete set, are developed near the upper calice margin as short ridges. All septa project over the theca and are slightly notched. Inner septal margins are moderately notched or slightly lacerate. The total number of septa is 28-36. Pali are not always clearly developed. The columella is trabecular, loose and very sparse. Costae are distinct, and slightly notched. The coenosteum is vesicular and ridged. Dissepiments are prominent to slightly prominent, medium sized, with single additional laminae. Axial margins of dissepiments are steeply plunging. 8-10 laminae are laid per cm.

Living colonies are pale-yellow, green with a brown or green oral disk.

Similar species. This species is the most variable among all representatives of the genus, and it is difficult to distinguish from *F. speciosa*. It is necessary to add to the morphological distinctions listed by Chevalier (1971), that, firstly, *F. pallida*, unlike *F. speciosa*, has a wall between corallites, well developed in the longitudinal section. Secondly, dissepiments of *F. pallida* are prominent with individual additional laminae, whereas in *F. speciosa* they are subhorizontal with frequent additional laminae, and dissepiments themselves are laid 2-2.5 times more often than in *F. pallida*.

Common.

Location. Distributed everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely distributed throughout the entire Indo-Pacific at the depth from 0 to 45 m.

Favia matthai Vanghan, 1918

Fig. 37 - 4

Favia matthai Vaughan, 1918: Veron et al. (1977) cum syn., Nakamori (1986), Veron (1986)

Massive round to flat colonies with round, elliptical or irregular corallites, slightly protruding above the colony surface. Their diameter varies from 7 to 13 mm. Calices are of a medium depth with vertical walls and slightly prominent bottom.

Septa are thin, reinforced by thickening in the axial space towards the periphery. First and second cycle septa reach the columella, where, forming distinct pali, they make a crown and a well developed depression over the columella. Third cycle septa reach up to ¾ of a corallite radius and have pali-like projections, which can be arranged in concentric circles. Fourth cycle septa have a length of from 1/2 to 2/3 of a corallite radius. All internal septal margins are lacerate, pali-like or serrated and notched; lateral surfaces are moderately ornamented. The total number of septa is 26-38. The columella is trabecular, dense, and located deep in the calice. Costae are thick to thin, even, usually not connected to the costae of neighboring corallites, and are covered with thick denticles. The coenosteum is vesicular. Dissepiments are inclined and vesicular with additional laminae developed of a medium size.

Living colonies are shades of brown-yellow.

Similar species. Readily distinguished from *F. pallida* and *F. speciosa* by the exsert or ragged septa and paliform crown.

Relatively common.

Location. Baitylong Archipelago, Phu Quy, Con Dao, Tho Chu, Nam Su and An Thoi Islands.

Distribution. Madagascar, Cocoa (Keeling) Atoll, Vietnam, Japan, Indonesia, New Caledonia, and the Great Barrier Reef of Australia, depth 3-25 m.

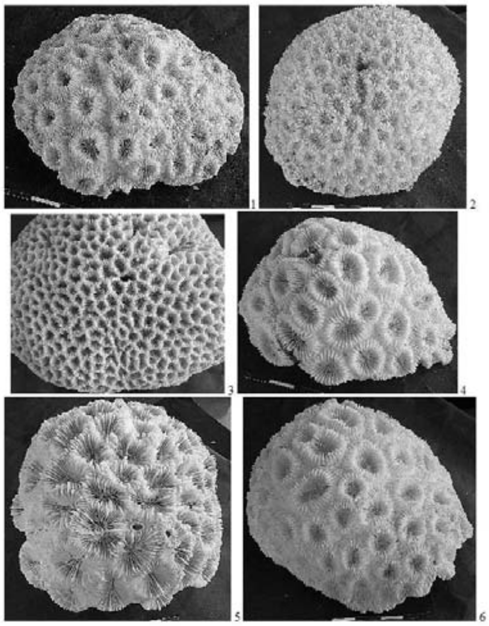


Fig. 37. Appearance of colonies. 1 – *Favia laxa*, spec. 1/9598, Namsu Islands; 2 – *F. amicorum*, spec. 1/95100, Tho Chu Isaland; 3 – *F. pallida*, spec. 1/9599, Thom Island, An Thoi Archipelago; 4 – *F. matthai*, spec. 1/95104, Namsu Island; 5 - *F. rotumana*, spec. 1/95105, An Thoi Archipelago; 6 - *F. maxima*, spec. 1/96106, Namsu Islands

Favia rotumana (Gardiner, 1899)

Fig. 37 - 5, C9 - 2

Astraea rotumana Gardiner, 1899

Favia rotumana (Gardiner): Hoffmeister (1925), Veron et al. (1977) cum syn.

Massive dome-shaped colonies with placoid, round, irregular to polygonal, closely adjoining corallites with a diameter of 6-9 mm. Calices are glass-shaped, deep to very deep (up to 10 mm) with well developed endo- and exotheca.

First and second cycle septa steeply descend from theca, do not reaching the axis, slightly bend and wave, with or without paliform lobes. Third cycle septa rarely reach more than half of a corallite radius. Fourth cycle septa are fine (thin) short ridges, mainly in the upper part of the calice. Axial septal margins are highly notched and serrated with flat wide denticles with divided tips. The lateral surface is densely covered with numerous fine granules. All septa protrude over the theca and are fan-like and notched. There are two orders of costae, not adjoining, and highly notched. The columella is compact and very dense. The coenosteum is weakly developed and vesicular. Dissepiments are steeply inclined with rare additional laminae.

Living colonies are deep green.

Similar species *F. matthaii* has irregular septa but corallites are circular and smaller.

Relatively common.

Location. Reefs of Khanh Hoa Province, Re, Pho Quy, Con Dao and An Thoi Islands.

Distribution. South Vietnam, the Philippines, Samoa, the Marshall Islands, and the Great Barrier Reef of Australia, depth 5-35 m.

Favia maxima Veron et al. 1977

Fig. 37-6, C9-1

Colonies are massive, hemispherical and dome-shaped with large placoid corallites with a round or oval shape, projecting above the colony surface for 3-5 mm. Corallite walls can adjoin or be at a distance of 5-9 mm from each other. Calices are deep and vertical, with a diameter of 11-25 mm.

First, second and more rarely third cycle septa are weakly distinguishable by length and structure, which reach the columella, which forming large paliform lobes, and which constitute a distinct crown around the columella. The length of higher order septa is highly variable: from short ridges (1-2 mm) on the upper wall of the calice to ¾ corallite radius. All septa are reinforced by thickening on the periphery and noticeably protrude over the upper corallite margin. Inner septal margins are serrated and notched. Denticles form radial rows on the lateral septal surfaces. The total number of septa is 30-42. The columella is trabecular, strong, formed by winding spine-like and blade-like lobes. Costae are uniform, flat, and can connect to adjoining corallites. Intercostal ridges are short and weakly developed. All costae are evenly dentate. The coenosteum is vesicular, covered with thinner costae. Dissepiments are steeply inclined to flat. They are larger in the axial zone (up to 4.5 mm) and in the periphery they form small swellings in regular rows.
Living colonies are yellow-brown with a green or deep-green oral disk.

Similar species *F. maritima* has more exsert corallites and does not have prominent paliform lobes.

Common.

Location. Known everywhere, except for Culao Cham Island.

Distribution. Vietnam, Japan, New Caledonia, the Great Barrier Reef of Australia, and the Seychelles Islands, depth 3-42 m.

Favia lizardensis Veron and Pichon, 1977

Fig. 38-1, C8-7

Massive, dome-shaped, nodular-shaped colonies with placoid round to elliptical corallites with well developed endothecal walls, with a diameter of 10-13 mm. Calices are glass-shaped with a medium depth.

First and second cycle septa are weakly distinguishable by length and structure, and reach the columella with the formation of small pali or without them. The third and fourth cycles of septa are not always complete, and are fine. A few in the upper part of the calice are short thin laminae over the theca, or they can reach ¾ of a corallite radius. All septa have fine dentation on the inner margins and minor ornamentation on the lateral surfaces. On the septal periphery they protrude over the theca and are slightly reinforced. The total number of septa is 28-42. The columella is trabecular, and loose or compact. Costae are thin (fine) or slightly tapered and reinforced. They rarely connect with the costae of adjoining corallites, and all costae are slightly notched. The coenosteum is distinctly vesicular.

Dissepiments are subhorizontal or slightly inclined, and rare.

Living colonies are brown with a green oral disk.

Similar species *F. speciosa*, which having corallites,a diameter of 8-17 mm, can adjoin neighboring walls or be at the distance of 3-6 mm from each other.

Common.

Location. Baitylong Archipelago, reefs of Khanh Hoa Province, Culao Cham, Con Dao, Tho Chu, Nam Su and An Thoi Islands.

Distribution. Vietnam, Japan, Indonesia, and the Great Barrier Reef of Australia, depth 5-20 m.

Favia maritima (Nemenzo, 1971)

Fig. 38-3, C8-8

Bikinastrea maritima Nemenzo, 1971

Favia sp. 1: Veron et al. (1977) cum syn.

Favia maritima (Nemenzo): Veron (1986), Latypov (1995)

Massive, hemispherical, sometimes flat colonies with large placoid corallites (12-24 mm) of cylindrical and elliptical shape, projecting over the colony surface for up to 11mm. Corallites can adjoin, but they are usually at the distance of 3-12 mm from each other. Calices are shallow to deep, depending on the height of the projecting corallite.

Most of septa are distinguishable by cycles. First and second cycle septa merge with the columella and are slightly reinforced near it. Third cycle septa usually have a complete set, but their length is highly variable. They can be short laminae with denticles, not more than 2 mm long and reaching ¾ of the corallite radius. The fourth cycle of septa is not complete. They are fan-shaped ridges over the theca and spines in the upper part of the calice. The total number of septa is 36-52. All septa project greatly over the corallite wall and have an intense serrated notching, in the same way as their inner margins. All septa are reinforced by thickening near the periphery. Paliform lobes are large, cannot be clearly discerned in all corallites, but sometimes can form a well-developed crown higher than the columella. The columella is of a medium size, usually loose. Costae are distinct, thick, and highly notched. Costae rarely connect with costae of the neighboring corallites. Intercostae ribs are always present. The coenosteum is vesicular and costate. Dissepiments are slightly to moderately inclined, medium to large. Additional laminae are more prominent than the dissepiments themselves.

Living colonies are green-brown.

Similar species. See *F. maxima.*

Usually common.

Location. Baitylong Archipelago, reefs of Khanh Hoa Province, Culao Cham, Phu Quy, Con Dao and Tho Chu Islands.

Distribution. Vietnam, the Philippines, and the Great Barrier Reef of Australia, depth 3-30 m.

Favia veroni Moll and Best, 1984

Fig. 38-2, C9-7

Favia sp. 2: Veron et al. (1977)

Favia veroni Moll and Best: Nakamori (1986), Veron (1986), Latypov (1995)

Massive, hemispherical and dome-shaped colonies with large (15-25 mm) placoid and subplacoid corallites from cylindrical to subpolygonal shapes. They are situated compactly, often adjoining each other. Calices are deep, open as a rule, not more than 10 mm, with vertical, slightly funnel-shaped thick walls.

Septa descend parallel to the endotheca, projecting for 1.5-2 mm down to the calice floor, where first and second cycle septa merge with the columella, with or without paliform lobes. In some corallites pali can be distinct and form a clearly developed crown and depression over the columella. Third cycle septa almost reach the columella, sometimes merge with the axial ends of the second cycle septa, and it becomes difficult to distinguish them from the latter septa. Fourth cycle septa are usually situated on endotheca, rarely reaching the calice floor and exceeding half of the corallite radius. Fifth cycle septa are always incomplete and developed mainly near the upper calice margin. Inner margins of all septa are highly serrated and dentated. Lateral surfaces are ornamented with spines, arranged in rows perpendicular to the endotheca. All septa protrude well over the theca in the shape of fan-like serrated dentate ridges. The columella is well developed, sometimes it twists clockwise, and is located in a deep depression.

Costae are distinct, slightly tapered and reinforced. They can merge with costae in neighboring corallites.

The coenosteum is not developed clearly due to the compactness of the corallites. Dissepiments are inclined, prominent, and large near the axis. One to two rows of fine numerous laminae, swollen into vesicular laminae, are formed on the periphery, and their upper surface is covered with fine spines.

Living colonies are green with a brown shade.

Similar species *F. maxima* has similar sized corallites with conspicuous paliform lobes. *F. maritima* has smaller, more exsert, more widely spaced corallites.

Uncommon.

Location. Reefs of Khanh Hoa Province, Phu Quy and An Thoi Islands.

Distribution. South Vietnam, Indonesia, and the Great Barrier Reef of Australia, depth 1-18 m.

Favia rotundata (Veron and Pichon, 1977)

Fig. 38-4

Favites rotundata n. sp.: Veron et al. (1977)

Favia rotundata (Veron and Pichon): Veron (1986), Latypov (1995)

Massive colonies of a hilly, dome-shaped or lumpy form with subplacoid closely adjoining corallites, having a diameter of 12-17 mm and protruding above the colony surface by 3 mm. Calices are glass-shaped, shallow with a thick wall.

The first two cycles and often the third as well are slightly tapered and reinforced, and reach the columella and form large paliform lobes. Second and third cycle septa are somewhat thinner. Fourth cycle septa can have a length of about a half of the corallite radius, but they usually project in a shape of ridges over the theca and along the upper part of endotheca. Fifth cycle septa (an incomplete set) are developed only the calice wall as fan-shaped ridges. Inner septal margins are highly serrated and dentate, their lateral surfaces covered with a few fine spines. All septa are tapered and reinforced and protrude near the upper calice margin as fan-shaped ridges, regularly dentate. The total number of septa is 50-72. The columella is compact, dense to very dense, and always in a depression. Costae are even, slightly reinforced, and in two cycles. Costae usually merge, though the boundaries of each corallite are clearly delineated. There is little coenosteum. Dissepiments are subhorizontal, flat, with irregular shapes and with rare prominent additional laminae.

Living colonies are shades of green-brown with clearly delineated lighter oral disks.

Similar species *F. maxima* and *F. veroni* have corallites of similar size, but these are generally more exsert.

Relatively rare.

Location. Phu Quy Con Dao, Tho Chu, and Namsu Islands.

Distribution. South Vietnam, the Great Barrier Reef of Australia, and Vanuatu. Depth 5-10 m.

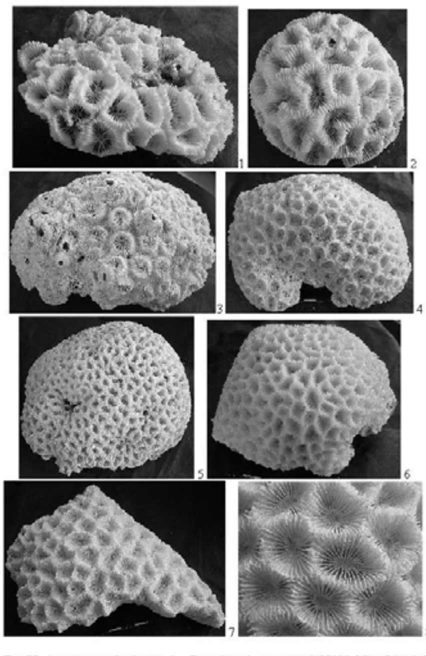


Fig. 38. Appearance of colonies. 1 – *Favia lizardensis*, spec. 1/95101, Mjeu Island; 2 – *F. veroni*, spec. 1/95107, Thu Island; 3 – *F. maritima*, spec. 1/95108, Bai Tu Long Archipelago; 4 – *F. rotundata*, spec. 1/95103, Thu Island; 5 – *Favites russeli*, spec. 1/95113, Mjeu Island; 6 – *Fvt. chinensis*, spec. 1/9511, Khanh Hoa Province; 7-8 - *Ft. crassicolumellae* sp.nov. spec. 1/95118, Nha Trang Bay, Chuong Island

Genus *Favites* Link, 1807

Type species: *Favites astrinus* Link, 1807 = *Madrepora abdita* Ellis and Solander, 1786.

Diagnosis. Massive cerioid corals with merging septa of adjoining polygonal corallites, having a common endothecal wall. The columella is formed of flat spiral twisting trabeculae, and is dense. Disssepiments are endothecal, a row of separate exothecal horseshoe-shaped dissepiments can be formed.

Favties russelli (Wells, 1954)

Fig. 38-5

Plesiastrea russelli Wells, 1954: Latypov, 1995 cum syn.

Favites russelli (Wells): Veron et al. (1977)

Massive hemispherical and dome-shaped colonies with irregularly polygonal, more rarely round corallites with a diameter of 7-18 mm. Calices are shallow with highly protruding walls and a crown of paliform lobes.

Septa can be in three cycles. First cycle septa are more prominent and thick than the other septa. Towards the axial space they become thinner. First and second cycle septa, reaching the columella, form distinct pali, ornamented by fine denticles, noticeably protruding above the columella in the form of a crown. Third and fourth cycle septa are developed in the form of low ridges along the calice wall. Inner septal margins have many fine denticles, which can be ornamented by even finer spines. Lateral septal surfaces are finely granulated. The total number of septa is 30-34. The columella is compact, dense, and slightly twists clockwise. Dissepiments are slightly inclined and subhorizontal, spaced, flat or slightly prominent. Additional laminae are sporadic, steeply inclined, are developed more often in the periphery and more rarely near the axis.

Living colonies are uually green, brown or mottled or with green oral discs.

Similar species *F. pentagona* has thinner walls and smaller corallites.

Rare.

Location. Hon Mieu Island (Khanh Hoa Province).

Distribution. South Vietnam, Indonesia, the Marshall Islands, New Caledonia, Vanuatu, and the Great Barrier Reef of Australia, depth 5-15 m.

Favites chinensis (Verrill, 1866)

Fig. 38-6, C9-4

Prionastrea chinensis Verrill, 1866

Favites chinensis (Verrill): Veron et al. (1977) cum syn.

Massive dome-shaped colonies with polygonal or round corallites with a moderately thick wall and a diameter of 8-13 mm. Calices are glass-shaped and shallow.

First and second cycle septa reach the axis mainly with the formation of pali. Third cycle septa do not reach the columella, reaching from ½ to ¾ of a corallite radius. Fourth cycle septa are no longer than half of the corallite radius, but more often they represent short ridges on the calice wall. All septa are highly serrated and dentate, more in the axial space than on the periphery. Lateral septal surfaces can be ornamented with spines arranged in fan shapes. The total number of septa is 40-60. Septa of the neighboring corallites are adjoining. Paliform lobes are not always developed. The columella is well developed, small, and dense. Dissepiments are subhorizontal, large and prominent to spherical.

Living colonies are shades of brown-green.

Similar species *F. complanata* has larger, more excavated corallites with thicker walls.

Usually common.

Location. Re, Phu Quy, Con Dao, Nam Su and An Thoi Islands.

Distribution. Ceylon, Vietnam, Indonesia, Japan, New Caledonia and the Great Barrier Reef of Australia, depth 3-30 m.

Favites abdita (Ellis and Solander, 1786)

Fig. 39-1, C9-8

Madrepora abdita Ellis and Solander, 1786

Favites abdita (Ellis and Solander): Vaughan (1918), Veron et al. (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986)

Massive colonies, hemispherical, dome-shaped or with numerous lumps. Corallites are polygonal, sometimes elongated or round, having a diameter of 8-16 mm. Calices are shallow or moderately deep.

Primary septa reach the axis and are detached from the other septa. The other septa are grouped in cycles, and most reach the columella, where their axial edges merge in groups of 3-5. Inner septal margins are highly dentate with saw- and needle-shaped spines. Lateral surfaces are ornamented with very fine granules. The total number of septa is 30-40. Paliform lobes are not developed in any corallites. The columella is dense and compact. Dissepiments are slightly inclined, uncommon and slightly prominent. Additional laminae are more prominent, fine, and rarely spaced.

Living colonies are brown-yellow with a green oral disk.

Similar species *F. halicora* has less angular corallites with thicker walls and paliform lobes.

Common in various reef zones.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely known throughout the entire Indo-Pacific from the Red Sea to Japan, Samoa and Lord Howe Island in Australia, depth 0-40 m.

Favites halicora (Ehrenberg, 1834)

Fig. 39-2

Astraea halicora Ehrenberg, 1834

Favites halicora (Ehrenberg): Vaughan (1918), Veron et al. (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986)

Massive-encrusting or dome-shaped colonies with polygonal corallites with thick walls and shallow calices having a diameter of 8-14 mm.

Half of all septa, poorly distinguished by cycles, reach the columella, where they form distinct pali, highly projecting and forming a crown. Third and fourth cycle septa are ridges, arranged along the calice, which fuse with septa of lower cycles by their axial edges, and rarely reach more than half a corallite radius. Inner margins of all septa are highly dentate with flat lanceolate or serrateded laminae. Lateral septal surfaces are highly ornamented with fine spines. The total number of septa is 30-40. The columella is in a distinct round depression, dense, slightly spiraling. Dissepiments are inclined, slightly prominent, with additional prominent laminae in the periphery.

Living colonies are shades of fawn.

Similar species *F. abdita* has more angular corallites with thinner walls.

Relatively common.

Location. Reefs of Khanh Hoa Province, Phu Quy, Con Dao, Tho Chu and Nam Su Islands.

Distribution. Widely known throughout the entire Indo-Pacific, depth 2-40 m.

Favites flexuosa (Dana, 1846)

Fig. 39-3, C9-6

Astraea flexuosa Dana, 1846

Part. *Favites flexuosa* (Dana): Chevalier (1971)

Favites flexuosa (Dana): Veron et al. (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986)

Massive, spherical, dome-shaped, encrusting-massive colonies with distinctly cerioid angular corallites with costate walls of a moderate thickness. Calics are not deep, and are wide, and glass-shaped with a diameter of 12-25 mm.

First and second cycle septa reach the columella, where their ends are reinforced by thickening, greatly protruding upwards, form one or several paliform lobes. Pali of primary septa are larger and thicker than on higher order septa. Third order septa are arranged similarly, but not all of them form pali. Fourth cycle septa rarely reach half a corallite radius, pali are formed in singlely. Fifth cycle septa are developed only near the upper calice margin. All septa are highly dentate with long triangular denticles, including on those parts which project over the calice walls. Lateral septal surfaces are moderately ornamented. The total number of septa is 50-70. The columella is in a depression, dense, and spirally twisted. Dissepiments are slightly inclined, slightly prominent, large, and uncommon. Additional laminae are uncommon and hemispherical.

Living colonies are green.

Similar species *F. abdita* has smaller, usually less angular corallites.

Common.

Location. Distributed everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely known throughout the entire Indo-Pacific, depth 2-35 m.

Favites complanata (Ehrenberg, 1834)

Fig. 39-4, C9-5

Favia complanata Ehrenberg, 1834

Favites complanata (Ehrenberg): Yabe et al. (1936), Veron et al. (1977) cum syn., Nakamori (1986), Veron (1986)

Massive dome-shaped and encrusting colonies with distinctly cerioid corallites with moderately thick walls, having a winding boundary due to displacement towards the septa of neighboring corals. Calics are shallow with a diameter of 8-15 mm.

First and second order thick tapered septa reach the columella with the formation of distinct paliform lobes. Third cycle septa also often reach the columella, but pali are rarely formed. The axial edges of third cycle septa sometimes fuse with second cycle septa. Fourth cycle septa are present in an incomplete set usually in the form of spines on the calice wall and fan-like low ridges over theca. All septa have 2-4 long, thick, rod-like denticles each on their inner margins. Lateral surfaces are covered with fine (thin) granules. The total number of septa is 36-48. The columella can reach up to 1/3 corallite diameter, and is dense to not dense, and slightly spirally twisted. Sometimes short costae in two cycles can be developed. Dissepiments are slightly inclined up to subhorizontal, slightly prominent, and uncommon.

Living colonies are brown.

Similar species *F. abdita* has more angular corallites and lacks the star-like costal pattern.

Relatively common.

Location. Baitylong Archipelago, reefs of Khanh Hoa Province, Re and Phu Quy Islands.

Distribution. Widely known from the Red Sea to Japan, Tahiti and the Tuamotus, depth 2-25 m.

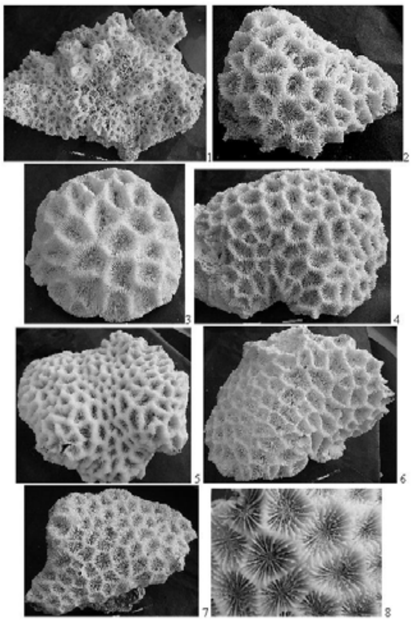


Fig. 39. Appearance of colonies. 1- *Favites abdita*, spec. 1/95109, Island Plazh, Bai Tu Long; 2 – *Fvt. halicora*, spec. 1/95110, Island Mjeu; 3 – *Fvt. flexuosa*, spec. 1/95114, Bai Thanh Bay; 4 – *Fvt. complanata*, spec. 1/95112, Tcho Chu Island; 5 – *Ftv. pentagona*, spec. 1/95115, Il Danjres Island, Bai Tu long; 6 – *Fvt. virens*, spec. 1/95116, Con Dao Islands; 7-8 – *Fvt.* sp. 2, spec. 1/95119, An Thoi Archipelago

Favites pentagona (Esper, 1794)

Fig. 39-5

Madrepora pentagona Esper, 1794

Favites pentagona (Esper): Matthai (1914), Veron et al. (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986)

Massive-encrusting and encrusting colonies with polygonal cerioid corallites, often longitudinally elongated or oval with low, round walls. Corallite diameter is 7-11 mm.

First and second cycle septa (primary septa are thicker) reach the columella, where they form distinct pali, ornamented by fine denticles and forming a crown. Third and fourth cycle septa sometimes are clavate and thick, more often they are short laminae, protruding from the calice wall and theca. All septa are evenly covered with abundant flat denticles. Lateral surfaces are ornamented with a few spines. The total number of septa is 36-48. The columella is not large, and not very dense. Dissepiments are steeply inclined, numerous, and prominent to vesicular. They can form dissepimentarium, occupying half of a calice cavity.

Living colonies are brown or green.

Similar species. The paliform crown makes this species *Goniastrea*-like.

Relatively rare.

Location. Baitylong Archipelago, Re and Phu Quy Islands.

Distribution. Widely known from the Red Sea to Japan, New Caledonia and the Great Barrier Reef of Australia, depth 2-15 m.

Favites virens (Dana, 1846)

Fig. 39-6

Astraea virens Dana, 1846

Favites virens (Dana): Vaughan (1914), Yabe et al. (1936), Umbgrove (1939), Crossland (1952), Wells (1954), Pillai and Scheer (1976)

Part. *Favites virens* (Dana): Wijsman-Best (1972, 1976)

Massive-encrusting colonies with cerioid polygonal corallites with a thin winding wall. Calices are shallow, open, with a diameter of 14-22 mm.

From 1/3 to ½ of all septa of the first through third cycles (not clearly distinguished) reach the columella with the formation of paliform lobes, slightly protruding above the columella. The main primary septa are isolated. Third and fourth order septa often fuse with septa of lower orders by their axial edges, forming fans of septa. Fouth cycle septa rarely exceed ¼ corallite radius. Fifth cycle septa are developed only near the upper calice margin as short tapered ridges and laminae. Inner surfaces of all septa are highly dentate with serrated denticles. Lateral surfaces are finely ornamented. The total number of septa is 58-86. Adjoining septa of neighboring corallites are slightly displaced from each other. The columella is distinctly outlined, dense, and slightly twisted clockwise. Dissepiments are inclined, large, prominent, and they form a dissepimentarium from the wall to the columella.

Similar species *F. pentagona* has smaller corallites with more dense walls.

Rare.

Location. Con Dao Islands.

Distribution. Known from the Red Sea to Japan and New Caledonia, depth 5-40 m.

Favites solidocolumellae sp. nov.

Fig. 38-7, 8

Favites sp. 1: Latypov (1995).

Holotype: spec. 1/95118, Museun of Institute of Marine Biology, Vladivostok, Russia, Nha Trang Bay, Chuong Island, depth 3 m, corallogenous reef slope.

Massive dome-shaped colonies of 50 mm height with distinctly cerioid polygonal corallites, having a diameter of 15-20 mm. Calices are deep (up to 10 mm) with thin winding walls.

The first two cycles of septa and more rarely the third cycle, reach the columella, where they form distinct pali, highly reinforced by thickening and forming a well-developed crown, protruding above the columella. The rest of septa of the third and fourth cycles have variable lengths from short laminae-ridges on the calice walls to ¾ of a corallite radius. All metasepta have a tendency to form a plumose arrangement with the primary septa, sometimes being arranged in groups, fusing on their axial edges. Primary septa, especially the directives, are distinguished by their thickness. All septa are moderately dentate with broad scars, onamented by fine numerous grains. Pali are especially ornamented. Lateral septal surfaces are covered with numerous, very fine grains. The total number of septa is 36-50. The columella is smoll and very dense. Dissepiments are inclined, prominent to vesicular, forming a wide zone of dissepimentarium including up to four rows of different length laminae, which are finer in the periphery. Budding occurs along the margin of corallites, more rarely intratentacular division occurs.

Living corals are yellow-green or pale-brown with a light oral disk.

Comparison. *Favites flexosa* has 1.5 times as many septa. *F. crassicolumellae* lacks the fifth cycle septa and the second cycle septo-costae. The most similar species is *F. flexuosa*, described by Veron and his co-authors (1977, p. 61, Fig. 106) which it differs from by distinct thick pali and a denser columella. They differ from *Favites virens* (Pillai and Scheer, 1976, p. 57, Pl. 24, Fig. 3) by larger corallites and well-developed paliform lobes.

Etymology. Solidus (Latin) – compact, columella (Latin) - columella

Rare.

Location. Khanh Hoa Province.

Distribution: South Vietnam. Are not widely known in the South-West Pacific, East Indian Ocean or Red Sea.

Favites sp. 2

Fig. 39-7, 8

Massive-lumpy colony with polygonal and oval corallites having a diameter of up to 30 mm. Corallites are shallow with moderately thick walls.

Septa are numerous (50-60), thick, up to 0.5 mm. One third of the septa reach the axis, with two to three thick (up to 0.8 mm), icicle-shaped pali, directed obliquely upwards. The length of the remaining 2/3 of the septa is highly variable. They can be thin, reaching ¾ of the corallite radius, or thick, projecting in the form of short laminae (2-3 mm) over the theca and along the calice wall. Distal septal margins are highly dentate with denticles or rods closer to the axis. Lateral surfaces are evenly covered with fine spines, whose density increases towards the distal septal margin. The columella is made of densely packed pali, not outlined distinctly. Septo-costae are tall, dense and thin. Dissepiments are inclined, prominent, large, uncommon, and in the periphery they are more numerous and prominent to vesicular.

Living colonies are yellow-green with a lighter oral disk.

Comparison. Differs from all other *Favites* by large corallites with very thick septa and by rod-shaped pali like icicles. Unlike *Favia rotundata*, this species has a hilly growth form, polygonal corallites, lacks a columella or a crown of pali.

Rare.

Location. An Thoi Archipelago, Wang Island, depth 8 m.

Distribution. South Vietnam, Gulf of Siam.

Genus *Goniastrea* (Lamarck, 1816)

Type species: *Astraea retiformis* Lamarck, 1816.

Diagnosis. Massive and meandroid corals. The first two cycles of septa are clearly distinguishable. Distinct pali form a crown. The columella is trabecular, compact, and always in a depression. Dissepiments are endothecal.

Goniastrea retiformis (Lamarck, 1816)

Fig. 40 - 1

Astraea retiformis Lamarck, 1816

Goniastrea retiformis (Lamarck): Edwards and Haime (1846), Veron et al. (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986)

Massive hemispherical colonies, dome-shaped or in the form of microatolls, with fine (3-5 mm) quadrangular-hexagonal corallites.

Four cycles of septa. Primary septa and some second cycle septa reach the columella, where they form distinct pali, forming a crown. Third cycle septa do not exceed half of the corallite radius. Fourth cycle septa are not always in a complete set; usually they are represented by ridges or rows of spines from the upper calice margin downwards along the endotheca. All septa are dentate with spines and denticles with divided margins. The columella periphery has especially strong dentation, where pseudosynapticulae may be formed. The total number of septa is 30-36. The columella is loose and not very large. Dissepiments are slightly inclined and subhorizontal, large, slightly prominent and wavy.

Living corals are shades of brown.

Similar species *G. edwardsi* has thicker walls and septa and more irregular corallites.

Common in various reef zones.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely distributed throughout the entire Indo-Pacific from the Red Sea to Samoa, depth 0-35 m.

Goniastrea edwardsi Chevalier, 1971

Fig. 40 - 2

Goniastrea edwrdsi Chewalier, 1971: Wijsman-Best (1976), Veron et al. (1977) cum syn.

Massive colonies of diverse shapes with 4 to 5 sided polygonal cerioid corallites, sometimes slightly elongated or oval, having a diameter of 4-8 mm. The theca is thick.

There are three to four cycles of septa. The first and more rarely second cycle of septa vertically descend from the calice margin and reach the columella with the formation of large paliform lobes, which are highly granulated. Third cycle septa (an incomplete set) are developed mainly in a form of ridges near the upper margin and on the walls of the calice. All septa are highly granulated with spines perpendicular to the center of the calice, which makes an impression of carination. Septa of the neighboring corallites fuse, but almost always with a higher cycle fusing with a lower one. The total number of septa is 30-36. The columella is loose or dense and compact.

Dissepiments are slightly inclined and subhorizontal, wavy and slightly prominent. Additional laminae are rare or absent.
Living colonies are yellow-brown.

Similar species *G. aspera* has larger corallites.

Usually common.

Location. Reefs of Khanh Hoa Province, Re, Phu Quy, Con Dao, Tho Chu, Nam Su and An Thoi Islands.
Distribution. Known from the Seychelles Islands in the Indian Ocean to Loyalty (????) Island in the Pacific Ocean, depth 1-35 m.

Goniastrea aspera Verrill, 1865

Fig. 40 - 3, C10 - 1

Goniastrea aspera Verrill, 1865: Veron et al. (1977) cum syn., Nakamori (1986), Veron (1986)

Round massive or massive-encrusting colonies with distinct cerioid 5 to 7 sided polygonal corallites with thin walls. Calice diameter is 7-13 mm.

Four cycles of septa. First and often second cycle septa reach ¾ of the corallite radius. At the boundary with the columella they form distinct slightly reinforced pali, which descend vertically. Third cycle septa are arranged in the same way, but they do not form pali and do not exceed ½ of the corallite radius. Fourth cycle septa are formed at the upper calice margin in the form of short laminae or ridges. Axial ends of primary septa and septa themselves are free. Septa of higher cycles fuse with lower cycle septa by their axial edges. Distal margins of all septa are dentate with sharp denticles, and lateral surfaces are highly ornamented with large granules. Septa which fuse with septa in a neighboring corallite, may fuse with septa of the same or a different cycle. The total number of septa is 36-40. The columella is small, dense, and located very deep in the calice. Dissepiments are vertically swollen, widely spaced, and large (up to 5-7 mm). Near the upper calice margin periodic vesicular fine additional laminae are developed.
Living colonies are usually uniform pale brown in color.

Similar species *G. edwardsi* has similar skeletal structures but is more smaller.

Common and may be a dominant species.

Location. Baitylong Archipelago, reefs of Khanh Hoa Province, Culao Cham, Re, Phu Quy, Con Dao and Nam Su Islands.
Distribution. Palau, Mergu Islands and Archipelago, Vietnam, Indonesia, Japan, the Philippines, New Caledonia, and the Great Barrier Reef of Australia, depth 2-15 m.

Goniastrea favulus (Dana, 1846)

Fig. 40 - 4

Astraea (Fissicella) favulus Dana, 1846

Goniastrea favulus (Dana): Wijsman-Best (1972, 1976), Veron (1986)

Submassive and encrusting colonies with pentagonal monocentric or polygonal elongated polycentric corallites. Calices have vertical high walls with twisted ridges. Calice width can be 6-10 mm, and calice length up to 25 mm.

There are three or more rarely four cycles of septa. First cycle septa and some second cycle septa reach the columella with the formation of fine (thin) long pali, slightly protruding above the columella and rarely forming a crown. The remaining second and third cycle septa rarely reach more than half of the corallite radius. They protrude as short laminae in the upper part of the calice, without reaching the calice floor. Fourth cycle septa, rarely a complete set, are developed only as ridges on the theca and on the uppermost part of the calice walls. Distal septal margins are highly dentate with fine denticles, and lateral surfaces are covered with numerous fine (thin) granules, which can merge in rows towards the distal margin. When extending to a neighboring corallite, septa connect to septa of a different cycle. The total number of septa is 30-36 in monocentric corallites, and 50-60 in polycentric corallites. The columella is small and loose. Dissepiments are vertical and horizontal, sometimes horseshoe-shaped, medium and large, always prominent, especially near the upper calice margin.

Living colonies are shades of brown.

Similar species *G. retiformis* has similar corallite structures but is always cerioid.

Uncommon.

Location. Reefs of Khanh Hoa Province, Con Dao Islands.

Distribution. Laccadives, South Vietnam, Hong Kong, Indonesia, Philippines, New Caledonia, Fiji, Torres Strait and the Great Barrier Reef of Australia, depth 0-20 m.

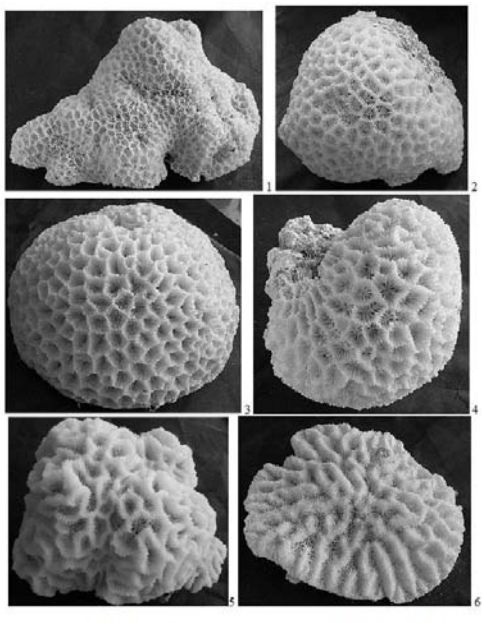


Fig. 40. Appearance of colonies. 1 – *Goniastrea retiformis*, spec. 1/95120, Bai Thanh Bay; *G. edwardsi*, spec. 1/95117, Tho Chu Island; 3 – *G. aspera*, spec. 1/95121, Kat Ba Island, Bai Tu Long; 4 – *G. favulus*, spec. 1/95122, Con Dao Islands; 5 – *G. pectinata*, spec. 1/95123, reef Gjang Bo; 6 – *G. australiensis*, spec. 1/95124, Bai Thanh Bay

Goniastrea pectinata (Ehrenberg, 1834)

Fig. 40 - 5, C10 - 2

Astraea pectinata Ehrenberg, 1834

Goniastrea pectinata (Ehrenberg): Klunzinger (1879), Veron et al. (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986)

Massive spherical, lumpy and encrusting colonies with 4 to 5 sided polygonal, oval or meandering coralites. Calices have thick curving-ridged walls and deep columellae.

Three cycles of septa are developed. Two cycles of 8-12 septa each reach the columella, where they form pali, projecting above the columella in the shape of a distinct crown. Third cycle septa are developed only at the upper calice margin in the form of short ridges or a series of spines. Septa of neighboring corallites, connecting, change the cycle. Total number of septa is 30-36. The primary septa are the thinnest of all septa, Septa that are the closest together are arranged in a fan shape. Distal septal margins are dentate with fine denticles, and lateral surfaces are ornamented with fine granules. The columella is compact but spongy. Dissepiments are slightly inclined, subhorizontal, irregular, slightly prominent, rarely more prominent. Additional laminae are umcommon.

Living colonies are shades of brown.

Similar species *G. edwardsi* has more smaller corallites.

Common in shallow water reef zones.

Location. Distributed everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely known throughout the entire Indo-Pacific, depth 0-40 m.

Goniastrea australiensis (Edwards and Haime, 1857)

Fig. 40-6

Prionastrea australiensis Edwards and Haime, 1857

Gonoastrea australiensis (Edwards and Haime): Wijsman-Best (!972), Veron et al. (1977), Veon (1986)

Flat-topped massive, cake-shaped or encrusting colonies with meandroid or sub meandroid corallites with 1-3 centers, with triangular or trapezoid ridged walls.

Septal cycles cannot be distinguished. Parallel to the calice wall they descend as short lanceolate laminae to the calice floor, where they become thinner, extend horizontally to the columella with the formation of distinct pali. The pali are covered with fine spines and noticeably rise above the columella as a distinct crown. Distal septal margins are finely dentate, and lateral surfaces are moderately granulated. The primary septa, and often the directive as well, are detached from the other septa. The total number of septa is 24-34. The columella is small and dense. Dissepiments are inclined, prominent, medium size to large with single additional laminae. Exothecal dissepiments may be developed.

Living colonies are deep green.

Similar species *G. australensis* is the only fully meandroid *Goniastrea*. Underwater, it may be difficult to distinguish from *Platygyra lamellina*, but skeletons are readily distinguished by their well developed columella centres and paliform lobes (Veron, 1986).

Relatively common.

Location. Khanh Hoa Province, Phu Quy, Con Dao Islands.

Distribution. South Vietnam, Kermadec Island, Japan, the Philippines, New Caledonia, and the Great Barrier Reef of Australia, depth 5-42 m.

Goniastrea cf. *palauensis* (Yabe et al. 1936)

Fig. 41-1

Massive-encrusting colonies with 4 to 6 sided polygonal slightly meandering round corallites with thick ridged walls. The calice is deep and funnel-shaped; its diameter is 7-15 mm. Two to three cycles of septa are developed, which are fairly clearly distinguished. Primary septa are reinforced more strongly than the other septa, and they project to a greater extent over the other septa and on the calice wall. First cycle septa, and more rarely second cycle septa, reach the columella with the formation of well developed pali, forming a distinct crown and protruding well upwards. Third cycle septa are short ridges or merging spines along the calice walls, not reaching more than ¼ of the corallite radius.

Inner margins of all septa are highly dentate with long flat denticles with complexly divided tips. Lateral septal surfaces are granulated with fine spines, arranged in rows, corresponding to the direction and number of denticles on the inner septal margin. The total number of septa is 26-38. The columella is spongy, but compact. Dissepiments are inclined and inclined, prominent, fine, uncommon and without additional laminae.

Living colonies are shades of brown.

Similar species *G. aspera* has smaller corallites.

Rare.

Location. Con Dao Islands.

Distribution. South Vietnam, Palau, New Caledonia, and the Great Barrier Reef of Australia, depth 3-20.

Genus *Platygyra* Ehrenberg, 1834

Type species: *Platygyra labirinthica* Ehrenberg, 1834-*Madrepora daedalea* Ellis and Solander, 1786.

Diagnosis. Massive meandroid and cerioid corals. Two cycles of septa can barely be distinguished by size. Pali are prominent or weakly developed . The columella is trabecular. Endothecal dissepiments are well developed.

Platygyra daedalia (Ellis and Solander, 1786)

Fig. 41-2, C10-4

Madrepora daedalia Ellis and Solander, 1786

Platygyra daedalia (Ellis and Solander): Nemenzo (1959), Veron et al. (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986)

Massive colonies of various shapes to encrusting with meandroid and long parallel corallites, more rarely polygonal, monocentric corallites. Septa are narrow and often perforated.

Septa are in two almost indistinguishable cycles. At the calice floor they reach the columella, and by the thecal margin they decrease to zero height. Distal septal margins are highly dentate, especially near the calice floor, where they twist and form horizontal lamnae, ornamented by fine spines. Lateral surfaces bear fine granulation. Paliform lobes are rarely found, usually in monocentric corallites. Columellae are spongy, with variable densities and sizes. Dissepiments are inclined and subhorizontal, prominent or slightly curving.

Living colonies are brown with green or a lighter color between corallite walls.

Similar species *P. lamellina* has thicker walls and neat rounded septa.

Common.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely distributed throughout the entire Indo-Pacific, depth 1-35 m.

Platygyra lamellina (Ehrenberg, 1834)

Fig. 41-3, C10-3

Meandrina lamellina Ehrenberg, 1834

Platygyra lamellina (Ehrenberg): Wells (1936), Veron et al. (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986)

Massive, spherical, cake-shaped with a lumpy surface, or encrusting colonies. Corallites are long, regular and meandering, polygonal corallites are also common, or round and monocentric, with thick walls.

First and second cycle septa are of a similar length, and situated at a uniform distance from each other. They reach the axis at the calice floor, and rise to the thecal margin. Distal margins are highly dentate with flat laminae. The upper septal margins protrude over the theca. Lateral surfaces are finely ornamented. Paliform lobes are not developed. The columella is small, rarely spongy, and dense. Dissepiments are inclined and horizontal, prominent, medium to large, and the laminae are thick. Neighboring corallites connect by exothecal horseshoe-shaped dissepiments.

Living colonies are brown or green.

Similar species *P. daedalia* has meandroid and long parallel corallites, more rarely polygonal, monocentric.

Common.

Location. Distributed everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely known throughout the entire Indo-Pacific from the Red Sea to Polynesia, depth 1-35 m.

Platygyra sinensis (Edwards and Haime, 1849)

Fig. 41-4

Astroria sinensis Edwards and Haime, 1849

Platygyra sinensis (Edwards and Haime): Wells (1954), Veron et al. (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986)

Massive, flat or encrusting colonies with monocentric and elongated to meandroid corallites. Walls are mainly thin, and calices are deep, more than 5 mm.

Septa are fine, vertical, and cycles are almost indistinguishable. They descend as low ridges to the calice floor, slightly extending to reach the axis or very small columella. Distal margins are less dentate, as in all the other *Platygyra*. In cerioid corallites columellae are composed of twisted loose rods and spines, whereas sparse pali are in the form of slight expansions of the septa. Peripheral septal ends slightly protrude over the theca. The columella is narrow, weakly developed, and consists of slightly interlaced trabeculae. Dissepiments are horizontal, prominent to slightly prominent laminae.

Living colonies are deep-green with a lighter color between the corallite walls.

Similar species. Resembles *Goniastrea favulus* underwater.

Usually common.

Location. Baitylong Archipelago, reefs of Khanh Hoa Province, Culao Cham, Phu Quy, Tho Chu, Nam Su and An Thoi Islands.

Distribution. Widely known in the entire Indo-Pacific, depth 1-35 m.

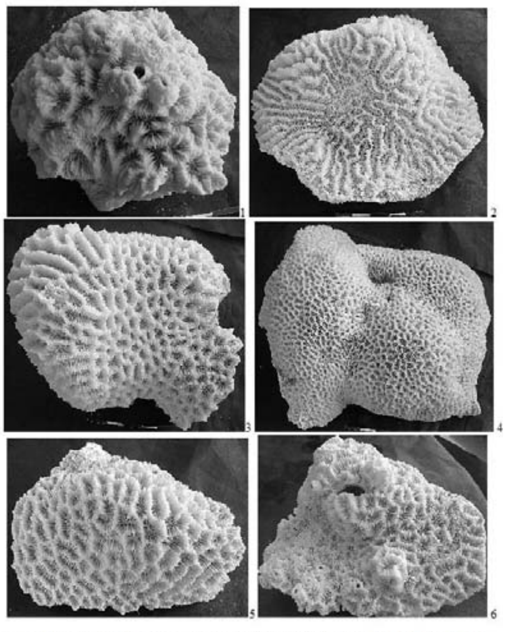


Fig. 41. Appearance of colonies. 1 – *Goniastrea* cf. *palauensis*, spec. 1/95125, Con Dao Islands; 2 – *Platygyra daedalea*, spec. 1/95225, Con Dao Islands; 3 – *Pl. lamellina*, spec. 1/95126, Bai Tu Long Archipelago; 4 – *Pl. sinensis*, spec. 1/95128, Bai Canh Bay; 5 – *Pl. pini*, spec. 1/95127, An Thoi Island; 6 – *Australogyra zelli*, spec. 1/95128a, Khanh Hoa Province

Platygyra pini Chevalier, 1975

Fig. 41-5, C24-2

Platygyra pini Chevalier, 1975: Wijsman-Best (1972), Veron et al. (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986)

Massive-encrusting and encrusting colonies. Corallites have one or two centers more often than long polycentric valleys. The walls are thick, and corallites are deep.

Septa are thick, short, often well distinguished only closer to the calice floor. They reach the columella, and due to the increased dentation towards the axis can form flat pali, ornamented with fine spines. The columella is extensive, occupying up to 1/3 of the lumen, and dense. Dissepiments are steeply inclined, prominent to vesicular. Laminae are fine (thin), but can be thick, up to 0.4 mm.

Living colonies are fawn colored with light or green corallite centers.

Similar species *P. ryukyuensis* has smaller valleys with thinner walls.

Usually common.

Locatio. Distributed almost everywhere, except for Culao Cham Island.

Distribution. Vietnam, Japan, New Caledonia, Chesterfield Islands, and the Great Barrier Reef of Australia, depth 5-20 m.

Genus *Australogyra* Veron et al. 1977

Type species: *Platygyra zelli* Veron et al. 1977.

Diagnosis. Ramose and incrusted corals with tubercules, with numerous, more rarely longitudinal corallites. Septa of two distinct cycles with protruding protosepta. Pali are absent, columella is made of individual rods. Dissepiments are numerous, endothecal.

Australogyra zelli (Veron and Pichon, 1977)

Fig. 41-6

Platygyra zelli n. sp.:Veron et al. (1977)

Australogyra zelli (Veron and Pichon): Veron (1986)

Encrusting-massive colonies with numerous mono to tricentric corallites with thick walls. Calices are of a moderate depth.

Septa are thick, short, and well distinguished by cycles. Primary septa and the directive, which is 2-2.5 times thicker than the other septa, reach half of the corallite radius (more rarely ¾). Second cycle septa are thinner and shorter. Sometimes septa of the third cycle are developed in the form of short ridges or spines in the upper part of the calice. Distal septal margins are regularly dentate, and lateral surfaces are ornamented with small granules. The columella is small, loose, and made of individual rods. Dissepiments are variously inclined up to subhorizontal. Laminae are prominent to slightly prominent, wavy, and thin. They are laid very often: up to 25-30 per cm of corralite length.

Living colonies are brown.

Similar species *Australogyra* is similar to *Platygyra* in corallite structure but not growth-form.

Rare.

Location. Reefs of Khanh Hoa Province, Re and Nam Su Islands.

Distribution. South Vietnam, Indonesia, and the Great Barrier Reef of Australia, depth 3-10 m.

Genus *Leptoria* Edwards and Haime, 1848

Type species: *Madrepora phrygia* (Ellis and Solander, 1786)

Diagnosis. Massive meandroid corals with long meandering corallites with a thick wall. Septa are short with a uniform interseptal interval, and cycles cannot be distinguished. Pali are not present. The columnella is in the form of a simple vertical lamina. Dissepiments are endothecal and frequent.

Leptoria phrygia (Ellis and Solander, 1786)

Fig. 41-1, C10-5

Madrepora phrygia Ellis and Solander, 1786

Leptoria phrygia (Ellis and Solander): Edwards and Haime (1857), Veron et al. (1977) cum syn., Veron (1986)

Massive, often large colonies with a firm solid skeleton. Corallites are long and nallow, strongly meandering, and with a deep calice.

Septa are short, situated at a uniform distance from each other, and cycles cannot be distinguished. They rise over the theca and often extend from one corallite to the other by a single lamina. Septa do not quite reach the axis, where they extend as horizontal laminae which form the columella. Distal septal margins are moderately dentate, and the denticles are often divided. Lateral ornamentation consists of fine grains. Dissepiments are inclined, prominent, frequent (up to 20-30 per 1 cm) and small (fine). Additional laminae are very rare, from the axial space to the periphery.

Living colonies are yellow-brown with lighter corallite centers.

Similar species *L. irregularis*, which has larger valleys which are straight at the colony margins, is distinctively coloured and has columellae which are not plate-like (Veron, 1986).

Common on reef slope.

Location. Distributed everywhere, except for the northern Gulf of Tonkin.

Distribution. Widely distributed from the Red Sea to Japan and Fiji, depth 1-25 m.

Genus *Oulophyllia* Edwards and Haime, 1848

Type species: *Oulophyllia crispa* (Lamarck, 1816).

Diagnosis. Massive and encrusting meandriod colonies with broad, deep corallites. Two to three cycles of septa with uinform spacing fuse at the axis with each other and the columella, which can be very dense and extensive. There is a wide zone of endothecal elements.

Oulophyllia crispa (Lamarck, 1816)

Fig. 42-2, C10-7

Meandrina crispa Lamarck, 1816

Oulophyllia crispa (Lamarck): Matthai (1928), Veron et al. (1977) cum syn., Veron (1986)

Thin dome-shaped and encrusting colonies with meandroid, polygonally polycentric corallites, more rarely monocentric corallites with a width and depth of up to 15 mm. The theca is thick and tapered upwards.

First and second cycle septa protrude along the calice walls rarely more than 1 mm. They sharply elongate towards the calice floor and merge with the columella, forming vertical pali-like laminae, which have up to three long flat rods distally. Third cycle septa protruce on the calice wall in the form of spines and ridges, or thin even laminae, reaching ¾ of the corallite radius. Distal septal margins have fine denticles, and lateral surfaces are moderately ornamented. Distinct pali, surrounding a depression over the columella, can be found in monocentric corallites. The columella is well-developed and spongy. Denser vertical connective laminae are formed between corallites. Dissepiments are steeply inclined, prominent, narrow and large (up to 4 mm), they fill the entire calice from the wall to the columella.

Living colonies are deep-green with lighter corallite centers.

Similar species *O. bennettae* has cerioid corallites, which often having 2-3 centers and thick ridged walls.

Relatively common.

Location. Baitylong Archipelago, Re, Phu Quy, Con Dao, Tho Chu and Nam Su Islands.

Distribution. Known throughout the entire Indo-Pacific from the Red Sea and Madagascar to Japan and the Great Barrier Reef of Asutralia, depth 3-30 m.

Oulophyllia bennettae (Veron and Pichon, 1977)

Fig. 42-3, C10-6

Favites bennettae Veron and Pichon, 1977

Oulophyllia bennettae (Veron and Pichon): Veron (1986)

Massive-encrusting colony with cerioid corallites, each corallite often having 2-3 centers and thick ridged walls. The width of polycentric corallites is 15-20 mm.

Slightly tapered, reinforced septa are poorly distinguishable by cycles, and almost reach the axis with the formation of distinct paliform lobes. The axial edges of primary septa are free. The rest of the septa usually fuse in pairs, more rarely in triplets. Septa are reinforced in the periphery, project well over the theca and pass from one corallite to another. All septa are highly serrated and dentate; the dentations are large and ornamented by fine spines. Lateral septal surfaces are moderately ornamented with fine spines, which are arranged in the form of rows near the dentations of the distal margin. The total number of septa is 20-34. The columella is compact, dense, and a twisted spiral. Dissepiments are steeply inclined, numerous, large, and prominent. Neighboring corallites are connected by a row of horseshoe-shaped dissepiments.

Living colonies are gray-green.

Remarks. In support of the assignment of *Favites bennetae* to the genus *Oulophyllia* (Veron, 1986) it is necessary to add that *F. bennetae* (Veron et al. 1977), as well as representatives of *Oulophyllia*, do not have second order septa, and the total number of septa in monocentric corallites usually doesn't exceed 30. *Favites* have 40-50 septa per corallite on the average, and their minimal number is 30 in corallites, so *Favites* usually has almost twice the number of septa of *Oulophyllia*. In addition, in *F. bennetae* a wide corallite wall is formed by large adjoining exothecal dissepiments, as in *Oulophyllia*, but not by septothecal dissepiments, as in *Favites*.

Rare and conspicuous.

Location. Con Dao Islands.

Distribution. South Vietnam, Indonesia, Vanuatu, and the Great Barrier Reef of Australia, depth 5-10 m.

Oulophyllia levis (Nemenzo, 1959)

Fig. C18-8

Colonies are thick plates or are hemispherical. Valleys are usually perpendicular to the margins of plates, and are sinuous towards colony centres. They are short, broad (up to 20 mm), V-shaped and have sharp upper margins. Columellae are weakly developed.

Living cjlonies are greenish- or yellowish-brown walls with yellow, green or pink valley floors.

Similar species: *Oulophyllia crispa*, which is less colourful and has slightly larger valleys with less developed columellae.

Rare

Location. Re Islands, Spratly Archipelago.

Distribution. South-west Pacific up to Taiwan and Japan.

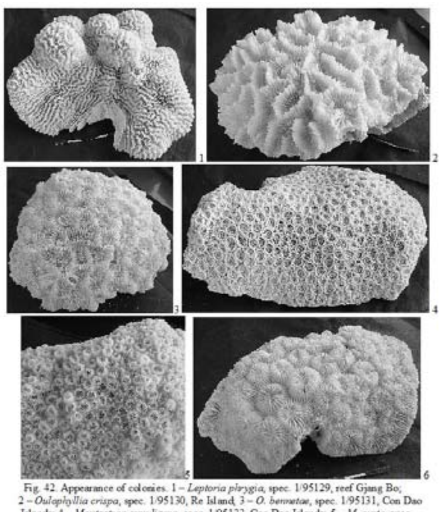


Fig. 42. Appearance of colonies. 1 – *Leptoria phrygia*, spec. 1/95129, reef Gjang Bo; 2 – *Oulophyllia crispa*, spec. 1/95130, Re Island; 3 – *O. bennetae*, spec. 1/95131, Con Dao Islands; 4 – *Montastrea annuligera*, spec. 1/95133, Con Dao Islands; 5 – *M. curta*, spec. 1/95132, reef Gjang Bo; 6 – *M. magnistellata*, spec. 1/95135, Tho Chu Island

Genus *Montastrea* De Blainville, 1830

Type species: *Astraea quettardi* Defrance, 1826.

Diagnosis. Massive placoid-cerioid corals with distinct costae and intercostal ridges and an intercorallite boundary. Septa are long, with clearly differentiated cycles, with or without pali. The trabecular columella is well developed. Dissepiments are endothecal, here and there being transformed into tabulae.

Montastrea curta (Dana, 1846)

Fig. 42-5

Orbicella curta Dana, 1846

Montastrea curta (Dana): Chevalier (1971): Wijsman-Best (1977), Veron et al. (1977) cum syn., Nakamori (1986), Veron (1986)

Massive subspherical and dome-shaped colonies with round conically protruding (up to 6 mm) corallites, with a diameter of 4-7 mm. Calices are deep and vertical.

The first two cycles of septa and up to 1/3 of the third cycle reach the columella with the formation of pali, projecting above the columella in the form of a crown. The remaining third cycle septa are thinner, and their length is rarely longer than a half of the corallite radius. Axial edges are free. Fourth cycle septa are developed only on the upper calice margins and as ridges or crests over the theca. All septa protrude well over the theca, and in the upper calice margin, they are noticeably tapered, reinforced and highly dentate. The primary septa are especially noticeable. Lateral surfaces are densely covered with spines. Septa can be porous. The total number of septa is 24-40. The columella is large, fairly dense, and situated deep in the calice. Costae are well-developed, in two cycles, and intercostal ridges are formed between separate corallites. The costae of neighboring corallites are not connected. Dissepiments, grading into tabulae, are horizontal, slightly prominent or wavy. Laminae are fine (thin) and frequent up to 16-20 per cm of corallite length.
Living colonies are brown.

Similar species *M. salebrosa* has smaller more exsert corallites.

Relatively common.

Location. Reefs of Khanh Hoa Province, Re, Phu Quy, Con Dao and Tho Chu Islands.
Distribution. Widely distributed throughout the entire Indo-Pacific from the Red Sea to Japan and the Tuamotu Archipelago, depth 5-20 m.

Montastrea annuligera (Edwards and Haime, 1849)

Fig. 42-4

Orbicella annuligera Edwards and Haime, 1849

Montastrea annuligera (Edawards and Haime): Wijsman-Best (1977), Veron et al. (1977) cum syn., Nakamori (1986), Veron (1986)

Massive subspherical and encrusting colonies with cylindrical, closely adjoining corallites with a diameter of 4-10 mm.

The first, second and half of the third cycle septa reach the columella with the formation of distinct pali. Primary septa, especially the directive, are thicker and protrude farther over the theca and into the calice. The other septa of the third and fourth cycles are developed mainly in the form of short laminae, no longer than ¼ of the corallite radius, in the upper part of the calice. The upper septal margins project over the theca in the form of fan-like dentate ridges. Distal septal margins are dentated with 2 to 3 long spines. Lateral surfaces are weakly granulated or smooth. The total number of septa is 38-50. The columella is small and loose. Costae are well developed, but do not connect to the neighboring corallite. Dissepiments are inclined, prominent and uncommon; in the axial space they transform into concave tabulae.

Living colonies are dark gray-green.

Similar species *M. curta* has no groove and tubercle formation and septa are much less dentate.

Uncommon.

Location. Baitylong Archipelago, Tam, Re, Phu Quy and Con Dao Islands.

Distribution. Known from the Red Sea to Japan and the Great Barrier Reef of Australia, depth 1-20 m.

Montastrea magnistellata Chevalier, 1971

Fig. 42-6, C21-3

Montastrea magnistellata Chevailer, 1971: Wijsman-Best (1977), Veron et al. (1977) cum syn., Veron (1986)

Massive flat and encrusting colonies with slightly projecting corallites, closely adjoining, with a diameter of 8-15 mm. Calices are wide and open.

First cycle septa do not fuse with other septa but do reach the columella. Second cycle septa also reach the columella, but they are somewhat thinner, and third cycle septa fuse their lateral surfaces to fourth cycle septa near the columella or on the boundary with it. Fourth cycle septa, have a length of ½-¾ of the corallite radius, and fuse with the third cycle septa. All septa are clavate and reinforced in the periphery grading up to the formation of a septotheca. The axial septal edges can form pali, forming a circle above the columella, which is moderately dense to very dense. All septa are highly dentate (serrateded). The total number of septa is 30-44. Costae are distinct, in two cycles, highly dentate, not adjoining in the neighboring corallites, and can be separated by a narrow groove. Dissepiments are slightly inclined, slightly prominent, large, thin and abundant.

Living colonies are dark gray-green.

Similar species *M. valenciennesi* has less compact, irregular septa.

Uncommon.

Location. Tho Chu and An Thoi Islands.

Distribution. South Vietnam, Indonesia, New Caledonia, and the Great Barrier Reef of Australia.

Montastrea valenciennesi (Edwards and Haime, 1848)

Fig. 43-1, C21-4

Phymastrea valenciennesi Edwards and Haime, 1848

Montastrea valenciennesi (Edwards and Haime): Veron et al. (1977) cum syn., Nakamori (1986), Veron (1986)

Massive round, flat and encrusting colonies with slightly conical corallites that are round or irregular to polygonal with a diameter of 8-15 mm. Between corallites there is a distinct boundary of fine polychaete tubes.

About half of all septa reach the columella, forming distinct pali. First cycle septa are usually more dense and protrude to a greater extent over the theca than other septa. Second cycle septa are equal to, or slightly thinner than the primary septa. Third cycle septa are thin in the axial space and usually slightly longer than half a corallite radius, and can fuse with the second cycle septa. Fourth cycle septa are developed only in the form of short ridges on the theca, but they are uniformly present and extend as costae on the outside of the corallite. Distal septal margins are regularly dentate, and lateral surfaces are abundantly covered by fine grains. All septa in the periphery are reinforced by thickening grading into the formation of a septotheca. The total number of septa is 30-40. The columella is compact, and often dense. Costae (and intercostaels as well) are well developed, dentate, but do not fuse with costae in the neighboring corallites. Dissepiments are slightly inclined to horizontal, slightly prominent and flat.

Living colonies are yellow-green with a lighter theca.

Similar species. See *M. colemani*. *M. magnistellata.*

Relatively common.

Location. Baitylong Archipelago, reefs of Khanh Hoa Province, Culao Cham, Phu Quy, Con Dao and Tho Chu Islands.

Distribution. Known from Madagascar and the Seychelles Islands to Japan and the Marshall Islands, depth 2-20 m.

Montastrea colemani Veron, 2000

Fig. C10-8

Colonies are submassive to encrusting, with compact rounded corallites 5-8 millimetres diameter. ‘Groove and tubercle’ formations are well developed. Two cycles of septa clearly alternate; both are thickened over walls and are uniformly toothed. A paliform crown is well developed.

Living colonies are uniform brown or brown with green centres.

Similar species: *M. valenciennesi* has a similar appearance underwater and is distinguished by having larger, more irregular corallites.

Uncommon.

Location. Reefs of Khanh Hoa Province,

Distribution. Madagascar, South Vietnam and South-West Pacific.

Genus *Diploastrea* Matthai, 1914

Type species: *Astraea heliopora* Lamarck, 1816.

Diagnosis. Large Massive placoid corals with *astraea*-like corallites with a thick septotheca. Septa reinforced by thickening but poorly distinguishable by cycles, fuse with an extensive columella. Dissepiments are endothecal and rare.

Diploastrea heliopora (Lamarck, 1816)

Fig. 43-2, C11-1

Astraea heliopora Lamarck, 1816

Diploastrea heliopora (Lamarck): Matthai (1914), Veron et al. (1977) cum syn., Nakamori (1986), Veron (1986)

Large hilly colonies with up to 2 m height and 5 m diameter with conical star-like corallites, unformly projecting above the colony surface, with a diameter of 8-13 mm.

Most septa reach the columella and fuse with it. First and second cycle septa are slightly thicker than the other septa. First and second cycle septa project the farthest – up to 1.5 mm – over the other septa, their upper margins extensively dentate with long thick spines. All septa are reinforced by thickening in the periphery, fuse with the septotheca, but are fine in the axial space . The total number of septa is 24-36. The columella is extensive and very dense. Costae are highly dentate. Triangular short intercostae are developed at the base of corallites. Dissepiments are horizontal and variously inclined, prominent and wavy. Their laminae are thin, laid not more than 15 per cm. Additional laminae are rare.

Living colonies are yellow-brown.

Similar species. None. This is one of the most easily recognised and least variable of all massive corals.

Common.

Location. Reefs of Khanh Hoa Province, Culao Cham, Re, Phu Quy, Con Dao, Tho Chu and An Thoi Islands.

Distribution. Known throughout the entire Indo-Pacific from the Red Sea and Madagascar to Japan and Samoa, depth 5-20 m.

Genus *Plesiastrea* Edwards and Haime, 1848

Type species: *Astraea versipora* Lamarck, 1816.

Diagnosis. Massive-encrusting placoid corals with fine corallites. Three cycles of septa, with the first two cycles reaching the axis, forming a distinct crown of pali. The columella is composed of several pinnacles in a depression. Endothecal dissepiments are frequent and thin, while exothecal disspiments are thick.

Plesiastrea versipora (Lamarck, 1816)

Fig. 43 - 3, C2 - 3

Astraea versipora Lamarck, 1816

Plesiastrea versipora (Lamarck): Edwards and Haime (1849), Veron et al. (1977) cum syn., Nakamori (1986), Veron (1986)

Cake-shaped or encrusting colonies, more rarely small submassive colonies. Corallites are placoid, sometimes subcerioid, fine (2-3, more rarely 3-5 mm in diameter), projecting above the colony surface. They can closely adjoin each other, or can be at a distance of several mm.

The first two cycles of septa almost reach the axis, forming pali which surround the columella. Third cycle septa are not more than ¼ of a corallite radius. Fourth cycle septa can be developed in the form of short ridges on the upper calice wall, which extend as distinct second cycle costae. Distal septal margins are serrated and dentate. Lateral surfaces are densely ornamented by spines looking like carinae. The total number of septa is 24-50. The columella is small, and composed of several pinnacles. Costae are distinct, dentate, of two cycles, and not fusing with those in the neighboring corallites. The coenosteum is smooth or granulated, and vesicular. Dissepiments are slightly inclined or horizontal, wavy and prominent. Laminae are thin and laid frequently – 18-20 per cm. Exothecal intercorallite dissepiments are twice as thick.
Living colonies are cream or yellow-brown.

Similar species. Sometimes confused with other faviids with corallites of similar size notably *Favia stelligera.*

Common.

Location. Known from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely distributed throughout the entire Indo-Pacific from the Red Sea and Madagascar to Japan and the Great Barrier Reef of Australia, depth 3-30 m.

Genus *Leptastrea* Edwards and Haime, 1848

Type species: *Leptastrea roissyana* Edwards and Haime, 1848.

Diagnosis. Small massive and encrusting cerioid corals with fine polygonal corallites with distinct intercorallite boundaries. Primary septa are clearly distinguished among the other three to four cycles. The columella is papillar. Tabulae are complete or incomplete to dissepiment-like.

Leptastrea bottae (Edwards and Haime, 1849)

Fig. 43-4

Cyphastrea bottae Edwards and Haime, 1849

Leptastrea bottae (Edwards and Haime); Klunzinger (1849), Veron et al. (1977) cum syn., Scheer and Pillai (1983), Veron (1986)

Massive-encrusting cerioid colonies with polygonal to rounded corallites with a diameter of about 3 mm.

First cycle septa are the longest and thickest. They reach the columella, rising above it vertically. Second cycle septa are thin, and no longer than half of the corallite radius. Third cycle septa are short ridges on the calice walls, which widen on the theca. All septa protrude over the theca; the total number of septa is 16-20. The columella is composed of several pinnacles and interlacing pali. Tabulae are complete, rarely incomplete, wavy and curved, prominent on the margins, and concave at the axis.

Living colonies are yellow-brown.

Similar species. *Leptastrea transversa* has relatively compacted angular corallites.

Uncommon.

Location. Gulf of Siam, An Thoi Archipelago.

Distribution. Known throughout the entire Indo-Pacific from the Red Sea to Hawaii, depth 5-20 m.

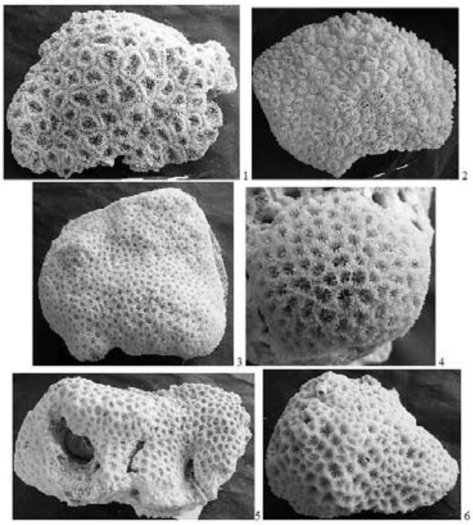


Fig. 43. Appearance of colonies. 1 – *Montastrea valenciennesi*, spec. 1/95134, Bai Thanh Bay; 2 – *Diploastrea heliopora*, spec. 1/95137, Con Dao Islands; 3 – *Plesiastrea versipora*, spec. 1/95136, Bai Tu Long Archipelago; 4 – *Leptastrea bottae*, spec. 1/95138, An Thoi Islands; 5 – *L. purpurea*, spec. 1/95139, Con Dao Island; 6 – *L. transversa*, spec. 1/95140, Namsu Islands

Leptastrea purpurea (Dana, 1846)

Fig. 43-5, C21-1

Astraea purpurea Dana, 1846

Leptasrea purpurea (Dana): Hoffmeister (1925): Veron et al. (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986)

Encrusting and small massive flat colonies with 5 to 6 sided polygonal distinctly discrete corallites with a diameter of 3-5 mm.

Four distinct cycles of septa. Primary septa are the thickest and the longest and reach the columella, dropping vertically to it. Second cycle septa also reach the columella; they are thin with free axial edges. Third cycle septa fuse with the second cycle septa near the columella, and part of them protrudes in the form of short laminae along the calice wall. Fourth cycle septa are short, usually an incomplete set, they can fuse with the third cycle septa and be in the form of short ridges. First cycle septa form pali and project over the theca. Distal septal margins are lacerate, and lateral surfaces are covered with numerous large granules. The columella is situated deep in the calice and formed of pinnacles with interlacing pali. Tabulae are complete, wavy, prominent, and solitary. Living colonies are yellow-brown with dark corallites.

Similar species *L. transversa* has more uniformly sized corallites and less compact septa.

Common on various reef zones.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely distributed throughout the entire Indo-Pacific from the Red Sea to Hawaii, depth 5-30 m.

Leptastrea transversa Klunzinger, 1879

Fig. 43-6, C21-2

Leptasrea transversa Klunzinger, 1879: Veron et al. (1977) cum syn., Wijsman-Best (1980), Scheer and Pillai (1983), Nakamori (1986), Veron (1986)

Massive-encrusting and encrusting cerioid colonies with distinctly discrete, mainly hexgonal corallites of 3-8 mm diameter.

Septa are in 4-5 cycles. Primary septa are distinct and distinguished by their increased size, reaching the columella. The primary septa merge with the columella, making it oblong. Second cycle septa are thin, but also reach the columella. Third cycle septa fuse with fourth cycle septa, and fourth cycle septa fuse with third cycle septa in the depth of the calice at a distance of ½ to ¾ of the cortallite radius. Fifth cycle septa, not always a complete set, protrude as short laminae (rarely longer than 0.5 mm) in the upper part of the calice. The total number of septa is 40-70. The columella is dense, narrow and laminar. Tabulae are complete to incomplete, wavy, and uncommon.

Living colonies are green or cream.

Similar species. See *Leptastrea purpurea*.

Relatively common.

Location. Baitylong Archipelago, reefs of Khanh Hoa Province, Culao Cham, Re, Phu Quy, Nam Su and An Thoi Islands.

Distribution. Widely known from the Red Sea to Tahiti, depth 5-20 m.

Leptastrea pruinosa Crossland, 1952

Fig. 44-1, C11-2

Leptastea pruinosa Crossland, 1952: Veron et al. (1977) cum syn., Veron (1986)

Encrusting, encrusting-massive colonies with cerioid polygonal, slightly rounded, discrete corallites with calices from 3 to 8 mm diameter.

Four or five cycles of septa. Primary septa are distinguished by their larger size and their greater protrusion over the theca. They, as well as the thinner septa of the second cycle, reach the columella. Third cycle septa fuse with second cycle septa, septa of the fourth cycle fuse with septa of the third cycle at the distance of ¼ of a corallite diameter. Fifth cycle septa are short, and form an incomplete set. First cycle septa rise vertically from the columella, forming a distinct crown and a deep fossa. All 48-50 septa are highly dentate with straight denticles and ornamented by numerous large carina-like spines. The columella is made of numerous pinnacles. Tabulae are complete to incomplete, concave with additional laminae, and sometimes dissepiment-like at the periphery.

Living colonies are brown-green with a lighter color in the center of the corallite.

Similar species *L. purpurea* has granulated septa giving a frosted appearance.

Relatively common.

Location. Reefs of Khanh Hoa Province, Phu Quy, Con Dao, Nam Su, An Thoi Islands.

Distribution. South Vietnam, Indonesia, New Caledonia, and the Great Barrier Reef of Australia, depth 5-20 m.

Genus *Cyphastrea* Edwards and Haime, 1848

Type species: *Astraea microphthalma* Lamarck, 1816.

Diagnosis. Massive, massive-encrusting or fruticose corals with densely packed or widely spaced fine cylindro-conical corallites and vesicular coenosteum with numerous exothecal spinules. Three cycles of septa are differentiated by length. The columella is deep in the calice. Tabulae and exothecal dissepiments are present.

Cyphastrea serailia (Forskål, 1775)

Fig. 44-2, C21-4

Madrepora serailia Forskål, 1775

Cyphastrea serailia (Forskål): Ortmann (1888), Veron et al. (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986)

Encrusting and massive colonies with lumpy or smooth surfaces. The corallites are round, slightly conical, or highly protruding. They are adjacent or are at a distance of up to 12 mm from each other. Corallite diameters vary from 1.5 to 2.8 mm.

Three cycles of septa with a total of 24 septa are present, which are clearly differentiated by length. First and second cycle septa are usually weakly differentiated by length, but primary septa are somewhat thicker. Both cycles of septa reach the columella and form pali, which are not always distinct. Third cycle septa reach no more than ½ of the corallite radius, transforming into distinct ridges on the theca and endotheca. Septal surfaces are highly dentate with complex divided denticles. Lateral surfaces are covered with numerous spines. All septa taper and are reinforced towards the periphery and protrude over theca. The columella is weakly developed from widely spaced rods. Costae are usually in two cycles, and rarely extend onto the coenosteum. The coenosteum is highly or weakly vesicular, always covered with moderately to weakly divided spinules. Tabulae are curved, frequent, and thin.

Living corals are yellow-brown with green or light corallite centers.

Similar species *C. chalcidicum* has well developed alternating costae.

Common.

Location. Known from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely distributed from the Red Sea to Japan and the Marshall Islands, depth 3-20 m.

Cyphastrea chalcidicum (Forskål, 1775)

Fig. 44-5, 6, C8-4

Madrepora chalcidicum Forskål, 1775

Cyphastrea chalcidicum (Forskål): Klunzinger (1879), Veron et al. (1977) cum syn., Nakamori (1986), Veron (1986)

Submassive and encrusting colonies with uneven lumpy surfaces. The corallites are cylindrical or slightly conical, as a rule, and evenly protruding, with a diameter of 2-2.5 mm.

There are 24 septa in three cycles. Primary septa are the longest and protrude to the greatest extent over the other septa. They reach the columella in the depth of the calice. Second cycle septa also merge with columella in most cases. Third cycle septa are rarely longer than ¼ of the corallite radius. First and second cycle septa form pali, forming a circle above the columella. Their distal margins are highly dentate, and lateral surfaces are highly granulated. All septa protrude well over theca. The columella is small and composed of several bent rods. Costae are in two cycles, distinct, and extend slightly onto the coenosteum. The coenosteum is slightly vesicular with a great number of highly complex spinules. Tabulae are horizontal, wavy, numerous, and thin.

Living colonies are yellow-brown.

Similar species *C. serailia* has round corallites, slightly conical, or highly protruding with diameters vary from 1.5 to 2.8 mm.

Relatively common.

Location. Baitylong Archipelago, Re, Phu Quy, Tho Chu and An Thoi Islands, reefs of Khanh Hoa Province.

Distribution. Widely known throughout the entire Indo-Pacific, depth 3-20 m.

Cyphastrea microphthalma (Lamarck, 1816)

Fig. 44-3, C20-6

Astraea microphthalma Lamarck, 1816

Cyphastrea microphthalma (Lamarck): Edwards and Haime (1849), Veron et al. (1977) cum syn., Head (1980), Wijsman-Best (1980), Nakamori (1986), Veron (1986)

Massive colonies with lumpy surfaces, having a tendency toward branching and dichotomous branching. The corallites are round, slightly conical, and slightly protruding over the colony surface. Calices are up to 3 mm deep, and 1.5-2.5 mm in diameter.

In the most corallites 29 septa in three cycles are developed. It is very typical that only 10 septa of the first and second cycles are developed in representatives of this speices. They reach the columella at the base of the calice. Primary septa are distinguished by their thickness. Third cycle septa are no longer than ¼ of the corallite radius. All septa are densely granulated. The columella is loose and composed of several curving trabecules. Costae are uniform in length. The coenosteum is more often smooth than vesicular, densely covered with moderately divided spinules. Tabulae are horizontal, slightly prominent, and thin.

Living colonies are brown or green.

Similar species *C. microphthalma* is readily identified by its 10 primary septa which are visible underwater (Veron, 1986).

Common.

Location. Culao Cham, Re, Phu Quy, Con Dao, Tho Chu and An Thoi Islands, reefs of Khanh Hoa Province.

Distribution. Widely distributed from the Red Sea to Tahiti, depth 3-20 m.

Cyphastrea japonica Yabe and Sugiyama, 1932

Fig. 44-4, C8-5

Cyphastrea japonica Yabe and Sugiyama, 1932: Utinomi (1971), Veron et al. (1977) cum syn., Veron (1986)

Encrusting colonies with tubular corallites irregularly protruding over the colony surface with a calice diameter of 2-2.5 mm and a depth of 3-4 mm. There are 24 septa of two sizes, differentiated by length. First and second cycle septa protrude well over theca. They vertically drop into the depth of the calice in the form of short laminae, where they form pali, and form a wide columella. Primary septa are thicker and protrude upwards farther than other septa. Third cycle septa protrude as spines or very short laminae along the endotheca. All septa are highly dentate and granulated. The columella is composed of needle-shaped trabeculae. Two cycles of costae are distinctly developed, especially on protruding corallites. The coenosteum is smooth and slightly vesicular, and moderately densely covered with divided spinules. Tabulae are concave, numerous, and thin.

Living colonies are green-brown.

Similar species *C. chalcidicum* has strongly alternating costae.

Uncommon.

Location. Reefs of Funhan Province, Phu Quy, An Thoi Islands.

Distribution. South Vietnam, Japan, and the Great Barrier Reef of Australia, depth 5-15 mm.

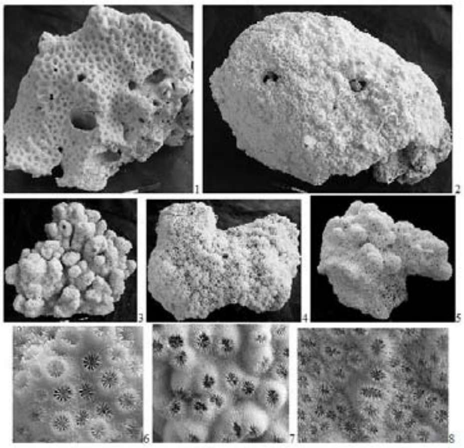


Fig. 44. Appearance of colonies. 1 – *Leptastrea pruinosa*, spec. 1/95141, Namsu Islands; 2 – *Cyphastrea serailia*, spec. 1/95142, Thu Island; 3 – *C. microphthalma*, spec. 1/95144, Cham Island; 4 – *C. japonica*, spec. 1/95145, Bai Thanh Bay; 5-6 – *C. chalcidicum*, spec. 1/95143, Mjeu Island; 7- *Echinopora lamellosa*, spec. 1/95146, Bai Tu Lon Archipelago; 8 – *E. gemmacea*, spec. 1/95147, Bai Tu Long Archipelago

Genus *Echinopora* Lamarck, 1816

Type species: *Echinopora rosularia* Lamarck, 1816 (=*Madrepora lamellosa* Esper, 1897).

Diagnosis. Lamellar, foliose, ramose and encrusting-lamellar corals with conical protruding corallites, widely spaced or densely arranged on spinulose costate coenosteum. Three cycles of septa are present, two of which merge with the extensive columella. Costae have well developed ornamented spinules.

Echinopora lamellosa (Esper, 1795)

Fig. 44-7, C11-3

Madrepora lamellosa Esper, 1795

Echinopora lamellosa (Esper): Matthai (1914), Veron et al. (1977) cum syn., Head (1980), Wijsman-Best (1980), Scheer and Pillai (1983), Nakamori (1986), Veron (1986)

Laminar foliate, funnel-shaped colonies often with a bumpy surface or vertical protuberances. Corallites are conical and slightly protruding with a diameter of 3-4 mm.

First and second cycle septa reach the columella. Primary septa are usually thicker and protrude farther over the theca than other septa. They have two to three lobes, ornamented by needle-shaped spines. Third cycle septa are spine-shaped, more rarely short thin laminae. Paliform lobes can merge with septa through thickening of subhorizontal dentation and form a groove or pores between them. The columella is well developed and merges with the lower part of septal lobes. Interseptal ridges can be distinct and weakly developed. Usually they are better developed in the upper part of endotheca. Exothecal costae can be arranged in long parallel rows, especially well developed in the periphery of a colony. The coenosteum is evenly covered with thin ornamented spinules, which can be arranged in parallel rows.

Living colonies are yellow-green, sometimes with a brown-red or green oral disk. Colony margins are colored lighter.

Similar species *E. gemmacea* has lamellar-encrusted foliose colonies with tubercular surfaces.

Common may form monosettlement.

Location. Widely known everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Widely distributed throughout the entire Indo-Pacific from the Red Sea and the southwestern Indian Ocean to Japan and the Bonin Islands and Samoa, depth 3-35 m.

Echinopora gemmacea (Lamarck, 1816)

Fig. 44-8

Explanaria gemmacea Lamarck, 1816

Echinopora gemmacea (Lamarck): Edwards and Haime (1849), Veron et al. (1977) cum syn., Head (1980), Wijsman-Best et al. (1983), Nakamori (1986), Veron (1986)

Lamellar-encrusted foliose colonies with tubercular surfaces. The corallites are cylindrical or slightly conical, protruding for up to 3 mm, with a diameter of 3-5 mm.

A total of 18-24 septa in three cycles are formed. Primary septa are very highly reinforced and protrude over the theca. Towards the axis they not very often become thinner and merge with the columella. The directive septa are often detached from other septa. Second cycle septa, thin and less protruding, also reach the columella. Third cycle septa are represented by short laminae or by rows of spines on the endotheca. Primary septa have lobes, protruding upwards, which elongate and become subvertical in the depth of a calice. Lateral septal surfaces are covered with numerous needle-shaped granules, which are arranged in rows towards the septal periphery. The columella is well developed and consists of subvertical trabecules with flat twisting tips. Two cycles of costae are more developed on more widely separate corallites. Dentition is similar to that of septa. The exotheca is compact with not many exothecal dissepiments.

Living colonies are yellow-brown.

Similar species *E. horrida* has similar corallite characters but is usually branching.

Relatively common.

Location. Baitylong Archipelago, reefs of Khanh Hoa Province, Re, Phu Quy and Con Dao Islands.

Distribution. Widely distributed throughout the entire Indo-Pacific from the eastern coast of Africa to Japan and the Great Barrier Reef of Australia, depth 3-35 m.

Echinopora hirsutissima Edwards and Haine, 1849

Fig. 45 - 1

Echinopora hirsutissima Edwards and Haime, 1849: Veron et al. (1977) cum syn., Head (1980), Wijsman-Best et al. (1983), Nakamori (1986), Veron (1986)

Lamellar foliate colonies with lumpy surfaces. Cylindrico-conical corallites with a diameter of 4-5 mm densely cover the colony surface, often adjoining each other and not strongly protruding over the colony surface.

Three cycles with a total of 18-24 septa are present. Primary septa are thicker and protrude over the theca more than other septa. They are tapered and reinforced towards the axis and merge

with the columella. Distal primary septal cycle septa also reach the columella. Inner parts of the septa are perforated, margins are dentate with two to three lobes, and distinctly granulated. Second dentate and merge with vertical paliform lobes. The columella is well developed. It is formed from vertical rods and inner septal lobes, anastomousing and interlacing. There are two cycles of costae, covered with 2-5 distinct on spinules, granulated and needle-shaped. The exotheca is compact with numerous, densely ornamented with spinules.
Living colonies are yellow-brown.

Similar species *E. gemmacea* has less coarse corallite structures and smaller corallites.

Uncommon.

Location. Reefs of Khanh Hoa Province, Con Dao, Nam Su and An Thoi Islands.
Distribution. Widely distributed throughout the entire Indo-Pacific from the Red Sea to Japan and New Caledonia, depth 3-20 m.

Echinopora horrida Dana, 1846

Fig. 45 - 2

Echinopora horrida Dana, 1846: Veron et al. (1977) cum syn., Veron (1986)

Branching dendroid colonies with a thin lamina at the base or in the middle of the colony. Branches are up to 15 cm long with a diameter of 15 mm and with a tendency to dichotomous branching.

Corallites are weakly protruding, having a diameter of 3-4 mm. Three cycles with a total of 12-18 septa are formed. The first two cycles of septa reach the columella. Primary septa are always noticeably protruding over the theca, highly clavate and reinforced, and thin in the axial space. Second cycle septa are thin. They reach the columella in the depth of a calice. Third cycle septa are short, and their axial ends are free. The upper parts of primary septa have several lobes, which are complicated by even smaller lobes with granulation and fine needles. Inner septal margins have subvertical or inclined paliform lobes, which, being detached from the lower parts of septa, form a series of vertical pores. The lateral surface is covered with fine granules, arranged in trabecular rows. The columella is well developed from vertical trabucules, alternating or spirally twisting. Costae increase towards the colony base and have spinules with sharp tips. The exotheca is compact with a few vesicular dissepiments.
Living colonies are brown.

Similar species *E. gemmacea* does not form extensive branches.

Rare.

Location. Con Dao, Culao Cham Islands.
Distribution. Reefs of Singapore, South Vietnam, Indonesia, Philippines, New Guinea, New Caledonia, Fiji and the Great Barrier Reef of Australia, depth 3-15 m.

Genus *Moseleya* Quelch, 1884

Type species: *Moseleya latistellata* Quelch, 1884.

Diagnosis. Massive cerioid corals with a very large central corallite, from which smaller polygonal corallites radiate. Septa are long, have up to five cycles, form large distinct pali, and form a wide crown over the fossa with a dense columella.

Moseleya latistellata Quelch, 1884

Fig. 45 - 3

Moseleya latistellata Quelch, 1884: Veron et al. (1977) cum syn., Veron (1986)

Massive cerioid colonies with a large central corallite, surrounded by smaller polygonal-round corallites with a diameter up to 15-20 mm. Calices are glass-shaped with vertical walls, a wide flat bottom and a distinct fossa over the columella.

The first two cycles of septa and some septa of the third cycle reach the columella and form large distinct lanceolate reinforced pali, forming a wide crown, often of two concentric circles. Fourth order septa septa form thin short laminae along the calice walls, not quite reaching the columella. Fifth cycle septa project in the form of ridges only in the upper part of the calice. Inner septal margins are highly serrated and dentate, and lateral surfaces are moderately granulated, while in the fossa they are highly granulated. There are a total of 50 septa. Septa of the neighboring corallites are fused. The columella is large, dense, composed of complex interlacing trabecules, and spirally twisted. Dissepiments are inclined to vertical, medium to small sizes, and highly swollen. Living colonies are dark brown-green.

Similar species. May resemble the mussid *Acanthastrea*, which can have the same colony and corallite shapes.

Rare

Location. Fukuok Island, Gulf of Siam.

Distribution. Known in South Vietnam, in the northwestern Australia, in Torres Strait, New Guinea, the Philippines, Indonesia, and the Great Barrier Reef of Australia, depth 5-15 m.

Genus *Oulastrea* Edwards and Haime, 1848

Type species: *Astrea crispata* Lamarck, 1816.

Diagnosis. Encrusting-massive placoid corals with small to medium corallites. Three to four cycles of septa, abundantly ornamented with large spines. Primary septa are always reinforced and protrude upwards more than other septa. The columella is composed of merging pali. Dissepiments are endothecal, widely spaced, and irregular.

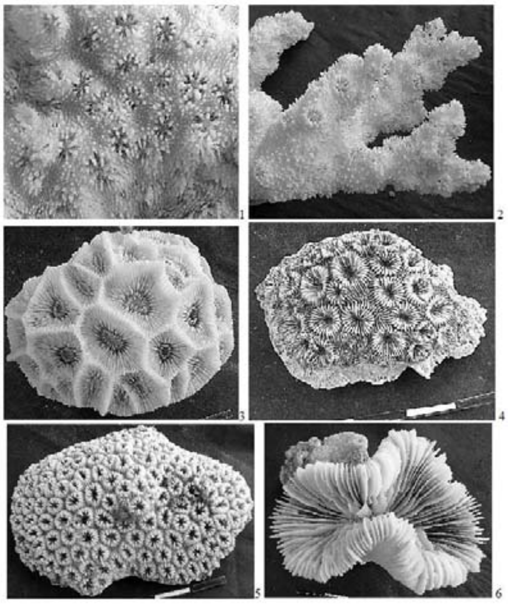


Fig. 45. Appearance of colonies. 1 – *Echinopora hirsutissima*, spec. 1/95148, Namsu Islands; 2 – *E. horrida*, spec. 1/95149, Con Dao Islands; 3 – *Moseleya latistellata*, spec. 1/95226, An Thoi Islands; 4 – *Oulastrea alta*, spec. 1/95186, Namsu Island; 5 – *O. crispata*, spec. 1/95185, Namsu Island; 6 – *Trachyphyllia geoffroyi*, spec. 1/95150, An Thoi Islands

Oulastrea crispata (Lamarck, 1816)

Fig. 45 - 5

Astrea crispata Lamarck, 1816

Oulastrea crispata (Lamarck): Veron (1986)

Small encrusting round colonies with a diameter of up to 10 cm, rarely more than 10 mm height. Corallites are placoid, evenly projecting, closely spaced or adjoining, 3-5 mm in diameter. Calices have vertical walls.

Three cycles of septa are highly tapered and reinforced. Primary septa are clearly distinguished by their thickness and height, and their axial ends are free and reach the columella. Third cycle septa fuse to second cycle septa near the columella by their axial edges. Axial septal margins are smooth. All septa surfaces are densely covered with large sharply conical spines. Pali have complex spination. The total number of septa is 24-30. The columella is compact, spongy, and formed of merging pali and axial septal edges. It is located in the fossa. Costae are thick and distinct, often merging between corallites, and densely ornamented in the same way as septa. Dissepiments are large, steeply inclined and subhorizontal. Their laminae are slightly prominent, and wavy.

Living colonies are deep-green with light projecting corallites.

Similar species *O. alta* has calices open and funnel-shaped.

Usually common.

Location. Distributed everywhere from the Gulf of Tonkin to the Gulf of Siam, depth from littoral to the reef slope base.

Distribution. Known in the southwestern Pacific from Malaysia to Japan and Samoa.

Oulastrea alta Nemenzo, 1981

Fig. 45 - 4

Small massive-encrusting colonies with a diameter up to 10 cm and a height up to 20 mm. The corallites are placoid, slightly protruding, unevenly located, and have a diameter of 4-7 mm. Calices are open and funnel-shaped.

Four cycles of septa are long, slightly tapered and reinforced. The first and often second cycle of septa are noticeably thicker than the other septa and protrude upwards more than other septa, and their axial edges reach the columella. Axial primary septal edges are free. Fourth cycle septa fuse on the axial edges to the lateral surface of the third cycle septa. The distal septal margin is smooth, and lateral surfaces are intensively covered with large pointed spines. 3-5 paliform lobes are formed with distinctly spiny tips. The total number of septa is 30-44. The columella is compact, more dense than that of the species described above, and is composed of fusing axial septal ends and pali. Costae are thin with deep narrow intercostael spaces. Dissepiments are very widely spaced, thin, and irregular in shape.

Living colonies are deep-green with light corallites.

Similar species *O. crispata* has calices with vertical walls.

Uncommon.

Location. Gulf of Siam, Mok Island, depth 1.5 m.

Distribution. South Vietnam, and the Philippines.

3.5.4.Family Trachyphyllidae Verrill, 1901

Genus *Trachyphyllia* Edwards and Haime, 1848

Type species: *Turbinola geoffroyi* Audouin, 1826.

Diagnosis. Flabello-meandroid unattached corals with intrawall budding. Corallites are large with a very deep cup and highly protruding primary septa. The columella is trabecular and dense. Costae are tall, highly dentated, and with a distinct consistent insertion.

Trachyphyllia geoffroyi (Audouin, 1826)

Fig. 45-6, C18-6

Turbinolia geoffroyi Audoin, 1826

Trachyphyllia geoffroyi (Audouin): Haeckel (1875): Veron et al. (1977) cum syn., Scheer and Pillai (1983), Veron (1986)

Flabello-meandroid colonies with large, longitudinally elongated corallites. Calices are deep (up to 30 mm), narrow with straight and slightly inclined vertical walls.

The first two cycles of septa, and often of the third cycle as well, reach the columella, where they protrude upwards greatly. These septa can rise up to the half of a calice height, forming a paliform lamina. Higher cycles of septa (fourth to sixth cycles) can reach the columella, or can be no longer than ½ of the corallite radius. All cycles are clearly distinguishable only in young, colonies that are not yet meandering. Inner septal margins are highly dentate with fine saw-shaped thin denticles, which are the ends of fan-shaped rows of fine spines which ornament lateral septal surfaces. The upper septal margin protrudes well over the theca and has the same dentation and ornamentation as all septa. The columella consists of flat, complexly divided and interlacing laminae, sometimes slightly spirally twisting. Costae are long and thick. They are clearly distinguishable by cycles, corresponding to the septa. Septa are densely dentate with flat long denticles with divided tips. The lower part of a colony is covered with thin epitheca, which varies from 1 to 6 cm high. Dissepiments are inclined, prominent, very widely spaced, and medium to large.

Living corals are shades of green, yellow or pink.

Similar species. None.

Relatively common.

Location. Reefs of Khanh Hoa Province, Con Dao, Nam Zu and Ant Hoy Islands.

Distribution. Distributed from the Red Sea and Seychelles Islands to Japan and New Caledonia, depth 11-45 m.

3.5.5. Family Fungiidae Dana, 1846

Mono- or polystomatal disks or elongated oval corals usually with unattached adults. Septa are thin, long, more rarely short, reinforced, and from 7 to 17 cycles are formed. Lower cycle septa are longer, project over the other septa, and are highly perforated as a rule. Neighboring septa are connected by synapticulae. Septa and costae are alwayd dentate and ornamented. The columella is trabecular and weak.

Genus *Cycloseris* Edwards and Haime, 1849

Type species: *Fungia cyclolites* Lamarck, 1801.

Diagnosis. Small isolated disks and dome-shaped corals. The axial ends of lower cycle septa are always reinforced and reach the axis. The ornamentation of septa and costae is moderate or intensive, and mainly consists of irregular spines and granules. The fossa is elongated.

Cycloseris cyclolites Lamarck, 1801

Fig. 46 - 1, C21 - 6

Fungia cyclolites Lamarck, 1805

Cycloseris cyclolites (Lamarck): Edwards and Haime (1851), Hoeksema (1989) cum syn.

Round or slightly oval, arched and dome-shaped corals, reaching 45 mm diameter and 16 mm height. The lower aurface is slightly or moderately concave. The fossa is elongated, narrow, and 8-10 mm in length.

Septa are moderately thick, and 6 to 7 cycles are formed. Lower cycle septa are of similar heights. First and second cycle septa reach the columella, their axial ends are noticeably reinforced by tapering, rising upwards vertically, protruding high over columella. Third cycle septa are noticeably thinner and also reach columella, but their axial ends are sloped towards the periphery. Fourth cycle septa are no longer than ¾ of the corallite radius, and have weak tentacular lobes. The rest of the higher cycle septa are 1.5-2 times lower, and merge on their axial ends. They can be developed only in the periphery or reach ½ of the corallite radius.??? Peripheral ends of the fifth cycle septa slightly protrude upwards. The upper septal margins are sea-shaped or moderately lacerate and dentate. Lateral septal surfaces are densely covered with fine spines, often with divided tips, arranged in vertical rows, especially distinct near the upper septal margins, where they merge with denticles of the marginal septal dentation. Synapticulae are rare, and developed between septa of every cycle. The columella is well developed, and consists of wide curved and complexly divided laminar-shaped spinules. Costae are numerous with a distinct sequence of insetion of their various cycles. Towards the coral center they become thinner and less developed. Tall peripheral costae are ornamented with granules and spines.

Living corals are shades of brown.

Similar species *C. vaughanis* is less strongly dome-shaped and septa around the mouth are less exsert.

Relatively common.

Location. Reefs of Culao Cham, Con Dao, Nam Zu and Tho Chu Islands of Khanh Hoa Province, depth 11-41 m.

Distribution. Known throughout the entire Indo-Pacific from Western Africa to Japan, Hawaii and Western Australia.

Cycloseris costulata (Ortmann, 1889)

Fig. 46 - 2, C21 - 5

Fungia costulata Ortmann, 1889

Cycloseris costulata (Ortmann): Pillai and Scheer (1976), Veron and Pichon (1979), cum syn., Hoeksema (1989) cum syn.

Round thin disk-shaped corals, slightly arched, having a diameter up to 60 mm and no more than 10 mm height. The lower surface is concave. The fossa is slightly elongated, of a moderate width, and 12-15 mm in length.

Seven cycles of septa are thin. The first two cycles of septa are moderately reinforced at the axis, and protrude well over the other septa. Third cycle septa reach the columella, and their axial ends are highly sloped from the center to the coral periphery. Fourth cycle septa have a length not shorter than ¾ of the corallite radius, and have slight tentacular lobes. Higher cycle septa are low; only the peripheral ends of fifth cycle septa rise to the same level as the lower cycle septa. The axial ends of the seventh cycle septa fuse with septa of the sixth cycle, and axial ends of the sixth cycle septa with fifth cycle septa. Septal margins are densely dentate with thin saw-shaped or lacerate denticles. Lateral septal surfaces are highly ornamented with fine irregular spines, which can be arranged in vertical rows at the upper septal margins. Numerous synapticulae can be traced between every cycle of septa. The columella is compact and composed of simple, slightly curved spinules. Costae are thin and numerous, and well distinguished by cycles. They distinctly protrude in the periphery and can be smooth in the coral center. Costae are ornamented with fine granules. Living corals are brown.

Similar species *C. tenuis* is less strongly dome-shaped and septa around the mouth are more exsert.

Relatively common.

Location. Culao Cham, Re, Con Dao, Tho Chu and Nam Zu Islands, reefs of Khanh Hoa Province, depth 9-41 m.

Distribution. Known from the Red Sea and Madagascar to Japan and the Central Pacific.

Cycloseris tenuis (Dana, 1846)

Fig. 46 - 3

Fungia tenuis Dana, 1846

Cycloseris tenuis (Dana): Cairns (1984), Hoeksema (1989) cum syn.

Round thick flat corals, slightly arched, with a strong central arch. The diameter is 60-70 mm, and height is 18-25 mm. The fossa is elongated, narrow, with a length of 20-25 mm. Septa are thick, in seven to eight cycles, and compact. The first four cycles of septa are uniform in height and almost uniform in length. First and second cycle septa are more reinforced in the central elevated part of the coral. Septa of the previous cycles increase their height at the points of fusing with septa of the following, later cycles. Fifth cycle septa increase their height in the periphery in the flat part of the coral. Fourth and fifth cycle septa can have weak tentacular lobes. The upper septal margins are very densely and highly dentate. Dentation can be lacerate-laciniate to perforated in the upper reinforced part of the septa and in the form of thin denticles of uneven fence. Lateral septal surfaces are densely granulated with fine unoriented spines. Synapticulae are more often developed in the septal periphery near the base of the septa. The columella is compact and composed of simple spinules, directed upwards, slightly curved and sometimes interlacing. Costae are thin and slightly curving. They are well developed in the coral periphery. They are in distinct cycles that differ in height. Towards the coral center costae become hollow.??? They are densely covered with thin granules and spines, which increase in number and size towards the coral periphery.

Living corals are brown-white.

Similar species *C. costulata* has thinner, more regular costae.

Rare.

Location. Culao Cham, Con Dao Islands, depth 9-12 m.

Distribution. Known in the Red Sea, on the Seychelles and Maldives, in South Vitnam, Japan, the Philippines, Indonesia, New Guinea and on the Great Barrier Reef of Australia.

Cycloseris somervillei (Gardiner, 1909)

Fig. 46 - 4

Fungia somervillei Gardiner, 1909

Cycloseris somervillei (Gardiner): Pillai (1972), Veron and Pichon (1979), Hoeksema (1989) cum syn.

Round disk-shaped, slightly arched corals, reaching 65 mm diameter and 18 mm height. The lower surface is flat or slightly concave. The fossa is slightly elongated, 12 mm in length.

Septa are thin and in seven to eight cycles, densely packed. The first through fifth cycles of septa are of a similar height. The axial edges of the lower cycle septa protrude more than the other septa and they are less reinforced. Higher cycle septa are low, and highly perforated to fenestrated. The upper septal margins are highly dentate with fine sawtooth-shaped denticles. Lateral septal surfaces are densely ornamented with fine granules and spines, arranged in dense rows, perpendicular to the upper septal margin. All septa are connected to each other by many synapticulae up to the height of the higher cycle septa. Tentacular lobes are sporadic. The columella is dense and compact, composed of thin trabecules, interlacing in an almost solid spongy mass. Costae are thin, and slightly curving near the coral center. Consistent cycles and differentiation by size are well developed on the periphery. All costae are covered with fine granules and spines.

Living corals are shades of brown.

Similar species *C. patelliformis* is not distinctly oval.

Rare.

Location. Ba Island (Con Dao Islands), depth 12 m.

Distribution. Seychelles and Amirante Islands, South Vietnam, Indonesia, the Philippines, Northern and Eastern Australia, Guam and Fiji.

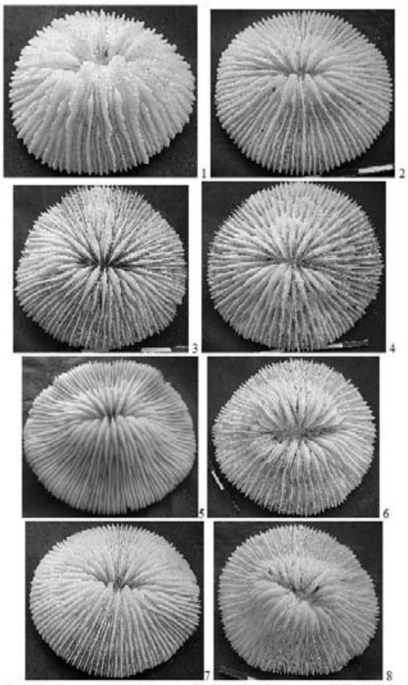


Fig. 46. Appearance of colonies. 1 – *Cycloseris cyclolites*, spec. 1/9515, Cham Island; 2 – *C. costulata*, spec. 1/95152, Tho Chu Island; 3 – *C. tenuis*, spec. 1/95153; 4 – *C. somervillei*, spec. 1/95154, Tyakl on Island; 5 – *C. patellioformis*, spec. 1/95155, Thu Island; 6 – *C. vaughani*, spec. 1/95156, An Thoi Archipelago; 7 – *C.* cf. *sinensis*, spec. 1/95157, Tho Chu Island; 8 – *Cycloseris densicolummelus* sp. nov. spec. 1/95158

Cycloseris patelliformis (Boschma, 1923)

Fig. 46 - 5

Fungia patelliformis Boschma, 1923

Cycloseris patelliformis (Boschma): Wells (1954)

part. *Fungia fragilis*: Hoeksema (!989)

Round, discoid, thin corals with a central arch. The diameter reaches up to 70 mm and height to 18-20 mm. The lower surface is slightly concave. The fossa is slightly elongated, narrow, 15 mm long.

Septa are thin, straight, in seven to eight cycles, tightly arranged. Septa in the lower cycles can be slightly wavy in the center, where they are slightly or moderately reinforced. The first four cycles of septa are equally tall. Septa of the fifth and sixth cycles are tall only in the coral periphery up to where they fuse with the higher cycles septa. The axial ends of the first two cycles septa protrude farthest upward and the axial edges plunge vertically into the fossa. The upper septal margins are dentate with fine numerous sawtooth-shaped denticles. Lateral septal surfaces are covered with very fine granules, arranged in weak rows, which are perpendicular to the upper septal margin and merge with denticles. Synapticulae are rare, developed mainly at the septal bases in the axial area. Tentacular lobes are weakly developed, often sporadic, formed on the fourth and fifth cycle septa. The columella is smool, loose, and composed of simple flat pali. Costae are thin and short, weakly developed at the axis and inserted in the periphery with distinct cycles. The peripheral parts of costae are covered with fine spines and fine denticles.

Living corals are yellow-brown.

Similar species. See *C. somervillei*.

Rare.

Location. Culao Cham and Ant Hoy Islands, depth 11-20 m

Distribution. Seychelles and Nicobars, South Vietnam, Indonesia, the Philippines, the Great Barrier Reef of Australiam, and Samoa.

Cycloseris vaughani (Boschma, 1923)

Fig. 46 - 6

Fungia vaughani Boschma, 1923

Cycloseris vaughani (Boschma): Wells (1954), Hoeksema (1989) cum syn.

Discoid thin corals with moderately protruding central arch, corals reach 70 mm diameter and 20 mm height. The lower surface is flat with a small depression in the center of the coral. The fossa is wide, deep, and 16-20 mm long.

Septa are slightly reinforced, curving and in seven cycles. Axial septal ends of the first two cycles are noticeably reinforced and protrude upwards farther than other septa. The four lower cycles of septa are equal in height. Fifth and sixth cycle septa protrude slightly only in the periphery. They are mostly perforated. The upper septal margins are densely dentate with sawtooth-shaped, more rarely lacerate teeth. Lateral surfaces are ornamented with numerous spines and granules, arranged in distinct rows, merging with denticles on the upper septal margin. Synapticulae are numerous, formed along the entire septal length up to ½ or 2/3 of the height of the septa. Sporadic tentacular lobes can be developed on the fourth and fifth cycle septa. The columella is dense and fills the entire floor of the fossa and is formed of curved and straight spinules and paliform lobes. Costae are distinct. Lower cycle costae protrude more on the coral periphery, become septa-like and have the same dentation and granulation as septa. Near the axis costae can become flat and completely undistinguishable.

Living corals are brown with light spots.

Similar species *C. patelliformis* does not have alternating costae and septa at the polyp margin.

Rare.

Location. Culao Cham and Ant Hoy Islands, depth 6-20 m.

Distribution. Known throughout the entire tropical Indo-Pacific from Madagascar to Hawaii.

Cycloseris cf. *sinensis* (Edwards and Haime, 1851)

Fig. 46 -7

Diskoid flat or slightly domed corals, having 40-50 mm diameter and less than 10 mm height. The lower surface is flat or slightly concave. The fossa is narrow and slightly elongated, reaching 10-13 mm length.

Septa are thin, straight, equal in height, which increases from the periphery to the coral center. Six to seven cycles of septa are formed. Axial septal ends are vertical and straight, as are

septal ends at the points of fusion of the lower cycle septa with higher cycle septa. The first two cycles of septa are slightly reinforced at the axis. The upper septal margins have very fine sawtooth-shaped denticles. Lateral surfaces are densely ornamented with fine granules, distinctly arranged in regular vertical rows, corresponding to denticles on the upper septal margin. Synapticulae are developed at the base of septa. Towards the periphery they become less common. The columella is compact, loose, ???? and consists of pointed or slightly divided spinules. Costae are thin, distinct, with well-developed cycles and fine ornamentation.
Living corals are brown or deep green.

Similar species. Septa are similar to those of *Diaseris distorta*.

Rare.

Location. Culao Cham and Nam Zu Islands, depth 12 m.
Distribution. Known on the reefs of Mozambique, Seychelles and the Maldives, Vietnam, the Philippines, Japan, Western and Eastern Australia.

Cycloseris densicolummelus sp. nov.

Fig. 46 - 8

Holotype – spec. 1/95158, Museum of Institute Marine Biology, Vldivostok 69041, Russia, Mai Rut Island, Gulf of Tailand, depth 11 m.

Diskoid slightly oval fine coral with well developed arch with a 55 mm diameter and 15 mm height. The lower surface is slightly concave with a distinct depression in the center. The fossa is narrow and 13 mm long.

Seven cycles of thin septa, curved or straight, very densely compact in the central area. Axial septal edges of the first three cycles are moderately reinforced. All septa are tall, almost equal in height. Only the sixth and seventh cycle septa, through slightly, but are always shorter than the other septa. The upper septal margins are uneven, and have very fine sawtooth-shaped dentation. Lateral septal surfaces are highly ornamented with spines, granules, flat irregularly arranged bumps, often with additionally divided tips. Synapticulae are formed along the entire septal length, mainly near their base. Distinct tentacular lobes are formed on septa of the third to fifth cycles. The columella is compact, very dense, with abundant granulation, similar to the septal granulation. Costae are thin but distinct along the entire lower surface. Costal cycles and their dentation are more developed in the coral periphery.

Remarks. *Cycloseris densicolummelus* differs from all known species of the genus by well-developed tentacular lobes, intensive granulation of the lateral septal surfaces and by the densely ornamented columella.

Etymology. Densus (Latin) – densely, columella (Latin) - columella

Rare.

Location. May Rut Island (An Thoi Archipelago), depth 11 m.

Distribution. Vietnam, Gulf of Siam.

Genus *Diaseris* Edwards and Haime, 1849

Type species: *Fungia distorta* Michelin, 1843.

Diagnosis. Small individual flat tapered segmented or discoid corals. Septa are thin with vertical axial ends, equal in height, increasing from the periphery to the center. Septa and costae are densely ornamented with small regular spines. The fossa is rounded or irregular.

Diaseris fragilis Alcock, 1893

Fig. 47 - 1

Diaseris fragilis Alcock, 1893: Veron and Pichon (1979) cum syn.,

Cycloseris fragilis (Alcock): Hoeksema (1989) cum syn.

Discoid flat thin corals with frequent tapered (wedge-shaped) fragments, reaching 60 mm diameter and 6-8 mm height. The lower surface is flat or slightly concave. The fossa is slightly elongated or irregular-shaped, 12-20 mm long.

Septa are thin to very thin, straight or curved according to the shape of wedge-shaped regenerating fragments. Seven to eight septal cycles are developed. Lower cycle septa are very slightly reinforced at the axis. All septa are equal in height, which increases from the periphery towards the coral center. Axial edges of septa are vertical or steeply inclined. The upper margins of all septa are densely dentate with very fine sawtooth-shaped denticles. Lateral surfaces are densely covered with granules, arranged in regular vertical rows and ridges, with height and density growing towards the upper septal margin, where they fuse with the septal dentation. Synapticulae are developed at the base of septa, towards the center they are closer together. The columella is compact or extensive depending on the number and shape of regenerating fragments. It is more often dense than loose, is formed of reinforced straight or slightly curved spinules and pali. Costae are thin and distinct throughout the entire wall. The cycles of costae and their fine ornamentation are well developed and similar to that on septa.

Living corals are brown-green with light spots.

Similar species *D. distorta* is with thickness margins and has thick beaded septa are of unequal height.

Relatively common on soft substrates.

Location. Culao Cham, Nam Zu Islands, reefs of Khanh Hoa Province, depth 11-41 m.

Distribution. Widely distributed throughout the entire tropical Indo-Pacific.

Genus *Fungia* Lamarck, 1801

Type species: *Fungia fungites* Linnaeus, 1758.

Diagnosis. Large and medium sized monostomatal discoid or linear-oval corals. Septa are thin or moderately reinforced, of equal height with distinct large triangular dentation. Lateral granulation on septa is arranged in vertical or zigzag rows. The fossa is elongated and deep. Costae are of equal height with numerous conical or clavate spines, often with divided and granulated tips. The wall is perforate.

Fungia fungites (Linnaeus, 1758)

Fig. 47 - 3, C11 - 4

Madrepora fungites Linnaeus, 1758

Fungia fungites (Linnaeus): Döderlein (1902), Veron and Pichon (1979) cum syn., Hoeksema (1989) cum syn.

Round or slightly oval, flat or slightly arched and dome-shaped corals, reaching 30 cm diameter and 60 mm height. The lower surface is flat or wavy. The fossa is narrow, of a moderate length up to 1/5-1/6 of a corallite diameter, with a depth of 15-20 mm.

Septa are numerous, in up to 8-10 cycles, straight or slightly wavy, thin or of a moderate thickness, and can be slightly reinforced at the axis. The first four to five cycles of septa protrude 1/3 of their height over the other septa. Higher cycle septa are thinner, lower, and predominantly fenestrate. Tentacular lobes are weakly developed. The upper septal margins are densely dentate with triangular pointed denticles. In large corallites they can be lobate. Lateral septal surfaces are covered with very thin granules, arranged in vertical rows, which can merge in rows or thin ridges at the upper septal margins. Synapticulae are developed throughout the entire septal length up to the height of the higher cycle septa. Towards the coral periphery they become more frequent. The columella is spongy, represented by separate papillae, fusing with the lower parts of septa. In some specimens the columella is almost not developed. Costae are well distinguished by cycles. Lower cycle costae protrude more. All costae are covered with long conical thick spines, with echinoid tips and complicated by additional branching.

Living corals are fawn (russet, tan).

Similar species *F. repanda* has finer septal teeth.

Common.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam depth 3-21 m.

Distribution. Widely distributed throughout the entire tropical Indo-Pacific.

Fungia danai Eswards and Haime, 1851

Fig. 47 - 4, C11 - 5

Fungia danai Edwards & Haime, 1851: Veron and Pichon (1979) cum syn., Scheer and Pillai (1983), Zou and Chen (1983), Hoeksema (1989) cum syn.

Round, flat and wavy curved corals, having a diameter up to 15-20 cm and a height up to 15-20 mm. The lower surface is flat or slightly concave. The fossa is deep and short, rarely reaching more than 20 mm length.

There are eight to nine cycles of septa, thin and straight or wavy, and slightly reinforced towards the fossa. The first four cycles of septa are slightly thicker than the other septa, and protrude over them for 2-3 mm. All septa, except for the seventh and eighth cycles, are of equal height, and not fenestrate. Tentacular lobes are developed on septa of the 3rd through 6th cycles. The upper septal margins are covered with many pointed sawtooth-shaped denticles, commonly merging in pairs. Lateral surfaces are moderately ornamented with fine spines and granules, the density and size of which increase towards the septal base. Synapticulae are formed along the entire length of the lower half of the septa. The columella is compact, spongy, and consists of thick concave spinules. Costae are distinct and unequal in height. Lower cycle costae are thicker and taller, and can be traced throughout the entire coral wall. Higher cycle costae are noncontinuous, and less developed towards the axis. Costal spines are thick, cylindro-conic with pointed simple tips, sometimes slightly echinoid. The wall is strongly perforate with slits, strongly at the periphery.

Living corals are fawn (russet, tan).

Similar species *F. horrida* does not have prominent tentacular lobes.

Common.

Location. Reefs of Culao Cham, Tho Chu and Con Dao Islands, Baitilong Archupelago of Khanh Hoa Province, depth 3-20 m.

Distribution. Known throughout the entire tropical Indo-Pacific from Madagascar to Tahiti.

Fungia scruposa Klunzinger, 1879

Fig. 47 - 5

Fungia scruposa Klunzinger, 1879: Veron and Pichon (1979) cum syn.,

part. *Fungia (Danafungia) scruposa* Klunzinger: Hoeksema (1989) cum syn.

Corals are round, flat or with wavy curved margins, and moderately thick. They have a diameter of 12-15 mm and a height of up to 20 mm. The lower surface is flat or slightly convex. The fossa is short, not less than 20 mm long, wide, and moderately deep. The skeleton is densely calcified, heavy, and sometimes irregular fragmentation can be observed.

Seven to eight cycles of septa are very compact, thin, straight or slightly curved. The first three cycles of septa are slightly thicker and project upwards for 1-2 mm over the other septa. All septa, except for the two higher cycles, are almost equal in height. Perforation can be observed mainly closer to the upper margin of septa of two, more rarely three, of the highest cycles. The upper septal margin is moderately densely covered with denticles that are highly variable shape and size. They are mainly represented by irregularly triangular denticles, but can be needle-shaped or lacerate. Dentation can cover the entire septal margin or be available in the form of rare spines, needles and irregularly lacerate laminae. Lateral surfaces are ornamented with unoriented thin granules. Tentacular lobes are formed on the higher cycle septa. Synapticulae are better developed near the center of the coral. The columella is dense and compact, and consists of thick spinules which widen upwards, compact and fusing. Costae are well developed only in the periphery.

Lower cycle costae are slightly taller and thicker than the other costae, and they have more abundant dentition. Spines are elongated, variously curved with complexly divided tips, having a tendency to branching. Towards the coral center the number and size of spikes decreases until they are almost completely absent. The wall is not perforate.

Living corals are yellow-brown with light spots at the tentacular lobes.

Similar species *F. corona* has a thin polyp disc.

Rare.

Location. Phu Quy Island, depth 14 m.

Distribution. Known throughout the entire tropical Indo-Pacific.

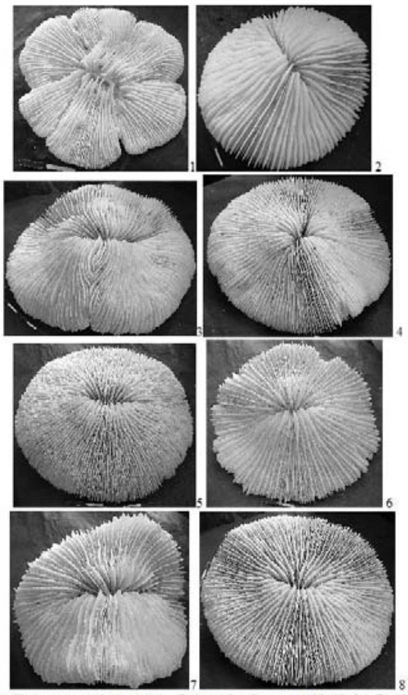


Fig. 47. Apperance of colonies. 1 – *Diaseris fragilis*, spec. 1/95159, Con Dao Islands; 2 – *Fungia repanda*, spec. 1/95167, Khanh Hoa Province; 3 – *F. fungites*, spec. 1/95160, Tho Chu Island; 4 – *F. danai*, spec. 1/95161, Re Isaland; 5 – *F. scruposa*, spec. 1/95162, Thu Island; 6 – *F. corona*, spec. 1/95163, Tho Chu Island; 7 – *F. horrida*, spec. 1/95164, Tho Chu Island; 8 – *F. concina*, spec. 1/95166, Khanh Hoa Province

Fungia corona Döderlein, 1901

Fig. 47 - 6, C11 - 7

Fungia corona Döderlein, 1901: Veron and Pichon (1979) cum syn.,

part. *Fungia (Danafungia) scuposa* Klunzinger: Hoeksema (1989) cum syn.

Round, flat, thin or slightly concave corals with a central arch, having a diameter of 12-15 cm and a height of 10-15 mm. The fossa is shorter than 20 mm, and of a medium width and depth. The lower coral surface is slightly concave. The skeleton is weakly calcified.

There are seven to eight cycles of septa, thin to very thin and straight. The first four cycles of septa project over the other septa of the higher cycles. The height of septa increases from the periphery to the center of the coral. The height of the other cycles of septa decreases from the periphery to the points of fusion of septa of lower and higher cycles. The upper septal margin is densely dentate with irregular triangular and spine-like denticles with pointed tips. On the lateral septal surface denticles merge into thin ridges, slightly inclined towards the periphery in the form of a fence.??? Lateral surfaces are densely ornamented with irregular and subvertically oriented granules. Tentacular lobes are weakly developed. Synapticulae are numerous, formed along the entire length of the lower parts of septa. The columella is compact, spongy, and consists of thin variously curved needle-shaped trabeculae with round dulled tips. Costae are well developed at the periphery. Lower cycle costae are taller than the other ridges and can be lamellar. Spines are conical and cylindro-conic, frequent to rare, mainly with complexly divided echinoid tips. The wall is uneven and highly perforate at the periphery with slits.

Living corals are brown with a green or crimson stomadeum.

Similar species. See *F. danai* and *F. scruposa*.

Uncommon.

Location. Tho Chu, Ant Hoy Islands, depth 6-18 m.

Distribution. Reefs of the Andaman Islands, Chagos, Mergui Archipelagoes, Singapore, South Vietnam, and the Great Barrier Reef of Australia.

Fungia horrida Dana, 1846

Fig. 47 - 7

Fungia horrida Dana, 1846: Veron and Pichon (1979) cum syn.,

part. *Fungia (Danafungia) horrida* Dana: Hoeksema (1989) cum syn.

Round flat corals, wavy or arched, having a diameter up to 15 cm, and a height of 20 mm. The fossa is 20-30 mm long, narrow, and of a moderate depth. The lower surface is flat or slightly concave.

Septa are thin, tall, and in seven cycles. The first four cycles of septa project for 2-4 mm above higher cycle septa. The height of the fifth and sixth cycle septa is gradually reduced from the periphery to the points of fusion of the lower and higher cycle septa. The upper septal margins are dentate mostly with triangular spines of various shapes and sizes. They can be obtuse, pointed or rounded, which makes the septa look very uneven and jagged. Lateral surfaces are densely covered with fine granules with pointed tips. Granulation is arranged in vertical rows, which are especially distinct, with fine distinct triangular denticles. Tentacular lobes are difficult to detect because of the septal unevenness. Synapticulae are numerous, almost fusing, and are developed throughout the entire length of the lower septal surface. The columella is narrow, long, and spongy. It consists of thin curved spinules, formed on the axial ends of septa. Costae are divided into distinct cycles. Lower cycle costae are thick, equal in height, and developed throughout the entire wall. Higher cycle costae project in the form of short, thin, low laminae. Costal spines are thick and cylindrical with complexly divided echinoid tips, with a tendency to bifurcation and irregular branching. The wall is rugose with radially longitudinal rows of spines. Granulation is abundant in the form of small spines, and perforation is moderate.

Living corals are shades of yellow-brown with a crimson stomadeum.

Similar species *F. corona* does not have a central arch.

Rare.

Location. Tho Chu Island, Gulf of Siam, depth 5-12 m.

Distribution. Known on the reefs of the Red Sea, Zanzibar, Madagascar, South Vietnam, Indonesia, the Philippines, Tahiti and the Great Barrier Reef of Australia.

Fungia valida Verrill, 1864

Fig. 48 - 1

Fungia valida Verrill, 1864: Veron and Pichon (1979) cum syn.,

part.*Fungia (Danafungia) horrida* Dana: Hoeksema (1989) cum syn.

Diskoid flat corals with fragmented arched coralla, having a diameter of 12 cm and height of 12-15 mm. The fossa is short, narrow, deep, subconical, with a flat floor.

Septa are thin and straight and in eight cycles. All septa, except for the seventh and eighth cycles, are equal or almost equal in height, which gradually increases towards the coral center. The height of the higher septal cycles decreases from the periphery to the points of their fusion with septa of lower cycles. The upper septal margins are densely dentate with mostly large lacerate and triangular lamimae, and the latter can be needle-shaped. Laminae and spines can fuse in pairs, forming series of long, rectangular, sawtooth-shaped or fence-like denticles. Towards the coral periphery denticles decrease in size and become regularly triangular. Lateral septal surfaces are covered with numerous fine granules, of which there are noticeably fewer towards the upper septal margin. Synapticulae are formed along the entire septal length up to 2/3 of the height of the eighth cycle septa. The columella is small, loose, and composed of simple needle-shaped spinules. Costae are distinguishable by height and length. Lower cycle costae are tall, noticeably protruding upwards in the form of thick ridges throughout the entire wall. Higher cycle costae are developed mainly in the coral periphery in the form of thin uniform-sized laminae. All costae are covered with long thick cylindro-conic spines. They can fuse in groups of three to six, forming laminae with fan-shaped radiating spines. Spine tips are slightly divided in an echinoid fashion. The wall is ungranulated, tubercular-rugose, moderately perforated, and at the periphery strongly perforated with slits.

Living corals are yellow-brown.

Similar species *F. fungites* has less dsntate septa.

Rare.

Location. Pe Island, Baitylong Archipelago, depth 3 m.

Distribution. Known on the reefs of Zanzibar, Molucca Islands, North Vietnam, and the Great Barrier Reef of Australia.

Fungia concina Verrill, 1864

Fig. 47 - 8, C11 - 6

Fungia concina Verrill, 1864: Veron and Pichon (1979) cum syn., Scheer and Pillai (1983) part. Hoeksema (1989).

Round flat and slightly arched corals, sometimes with an arched elevation around the fossa, with corals having a diameter of 12-15 cm and a height up to 25 mm. The fossa is narrow, short, about 20 mm long, and moderately deep. The lower surface is flat, concave, more rarely convex. The skeleton is densely calcified and heavy.

Septa are straight or wavy, thin at the periphery and slightly or moderately reinforced towards the axial space. Seven to eight cycles of septa are developed. The first four cycles of septa protrude upwards more and are more reinforced than other septa, especially near the fossa. The first five to six cycles of septa are equal or almost equal in height in the periphery. The last two cycles of septa are thin, very short, and can be fenestrate. The upper septal margins are dentate with fine very numerous sawtooth-shaped denticles. Lateral surfaces are densely granulated with fine granules, not oriented at the septal base, and arranged in a zigzag fashion parallel to their upper margin. Tentacular lobes are found on the fifth cycle septa. Synapticulae are rare, formed mainly near the center of the coral. The columella is compact, spongy, and consists of simple, almost intergrown spinules. Costae are low, cycles are almost equal, and developed mainly in the coral periphery. Spines are cylindrical with obtuse rounded tips. All spines, especially their tips, are covered with numerous small spinules. Many spines have a tendency to branch. In the center, costal spines are not arranged in rows, and are located disorderly. The wall is thick and not perforate, rugosely undulated, and not ornamented.

Living corals are brown with violet-crimson central and peripheral parts.

Similar species *F. repanda* has coarser septal teeth, pits between the costae.

Relatively common.

Location. Phu Quy, Con Dao and Ant Hoy Islands, reefs of Khanh Hoa Province, dept 520 m.

Distribution. Widely distributed throughout the entire tropical Indo-Pacific zone.

Fungia repanda Dana, 1846

Fig. 47 - 2, C21 - 8

Fungia repanda Dana, 1846: Veron and Pichon (1979) cum syn., part. Hoeksema (1989)

Round flat or arched corals, having a diameter of 15-20 cm, and a height of 30-40 mm. The fossa is short, less than 20 mm, narrow, and deep. The lower surface is concave to flat. The skeleton is dense and comparatively heavy.

Septa are straight, slightly reinforced and compact, with seven cycles of septa developed. The first four cycles of septa protrude upwards for 3-5 mm over the other septa. The height of septa of the fifth and sixth cycles decrease from the periphery to the points of fusion with lower and higher cycles. The axial ends of the first through third cycles of septa are steeply inclined. A small

amount of perforation is found only on septa of the highest cycles. The upper septal margins are moderately dentate with low sawtooth-shaped, more rarely round denticles. Lateral surfaces are abundantly granulated with fine spines, arranged in parallel zigzag rows, which merge in distinct rows and ridges towards the upper septal margin. Tentacular lobes are not developed. Synapticulae are rare, formed evenly throughout the entire septal surface. The columella is compact and spongy, represented by thin vertically arranged simple spinules, diverging from the axial ends of the septa. Costae are clearly distinguishable by cycles. Costae of lower cycles are thicker and taller, and more dentate. Higher cycle costae are thin and lamellar at the periphery. Costal spines are thick, cylindrical, and irregularly ornamented throughout their entire surface with fine granules and spines. The wall is not granulated, and can be perforated by slits at the periphery.
Living corals are yellow-brown.

Similar species *F. scabra* has finer septal teeth.

Relatively common.

Location. Phu Quy, Con Dao and Tho Chu Islands, reefs of Khanh Hoa Province, depth 5-15 m.
Distribution. Widely known throughout the entire Indo-Pacific from the Red Sea and Madagascar to Japan and the Tuamotus.

Fungia granulosa Klunzinger, 1879

Fig. 48 - 2

Fungia granulosa Klunzinger, 1879

Fungia (Wellsofungia) granulosa Klunzinger: Hoeksema (1989) cum syn.

Round and slightly oval thick corals with flat, arched or highly arched coralla, having a diameter up to 15 cm and a height of 50 mm. The fossa is 20-30 mm long, narrow, and deep. The lower surface is flat, or slightly to highly concave. The skeleton is densely calcified and heavy.

Septa are thick, gradually becoming thinner to the periphery, wavy, and almost all are equal in height. Seven cycles of septa are developed. The height and thickness of septa, beginning from the fourth cycle, decrease at the points of fusion with septa of higher cycles. The upper septal margins are densely ornamented with complex irregular verrucose-echinoid spikes, arranged in wavy rows. Low tentacular lobes are developed. Synapticulae are evenly located throughout the entire length up to the half of the height of the septa. The columella is smoll loose, and consists of long simple, twisting spinules. The wall is slightly perforated with slits, and not granulated.
Living corals are shades of yellow-brown.

Similar species *F. scabra* has thin septa with fine conical or granular teeth.

Uncommon.

Location. Islands of Baitylong Archipelago, Phu Quy, Con Dao Islands, depth 3-16 m.
Distribution. Widely distributed from Agaba Bay and Madagascar to Japan and the Society Islands.

Fungia scutaria Lamarck, 1801

Fig. 48 - 3, C22 - 1

Fungia scutaria Lamarck, 1801

Fungia (Lobactis) scutaria Lamarck: Hoeksema (1989) cum syn.

Elongated oval thick corals which are arched to the various degrees, having up to 18 cm length, 9 cm width and 6 cm height. The fossa is narrow, up to 70-80 mm long and 20 mm deep. The lower surface is variable from slightly to highly concave. The skeleton is densely calcified and heavy.

Nine to eleven cycles of wavy septa are developed, tapered and reinforced to the base. The first four cycles of septa almost reach the axis and form a distinct fossa by their vertical high axial ends. The lower parts of axial ends of the fifth cycle septa reach the columella at their base, whereas the upper upper parts do not reach the fossa by 2-3 mm. The inner ends of the higher cycles of septa have well expressed round-triangular reinforced tentacular lobes. The upper septal margins are dentate with very fine, numerous sawtooth-shaped denticles. Lateral surfaces are densely covered with fine granules, arranged in vertical rows, by the upper septal margin being transformed into thin triangular ridges, which merge with dentation of the distal septal margin. The columella is compact, dense, and consists of flat, fusing and curved paliform lobes, with tips that are slightly complex in the echinoid fashion. Costae are almost equal in height. They are better developed at the periphery and can be reduced towards the coral center. Lower cycles costae are slightly thicker and taller. Spines are thick and conical, numerous with divided echinoid tips. The wall is slightly perforate with slits at the periphery, and not granulated.

Living corals are shades of green-brown with bright green spots at tentacular lobes.

Similar species *F. seychellensis* tentacular lobes are inconspicuous or absent.

Usually common.

Location. Culao Cham, Re, Phu Quy and Nam Zu Islands, and reefs of Khanh Hoa Province, depth 3-18 m.

Distribution. Widely distributed throughout the entire tropical zone of the Indo-Pacific.

Fungia scabra Döderlein, 1901

Fig. C21-7

Corals are usually circular, flat or arched. Septa are thin with fine conical or granular teeth. Small tentacular lobes may be present. Costae are fine. There are no pits between the costae. The septa are densely packed and almost of equal thickness and height, they are either straight or slightly bending. The solid septa of lower arders are slightly thicker and more protruding than those of higher order which are usually perforated. Tentacular lobes are scarcely present. The septal margins are finely ornamented with sharp, irregularly angular dentations.

Living corals are usually brown.

Similar species: *Fungia concinna*, which is thinner and has thicker septa with coarser septal and costal ornamentations.

Rare.

Location. Reefs of Khanh Hoa Province, Re Island, depth 3-18 m.

Distribution. Madagascar, Seyshelles Islands, South-West Pacific.

Fungia seychelensis Hoeksema, 1993

Fig. C12 - 7

Polyps are elongate and up to 150 millimetres long. The skeleton is densely calcified and heavy. Mouths may occur outside the axial furrow. Septa are fine and long, densely packed and usually not very sinuous. The upper protruding septal margins are densely dentate with needle-shaped conic denicles with verrucose-echinoid granulated tips. Tentacular lobes are inconspicuous or absent.

Living corals are pale brown.

Rare.

Location. Are known on Nha Trang and Van Phong Bays, depth 4-10 m.

Distribution. Uncommon Madagascar, Seychelles and Maldives Islands, Central Vietnam.

Genus *Heliofungia* Wells, 1966

Type species: *Fungia actiniformis* Quoy and Gaimard, 1833

Diagnosis. Medium sized monostomatal discoid corals. Septa are thin, of varying height, with distinct large triangular-oval dentation, lateral granulation is rarely arranged in zigzag rows at the upper septal margin. The fossa is short and open. Costae are of varying heights with thick short spines, and densely echinoid. The wall is perforated with slits at the periphery.

Heliofungia actiniformis (Quoy and Gaimard, 1833)

Fig. 48 - 4, C12 - 1

Fungia actiniformis Quoy and Gaimard, 1833

Heliofungia actiniformis (Quoy and Gaimard): Veron and Pichon (1979) cum syn., Veron (1986), Hoeksema (1989)

Round, relatively thick, arched coral, 10 cm in diameter. The fossa is open, short, not longer than 25 mm. The lower surface is curved-concave with a large round attachment scar.

Septa are straight and long, and slightly reinforced at the axis. Six to seven septal cycles are developed. The first four cycles of septa are twice as thick as higher cycle septa and highly protruding above the higher cycle septa. Fifth cycle septa are of a similar height to septa of the lower cycles only at the periphery. The axial ends of all septa are steeply sloped, and some of them have tentacular lobes. The upper septal margins are moderately dentate with large triangular-round and lobate arrow-shaped spines. Lateral surfaces are densely covered with fine spines, which can be arranged in vertical or slightly zigzag rows. Synapticulae are regularly developed along all septa up to 1/3 of the height of higher cycle septa. The columella is compact and spongy, formed of interlacing widely spaced spinules and paliform lobes with pointed tips. Costae are lamellar with two distinct heights. They are densely covered with thick obtuse spikes, highly to moderately echinoid. The wall is moderately perforated at the periphery.

Living corals are brown with white spots at the ends of tentacles.

Similar species. *Heliofungia* tentacles resemble those of the euphyllid *Euphyllia glabrescens* but are larger.

Rare.

Location. Bay-Can Bay in the Khanh Hoa Province, depth 5 m.

Distribution. Known in the Central Indo-Pacific from the Malay Archipelago and North-Western Australia to Japan and New Caledonia.

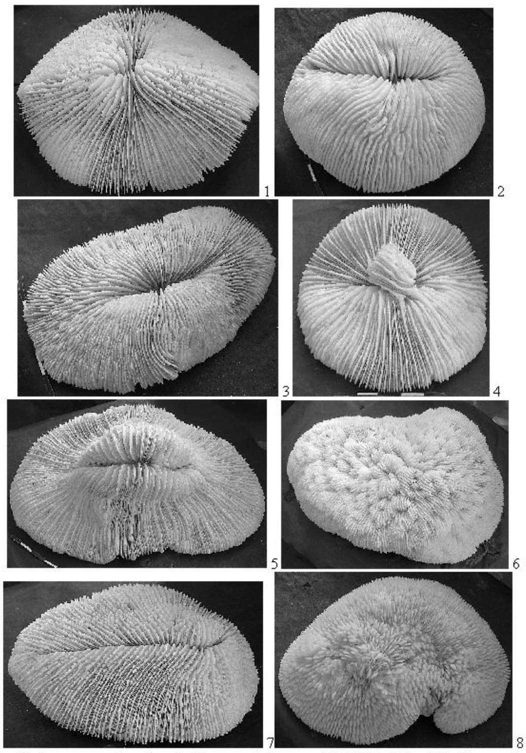


Fig. 48. Appearance of corals. 1 – *Fungia valida*, spec. 1/95165, Re Island, 2 – *F. granulosa*, spec. 1/95167, Thu Island, 3 – *F. scutaria*, spec. 1/95168, Tya La Island, 4 – *Heliofungia actiniformis*, spec. 1/95169, Bai Canh Bay, 5 – *Pleuractis paumotensis*, spec. 1/95170, Namsu Islands, 6 – *Sandalolitha robusta*, spec. 1/95179, Bai Tu long Archipelago, 7 – *Ctenactis echinata*, spec. 1/95172, Tya La Island, 8 – *Polyphyllia novaehibernia* spec. 1/95177, Con dao Islands

Genus *Pleuractis* Verrill, 1864

Type species: *Fungia paumotensis* Stuthbury, 1833.

Diagnosis. Monostomatal, rarely with several lateral stomata, oval and elongated corals with a central arch. Septa are moderately reinforced, and complexly dentate. Lower cycles septa are more reinforced and protrude upwards. The fossa is long, narrow, and deep. Costae are lamellar, varying in height, distinctly cyclic, and highly ornamented with complexly divided spines. The wall is weakly perforate.

Pleuractis paumotensis (Stuthbury, 1833)

Fig. 48 - 5, C11- 8

Fungia paumotensis Stuthbury, 1833

Fungia (Pleuractis) paumotensis Stuthbury: Hoeksema (1989) cum syn.

Oblong tongue-shaped corals with round ends and highly arched near the fossa. The corallum length reaches 17-20 cm, its width 7-11 cm and height 4-6 cm. The fossa is narrow, its length is slightly more than 1/3 of the coral length and its depth is about 20 mm. The lower surface is flat to concave with a large attachment scar.

Septa are straight or slightly wavy, moderately thick or thin. The first four cycles of septa are noticeably reinforced and taller than septa of higher cycles. Around the fossa axial septal ends are reinforced by thickening. Tentacular lobes are formed near the fusion of lower cycle septa with higher cycle septa, beginning with the fourth cycle. The upper septal ends are very highly dentate with divided verrucose-lacerate denticles, which sometimes are arranged in rows of laminae across the septa. Lateral surfaces are densely ornamented with fine irregular spines and granules, which can be arranged in vertical rows in the axial parts of septa. Synapticulae are formed along the entire septal length, near their base. They are denser outside the central arch. The columella is narrow, loose, and consists of reinforced, slightly twisting spinules with widening tips. Costae are lamellar, in two distinct orders by height with clear cycles. Spines are cylindro-conical with obtuse tips, verrucosely or echinoidly divided. The wall is smooth, firm, slightly perforate with slits at the periphery.

Living corals are shades of brown with a violet-lilac stomateum.

Similar species *Fungia moluccensis* usually has a strong central arch. In specimens which are not contorted, primary septa extend from the mouth to the perimeter.

Relatively common.

Location. Mung Islands of Khanh Hoa Province, Phu Quy, Nam Zu and Ant Hoy Islands, depth 6-25 m.

Distribution. Known throughout the entire tropical Indo-Pacific from the Red Sea to Japan, Hawaii and the Tuamotu.

Pleuractis moluccensis Van der Horst, 1919

Fig. C22-4

Fungia (Pleuractis) moluccensis Van Der Horst: Veron and Pichon (1979) cum syn., Veron (1986), Hoeksema (1989) cum syn.

Oblong tongue-shaped corals with round ends and a moderate central arch. Coral length reaches 18-20 cm, width 8-12 cm, and height 4-6 cm. The fossa is narrow, deep, and it is shorter than 1/3 of the length of the coral. The lower surface is moderately concave with a distinct small attachment scar.

Septa are very long, very compact, straight or curved on the boundaries of the main and opposite secteurs with lateral secteurs. The first four to five cycles of septa are thick, noticeably protruding above the other septa. In the lateral sectors they are reinforced by thickening at the axis and at the periphery. The other septa are a half to a third as thick, and fenestrate. Septa of the fourth to sixth cycles have small tentacular lobes near their fusion with septa of lower cycles. The upper septal margins are densely dentate with low, complexly divided denticles. Lateral surfaces are very densely ornamented with fine needle-shaped spines with divided granulated tips, looking like icing on the septal surface. Synapticulae are dense, formed along the lower septal margin. The columella is loose, represented by widely spaced slightly curved spinules with flat or widening tips. Costae are lamella of two orders, differing in height and thickness, with clear cycles, corresponding to septa. Spines are short and thick, with complexly divided echinoid tips. Spines are irregularly arranged, and form thick clusters on lower cycle costae. The wall is smooth, almost unperforated. Living corals are shades of brown-yellow with whitish spots.

Similar species *Fungia paumotensis*, which is heavier, less irregular and has thicker septa and costae which are straight and uniform.

Rare.

Location. Con Dao Islands, Gulf of Siam, depth 6-15 m.

Distribution. Known in the Red Sea, the Andaman Islands, South Vietnam, Indonesia, the Philippines, Western and Eastern Australia, New Guinea, Fiji, Samoa, Palau, and the Society Islands.

Genus *Ctenactis* Verrill, 1864

Type species: *Madrepora echinata* Pallas, 1766.

Diagnosis. Large and medium-sized monostomatous more rarely polystomatous, oblong and oval-oblong corals with a very long fossa. Septa are highly dentate with large lacerate and triangular denticles. Costae are weakly developed, and densely covered with long arborescent spines. The wall is highly perforate.

Ctenactis echinata (Pallas, 1766)

Fig. 48 - 7, C12 - 6

Madrepora echinata Pallas, 1766

Ctenactis echinata (Pallas): Hoeksema (1989) cum syn.

Oblong tongue-shaped arched corals, having a diameter of 15-18 cm, width of 8-10 cm and height of 3-4 cm. The fossa is narrow, open, and very long, reaching ¾ of the length of the coral. The lower surface is usually concave.

Eight to nine cycles of long straight septa are developed. The first four to five cycles of septa are thicker and considerably taller than septa of the rest of the cycles. Septa of the higher cycles are fenestrate. The cardinal and counter primary septa are distinctly detached from all the other septa, plumosely arranged towards protosepta. The upper septal margins are highly dentate with large lobate and subtriangular denticles with echinoid or spiny divided tips and granulated lower surfaces. Lateral septal surfaces are moderately granulated with spine-like granules, which towards the upper septal margin can be variously arranged: fan-like, in subparallel rows and streams, or in zigzag-like vertical meandering streams. Synapticulae are numerous, developed throughout the entire septal length up to ¼ of their height. The columella is loose, and consists of simple vertical flat spinules with widened tips. Costae are low, of a uniform height, becoming flat towards the coral center. Spines are cylindrical or arborescent with numerous short obtuse spines, irregularly diverging along the entire height of vertical spikes. The wall is not ornamented, but is highly perforate.

Living corals are shades of greenish brown.

Similar species *C. rassa* has a series of mouths along the axial furrow.

Common.

Location. Distributed everywhere, except for the northern part of the Gulf of Tonkin, depth 3-20 m.

Distribution. Known in the Indian Ocean, in the Red Sea, in the Seychelles and Maldives; and in the Pacific Ocean – from Malaysia to Japan and the Society Islands.

Genus *Herpolitha* Erscholtz, 1825

Type species: *Herpolitha limax* Houtuyn, 1772.

Diagnosis. Large polystomatous corals with intra- and circumstomatal budding centers, with an oblong shape, flat or highly arched, reaching 50-60 cm length. Septa are slightly tapered and reinforced, and densely dentated with fine spine-like denticles. Costae are low, densely covered with short obtuse spines. The wall is weakly perforate.

Herpolitha limax (Esper, 1797)

Fig. 49 - 1, C12 - 5

Madrepora limax Esper, 1797

Herpolitha limax (Esper): Eschscholtz (1825): Veron and Pichon (1979) cum syn., part. Hoeksema (1989) cum syn.

Long polystomatous corals with pointed or rounded ends in large specimens, and they are usually arched. The coral length is 30-40 cm, width is 10-12 cm and the height is 8-10 cm. The fossa is narrow with numerous (about 20) linear stomatal centers, separated by flat diverging septa. Numerous secondary budding centers are formed around a weak central arch. The lower surface is flat, variously curved or concave.

Septa are short, tapered and reinforced, with two distinct size orders in height and width. The first two cycles of septa and a part of the third cycle are noticeably thicker and slightly taller than the other septa. Septa of the secondary near-stomatal centers are shorter and thicker than all the other septa. The upper septal margins are densely dentate with fine pointed sawtooth-shaped denticles. Lateral surfaces are covered with granules and spines, which at the peripheral septal margins, especially on the long ends of the coral, are arranged in vertical rows and streams,

coinciding with dentation on the upper septal margin. Tentacular lobes are not found. Synapticulae are dense and high, in the axial area they can reach ½ of septal height. The columella is compact, spongy in the axial stomata and small, of several simple spinules, in the secondary budding centers. Costae almost are not found, except for at the peripheral coral margin, where they are rather distinct. Spines are thick, short, with obtuse round flat granulated tips. The wall is moderately or slightly perforate.
Living corals are yellow-brown.

Similar species *H. weberi* has mouths occuring only within the axial furrow.

Common.

Location. Reefs of Culao Cham, Re Islands, Khanh Hoa Province, Phu Quy, Con Dao, Nam Zu and Ant Hoy Islands, depth 5-20 m.
Distribution. Widely known throughout the entire tropical Indo-Pacific from the Red Sea and Mozambique to Japan and the Tuamotus.

Herpolitha weberi (Van der Horst, 1921)

Fig. 49-2

Fungia weberi Van der Horst, 1921

Herpolitha weberi (Van der Horst): Boschma (1925), Veron and Pichon (1979) cum syn.

Herpolitha limax (Esper): part. Hoeksema (1989) cum syn.

Long polystomatal corals, flat, arched or bent with pointed, more rarely round ends, reaching 15-20 cm length, 5-8 cm width and up to 4 cm height. The fossa is long and narrow with linear stomadeum centers (12-15 units), separated by reinforced diverging septa. Lateral secondary budding centers are single and rudimentary. The lower surface is flat, concave or curved.

Septa are long, thin, and uniform in height. The first two cycles of septa are uniform in height along the entire length. The third and fourth cycles of septa are of a similar height with septa of the lower cycles up to the points of fusion with septa of higher cycles. The upper parts of many septa are fenestrate. Higher cycle septa are low, thin, and highly fenestrate. The upper septal margins are dentate with frequent sawtooth-shaped thin denticles with flat echinoid tips. Lateral surfaces are covered with fine spine-like granules, arranged in distinct vertical rows, which merge with dentation on the upper septal margin. Tentacular lobes are absent. Synapticulae are numerous, and developed along the entire septal length. The columella is compact, spongy, and consists of interlacing and fusing flat spinules. Costal ridges are low, uniform in height, better developed at the periphery and are reduced towards the coral center. Spines are short and cylindrical with widening densely echinoid tips. The wall is moderately perforate, and highly perforate at the periphery.
Living corals are yellow-brown.

Similar species *H. limax* has secondary centres and seldom has axial furrows extending the full length of the colony.

Rare.

Location. Re, Tho Chu Islands, depth 9-15 m.

Distribution. Known on the reefs of the Seychelles (Des Roches Island), the Maldives, South Vietnam, Palau, and the Great Barrier Reef of Australia.

Genus *Polyphyllia* Blainville, 1830

Type species: *Polyphyllia talpina* (Lamarck, 1831).

Diagnosis. Long polystomatal corals of irregular oval arched to hilly forms. Secondary budding centers are inter- and circum-stomatal, numerous, and compact. Septa are short, tapered, reinforced, and highly dentate. Costae are dotted-lamellar, densely covered with short spines with ornamented tips. The wall is highly perforated.

Polyphyllia novaehiberniae (Lesson, 1831)

Fig. 48 - 8

Lithactinia novae-hiberniae Lesson, 1831

Polyphyllia novaehiberniae (Lesson): Edwards and Haime (1851), Hoeksema (1989) cum syn.

Polystomatal thin irregularly round corals of a hilly form with traces of repeated fragmentation, having a diameter up to 15-20 cm and a height up to 10 cm. The fossa or the line of axial centers in adult specimens can hardly be seen. The lower surface is highly concave, cup-shaped with distinct costae.

Septa are short, reinforced by thickening, and interrupted by secondary stomata. Adjacent septa fuse in subparallel wavy rows, divided by narrow grooves, of neighboring secondary stomata of peripheral circum-stomatal budding. The upper protruding septal margins are densely dentated with needle-shaped conic denicles with verrucose-echinoid granulated tips. Lateral surfaces are intensively granulated with large spines, which increase in number towards the upper septal margin, where they can be arranged in vertical curving streams. There are no tentacular lobes. The columella is small and sporadic, and consists of several twisted spinules, developed mainly in the primary stomata. Costae are interrupted lamellae, uniform in height with sawtooth-shaped flat spines, with tips that are echinoidly granulated. The wall is highly perforate, especially at the coral periphery.

Living corals are yellow-brown.

Similar species. Very distinctive although superficially like *Zoopilus echinatus* (Veron, 1986).

Rare.

Location. Con Dao Island, depth 12 m.

Distribution. South Vietnam, Indonesia, Vanuatu, Samoa, Tonga, Fiji, New Guinea, New Caledonia, and New Ireland.

Polyphyllia talpina (Lamarck, 1801)

Fig. 49 - 3, C22 - 2

Fungia talpina Lamarck, 1801

Polyphyllia talpina (Lamarck): Gardner (1909), Veron (1986), Hoeksema (1989) cum syn.

Polystomatous long prominent corals with pointed or round ends, reaching 35-40 cm length, 5-8 cm width and up to 4 cm height. Numerous axial stomatal centers (40-50) are elongated in the form of a straight or curving line, repeating the longitudinal form of the coral. The lower surface is deeply concave. The skeleton is thick and heavy.

The first cycle of septa are short and tapered, thick petaloids, gathered in the form of inflorescences in subparallel wavy rows along the coral. Lower cycle septa are thin, lamellar, and shorter. At the periphery septa are parallel lamellae, slightly reinforced by tapering. The upper septal margins are densely dentate with conical spines with abundant echinoid-verrucose granulation. Lateral septal surfaces are highly granulated with long, thick, obtuse spines, reinforced or bifurcated, vaguely arranged in vertical rows. Synapticulae are widely spaced and hard to see because of the dense septal packing. The columella is smoll or loose, and consists of disconnected paliform lobes. Costae are interrupted lamellae, uniform in height, developed mainly at the coral periphery. Spines are short and flat, with pointed and slightly echinoid tips. The wall is moderately or weakly perforate.

Living corals are yellow-brown.

Similar species. See *P. novaehiberniae*.

Common.

Location. Known everywhere, except for the northern part of the Gulf of Tonkin, dept 3-25 m.

Distribution. Known throughout the entire tropical Indo-Pacific from Madagascar to Japan and the Great Barrier Reef of Australia.

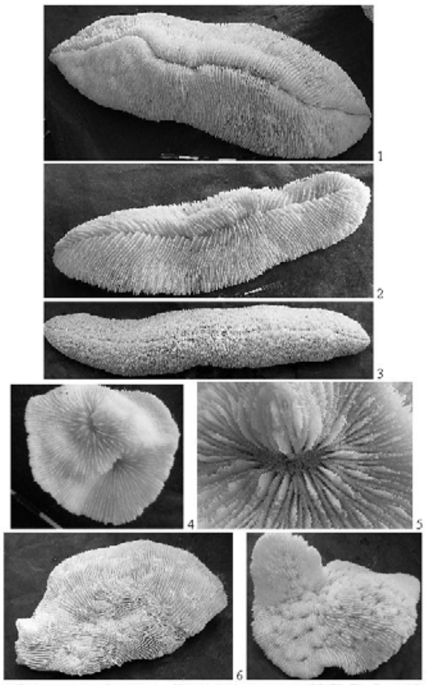


Fig. 49. Appearance of corals. 1 – *Herpolitha limax*, spec. 1/95173, Thu Island, 2 – *H. weberi*, spec. 1/95174, Tho Chu Island, 3 – *Polyphyllia talpina*, spec. 1/95175, Khanh Hoa Province, 4 – *Lithophyllon bistomatum*, spec. 1/95182, Dua Island, Bai Tu Long Archipelago, 5 – the same, primary stoma, 6 – *Halomitra pileus*, spec. 1/95183, Bai Tu Long Archipelago, 7 – *Podobacia crustace*, spec. 1/95184, Bai Tu Long Archipelago

Genus *Sandalolitha* Quelch, 1884

Type species: *Sandalolitha dentata* Quelch, 1884.

Diagnosis. Large polystomatous corals of oval elongated, arc-shaped or irregularly curved arched shape. There is no central fossa and axial stomadea, and budding is circum-stomatal. The septa are thick, mainly short, often petaloid, and roughly dentate. Costae are lamellar and low, and densely covered with rough complex spines. The wall is perforate.

Sandalolitha dentata Quelch, 1884

Fig. C22 - 3

Sandalolitha dentata Quelch, 1884: Hoeksema (1989) cum syn.

Polystomatous, wide, oval-elongated, arched or variously curved, slightly to highly arched corals, having up to 25-35 cm length, 8-12 cm width and 4-6 cm height. Secondary stomata are densely located in the central part of the coral, becoming rare or solitary towards the periphery. The lower surface is slightly to highly concave with the large attachment scar of a young coral.

Septa are straight or curved, short or long. In the presence fewer peripheral stomata septa are longer. Lower cycle septa are thicker and protrude upwards more than the other septa. The upper septal margins are highly dentate in a fence-like arrangement with numerous long, conical spines, with tips that are divided in an echinoid-verrucose fashion. Lateral septal surfaces are moderately granulated with fine and medium spines. Synapticulae are numerous and short. The columella is compact, in peripheral stomata it is small or rudimentary, and consists of simple flat spinules and paliform lobes. Costae are short interrupted lamellae, developed mainly at the periphery. Costal spines are short and cylindrical or cylindro-conical, often with widened and flat

tips that are slightly or moderately echinoid. Spine sizes increase towards the center of the coral where they become more echinoid. The wall is slightly perforate.
Living corals are greenish brown.

Similar species *S. robusta* has septa vary little in height.

Usualy common.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam, depth 1-15 m.
Distribution. In the Indian Ocean they are found in the Seychelles and Maldives, southwestern India, northwestern Australia, and in the Pacific Ocean, everywhere from Japan to the Society Islands.

Sandalolitha robusta (Quelch, 1886)

Fig. 48 - 6, C12 - 2

Podobacia robusta Quelch, 1886

Sandalolitha robusta (Quelch): Pillai and Scheer (1976), Veron (1986), Hoeksema (1989) cum syn.

Large wide polystomatous corals of oval-elongated and irregular round arched to highly arched shape, reaching 40-45 cm length, 15 cm width and 5-7 cm height. Numerous stomatal centers are densely located throughout the entire coral surface, except for the narrow peripheral zone. The lower surface is concave to highly concave with concentric growth rings. The coral skeleton is densely calcified and heavy.

Septa are flat and short. Lower cycles of septa are thicker and protrude upwards farther than higher cycles of septa. All septa are fenestrate, especially higher order septa, which are densely perforated. The upper septal margins are dentate with frequent long, lacerate lobate denticles, ornamented by needle-shaped spines. Lateral septal surfaces are moderately to densely covered with spine-shaped granules, which are arranged in rows of denticles on the upper septal margin. Synapticulae are numerous and regular along the entire septal length. The columella is weakly developed, and consists of several paliform lobes, variously arranged. Costae are lamellar, in two size orders by height. They become flat towards the center of the coral. Spines are numerous, vertically branching dichotomously or ramose, Ornamented by verrucose-echinoid granulation. The wall is moderately to highly perforate with slits.
Living corals are yellow-brown.

Similar species *S. dentata* is irregular in shape and less domed, with widely spaced corallites.

Common.

Location. Distributed everywhere from the Gulf of Tonkin to the Gulf of Siam, depth 1-15 m.
Distribution. Known on the reefs of the Seychelles and Maldives, widely distributed in the Southwestern Pacific from the Malay Archipelago to Japan and the Great Barrier Reef of Australia.

Genus *Lithophyllon* Rehberg, 1892

Type species: *Lithophyllon undulatum* Rehberg, 1892.

Diagnosis. Attached polystomatous encrusting and foliose colonies, often cup-shaped corals with circumstomal budding. Septa are thin and long or short and reinforced, depending on the number of secondary budding centers. Dentation is dense, thin, and lacerate-spiny. Costae are thin, rounded, with weak granulation. The wall is epitheca-like not granulated and not perforate.

Lithophyllon undulatum Rehberg, 1892

Fig. 50 - 1, C12 - 4

Lithophyllon undulatum Rehberg, 1892: Hoeksema (1989) cum syn.

Attached polystomatous corals with circumoral budding, with encrusting, cup-shaped and foliose growth forms. Colonies are thin with flat or wavy margins, with 10-15 cm diameter. The lower surface is irregularly convex-concave with a distinct attachment scar. Primary oval elongated stomata are larger than the other budding centers.

Septa are of a variable length from 10 to 45 mm, thin and straight or slightly reinforced by tapering. Lower cycle septa are slightly thicker and protrude considerably higher than higher cycle septa. In the central corallite septa radiate from the primary center, while at the periphery they are subparallel and thinner. All septa rise steeply upwards and sharply laterately reinforced by tapering in the form of tentacular lobes at the points of fusing with two neighboring septa of the next higher cycle. The upper septal margins are finely dentate with numerous lacerate needle-shaped denticles, which are echinoidly granulated. Lateral surfaces are finely granulated with small unordered spines. Synapticulae are frequent, high, and developed evenly throughout the entire septal length. The columella is formed in all corallites. In the axial centers it is denser, and consists of flat, variously curved merging spinules. Costae are thin, low, rounded, and evenly covered with slightly echinoid spines. The wall is not perforate, instead it is epitheca-like.

Living corals are shades of brown-green with light spots.

Similar species *L. lobata* is distinguished from *L. undulatum* by having a prominent central corallite.

Relatively common.

Location. Reefs of the Gulf of Tonkin, Khanh Hoa Province, Phu Quy, Con Dao and Tho Chu Islands, depth 11-25 m.

Distribution. Known from the Western coast of the Malay Archipelago to Japan and Samoa.

Lithophyllon mokai Hoeksema, 1989

Fig. 50 - 2

Lithophyllon mokai spec. nov. Hoeksema, 1989

Lithophyllon cf. *edwardsi* Rousseau, 1854:Veron and Pichon (1979

Lithophyllon edwardsi Rousseu: Wood (1983), Veron (1986)

Encrusting attached polystomatous corals with numerous secondary centers of circum-oral budding, of irregular round shape, reaching the diameter of up to 20 cm. Colony margins are thin and variously curved or subhorizontal.

Septa are short, reinforced, and continuous between neighboring corallites. First cycle septa are taller and thicker than the other septa. They can be straight, wavy or kneed curved. The axial ends of all septa plunge steeply and are tapered. The upper septal margins are densely dentate with lacerate, long thin teeth, ornamented by fine irregular spines. Lateral septal surfaces are covered with irregular fine spines, which can merge in short vertical rows at the topmost septal margin. Synapticulae are evenly formed between all septa from ¼ to 1/3 of their height. Tentacular lobes are irregularly developed. The columella is formed in all corallites. It can be small and consist of several pali grown together, is up to 4-5 mm tall, and is almost solid. Costae are low, weakly differentiated by height, and moderately granulated with fine spines. The wall is smooth, epitheca-like and not perforate.

Living corals are gray-green-brown with light spots.

Similar species. Sometimes resembles *Cantharellus jebbi* which is mostly monocentric.

Uncommon.

Location. Reefs of the Gulf of Tonkin and Gulf of Siam, Khanh Hoa Province, and Phu Quy Island, depth 6-15 m.

Distribution. Known mainly in the Southwestern Pacific from the Malay Archipelago to the Marshall Islands and Fiji.

Lithophyllon bistomatum Latypov, 1995

Fig. 49 - 4

Lithophyllon bistomatum sp. nov.: Latypov (1995)

Holotype – spec. 1/95182, Museum of Institute Marine Biology, Vldivostok 69041, Russia, Dag Ho Island, Gulf of Tonkin, depth 5 m. Paratype – spec. 2/95182, the same location.

Thin encrusted foliate corals with two large primary and several secondary smaller centers, with an irregular round shape, and reaching 60-70 mm diameter. The lower surface is epitheca-like, variously curved, with well developed root-shaped attachment extensions. Septa are long, thin and moderately thick. Seven distinct cycles are developed. Lower cycle septa protrude upwards farther and are thicker than the other septa. The axial ends of all of the first through fifth cycle septa, as well as the septal ends in the points of fusion with neighboring cycles are reinforced by tapering and rise upwards as sharp triangles, forming distinct tentacular lobes.

The upper septal margins are highly dentate with long thin lacerate spines with numerous irregular bumps, often branching dichotomously. Lateral surfaces are densely to moderately covered with large irregular granules with echinoid, often flat tips. Synapticulae are numerous, wide, and evenly formed along the entire septal length. The columella is well developed in all corallites. It is formed by flat irregular interlacing spinules. In the primary centers the columella is larger and consists of fused spinules. Costae are low and round with distinct cycles of successive septa, evenly covered with small numbers of fine spines. The wall is not perforate. Living corals are shades of yellow-brown with green stomata.

Comparison. Differs from all other *Lithophyllon* species by the presence of two primary stomata and corallite centers. From *L. undulatum* it differs by a smaller number of secondary stomata, and less well developed costae.

Relatively rare.

Location. Dua Island, Gulf of Tonkin, depth 5 m.

Distribution. Vietnam, Gulf of Tonkin.

Genus *Halomitra* Dana, 1846

Type species: *Halomitra pileus* (Linnaeus, 1758).

Diagnosis. Polystomatous, rounded, thin-walled convex corals with circum- and intra-stomatal budding. Septa are thin, numerous, mostly long, densely dentate and granulated. Costae are distinct and thin, up to laminae-like at the periphery, with clearly developed cycles.

Halomitra pileus (Linnaeus, 1758)

Fig. 49 - 6

Madrepora pileus Linnaeus, 1758

Halomitra pileus (Linnaeus): Dana (1846), Veron (1986), Hoeksema (1989) cum syn.

Unattached polystomatous round, convex thin-walled corals. Budding is circum-oral, more rarely intra-tentacular in several secondary centers. The lower surface is concave.

Septa are thin, staight and long at the periphery. Between closely located corallites they are reinforced by tapering, oriented subparallel, and common in neighboring corals. Lower cycle septa are thicker and protrude upwards more that the other septa. The upper septal margins are densely dentate with thin lacerated spines with irregularly divided reinforced tips. Lateral surfaces are granulated with small numbers of spines, sometimes oriented in weak rows at the upper septal margins. Synapticulae are frequently thick, and evenly distributed throughout the entire septal length. The columella is weak, sometimes massive, composed of fused reinforced paliform lobes, and rarely spiky. The costae are thin, lamelliform at the periphery with fine pointed, often merging spines. The wall is not perforate.

Living corals are yellow-green.

Similar species. None.

Rare.

Location. La Madon Island, Gulf of Tonkin, depth 3 m.

Distribution. Known from the southwestern part of the Indian Ocean to the central part of the Pacific Ocean.

Genus *Podabacia* Edwards and Haime, 1849

Type species: *Podobacia crustacea* (Pallas, 1766).

Diagnosis. Polystomatous encrusting-foliose corals with numerous circum-oral budding centers. Septa are short, fenestrate, slightly reinforced, and thin. Septal dentation is tall and consists of large, long flat echinoid spines. Lateral ornamentation is moderate or weak. Costae are flat, weak, and echinoid. T he wall is perforate.

Podabacia crustacea (Pallas, 1766)

Fig. 49 - 7, C12 - 3

Madrepora crustacea Pallas, 1766

Podabacia crustacea (Pallas): Edwards and Haime (1851), Veron and Pichon (1979) cum syn., Veron (1986), Hoeksema (1989) cum syn.

Attached polystomatous corals with enlarged central primary corallites and numerous fine circum-oral secondary budding centers. Colonies are encrusting-foliose, thin and moderately thick (rarely more than 20 mm), reaching 20-30 cm diameter. The lower surface is variously curved with a small distinct oval trace of attachment in the central part.

Living corals are shades of yellow-brown.

Similar species. Lightly calcified *Sandalolitha robusta* is structurally similar, but is not attached to the substrate.

Common.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam, depth 6-35 m.

Distribution. Widely distributed throughout the entire Indo-Pacific from the Red Sea to Madagascar to Japan and the Tuamotus.

3.6. Poritidae

The family Poritidae includes four genera: *Porites, Goniopora, Alveopora* and *Stylarea*. The latter genus is mono-specific and extremely rare. It has been found only at the eastern coast of Africa, the Red Sea and the northeastern coast of Australia. The first three genera are important reef-building corals of the Indo-Pacific, and *Porites* is an important genus in the Caribbean as well. The Poritidae contains about 10% of all reef-building scleractinian species, yet yet is often among the most abundant and important reef-builders on Indo-Pacific reefs along with the genera *Acropora* and *Montipora*. These corals are widely distributed in the tropics and often dominate reefs, and can grow in unfavorable ecological conditions.

The Poritidae occupy a considerable area on the reefs of Vietnam, living in areas of abundant continental discharge, and in low winter temperatures in the northern part of the South China Sea. However, the study of the range and distribution of the Poritidae is impeded by insufficient investigation of their intra-generic taxonomic structure. Poritidae, especially *Porites* species with their extremely small corallites, are very hard to identify. Their extremely wide range of variation hampers working with collection materials. The wide distribution of Poritidae in Vietnam, which can be found from the littoral to the bottom of reef-slopes, and from the northern part of the Gulf of Tonkin to the Gulf of Siam, allowed us to investigate in vivo and to collect a large amount of material to study the variability of species with massive colonies. Using the data on variation of these *Porites* colonies from different reef zones, author proposes a partially extended terminology for description of morphological features and discusses the most stable taxonomic features, revealed during their functional and taxonomic study. Branching species of *Porites* also exist in Vietnamese waters and the author is publishing a list of these (Dautova et al., in press). However, at the present time the author does not have a sufficient number of samples of branching colonies to describe their morphology in detail. This is the reason why this chapter includes mainly massive forms, in the hope that the next stage of *Porites* investigation in South China Sea will provide information on the branching species.

3.6.1. Taxonomic history

The history of investigation of the genera of Poritidae is rather complicated. Initially *Porites* with their small corallites were often mixed by taxonomists with scleractinians of other families (Veron and Pichon, 1982; Veron, 1986). In 1807 Link proposed the name "*Porites*" for the genus, which, in his opinion, included branching corals, covered with star-shaped orifices scattered throughout the surface. These were two species – *Porites polymorphus* and *Porites damicornis*. The latter was later re-identified as *Pocillopora damicornis*.

Before the 20th Century, establishment of boundaries and intragenus structure of *Porites* was hampered due to insufficient knowledge of the morphology and systematics of scleractinians as a whole. The taxonomy was often based only on differences in colony shape or in corallite sizes and the number of tentacles per polyp (Bernard, 1905). Among corals of the Arabian coast Forskål (1775) distinguished *Madrepora* (*Porites*) *solid*a. Edwards and Haime (1849) refer this species to the genus *Goniastrea*, but later Klunzinger (1879) returned it to the genus *Porites*. Ehrenberg (1834), being guided mainly by similarity of budding patterns, included 8 *Montipora* species from the family Acroporidae in the genus *Porites*. Dana (1846) for the first time characterized the *Porites* genus correctly, relying on the complex of features, representing a number of corallite structure peculiarities: such as the presence of pali and septal denticles arranged in concentric rows, etc.

Later on, as facts were accumulated, descriptions of new *Porites* species appeared without the revision of species described earlier. This resulted in an insufficiently justified increase in the number of species. This was the situation by the beginning of the 20th Century, when H. Bernard (1903, 1905, 1906) produced a monographic revision of the genus *Porites* and the entire Poritidae family. The first detailed description of the morphology of Poritidae was an undoubted advantage of his work. Characterizing the family as a whole, the author noted that the pattern of corallite structure is common for *Porites* and *Goniopora* genera: porous septa ascending from epitheca are united by synapticular rings and form a reticular wall, whereas a circle of synapticula surrounds the columella and fossa (central space). In his opinion, these genera differ by the fact that *Goniopora* has 24 septa, whereas *Porites* has 12, and septa of the third cycle almost are not developed at all in *Porites*. Bernard revised the family's taxonomy, being guided by peculiarities of corallite morphology and geographic localization of every form. He mentioned that the Poritidae, and most of all, the *Porites* genus, are characterized by a large amount of minor morphological variations. Ornamentation, shape and sizes of corallite elements vary even within the same colony. Trying to cover all variants of corallite architecture, Bernard gave a great number of descriptions of *Porites* species, which were actually ecomorphs, and differed only by one or two minor morphological features. In the process, he rejected the Linnaean nomenclature and the term "species" with reference to corals, replacing it by the term "local form". Bernard's studies concurred with the beginning of the discussion on the problem of species for corals and partially provoked it. Vaughan (1907) wrote that Bernard divided *Porites* and *Goniopora* into as many species as was possible, however, investigation of the limits of their intra-species variability was the key to identification of the Poritidae and other Scleractinian species. Vaughan (1907, 1918) completely reviewed the intra-generic taxonomy of the Poritidae, and produced the description of 35 species of *Porites* from the Indo-West Pacific and synonymised many species described earlier, including some "local forms" of Bernard. Thus, two tendencies in the classification of both the Poritidae and all Scleractinians were established. One of them lay in raising morphological distinctions, often minor ones, to the rank of species features. Another one was the investigation of the variability of features and establishment of its intra-species (and intra-generic) limits. However, most researchers held an intermediate point of view.

Among the number of systematic and taxonomic works of this period (Hoffmeister, 1925; Yabe and Sugiyawa, 1935; Eguchi, 1938; Umbgrove, 1939, 1940; Crossland, 1952; Wells, 1954; Stephenson and Wells, 1955; Nemenzo, 1955; Ma, 1959; Durham, 1962; Chevalier, 1968; Maragos, 1977) it is necessary to recognize a critical description of scleractinians of the Great Barrier Reef of Australia, carried out by Crossland (1952), one of the first followers of Vaughan. Crossland explained that the presence of a multilayer epitheca is typical for those scleractinian groups which exist in the environments where colonies are periodically damaged. This characteristic is not a diagnostic one for *Goniopora*, as Bernard thought (1903, 1905). Crossland states that *Alveopora* hardly differs substantially from *Goniopora*, and is derived from the latter by way of some reduction of the wall and septa. He notes that though Bernard (1903) in his time excluded *Alveopora* from the Poritidae, he admitted the extraordinary similarity of some Goniopora, having a "primitive wall type" in a corallite, with "true" Alveopora.

Talking on the problem of *Porites* identification, Crossland stressed the connection of variations of features with environmental conditions. In his opinion, a successful taxonomic work requires a purposeful collection of samples – young colonies from ecologically different biotopes and large intact colonies. At the same time an experimental study should be also executed.

J. Veron and M. Pichon (1976) carried out a critical investigation of the taxonomy of Scleractinian from eastern Australian waters based on population analysis of the variation of colony growth forms and an investigation of intra-colonial variability of features in three successive ways: variation within the same colony, growing in two and more microhabitats, situated at different levels; limits of variation of colony form within the same biotope; and between different biotopes. Having established in such a way the limits of variation, these authors synonymized many species described earlier.

At present the genus *Porites* includes not less than 122 species names (Veron, 1986; Foster, 1986). The taxonomic structure of the genus has not been finally established. Both Bernard's local forms and actual species, which have been subjected to synonymization up to the present time, are included in it. Definition of species, as a rule, has been impeded by indistinct diagnostics. This is caused by the following factors: 1) the absence of clear and convenient ways of describing skeletal structure features for taxonomic analysis; 2) a wide variation of skeleton elements; 3) an insufficient evaluation of the taxonomic value of these features.

The intricacy of taxonomic structures of *Porites* cannot be eliminated by a detailed redescription of species. First of all, it is necessary to examine the construction of such elements of *Porites* skeleton, the peculiarities of which can be used as species features, then to choose the most taxonomically important ones from all possible features and to follow a unified pattern of their presentation.

3.6.2. Terminology, morphological and taxonomic features

Corallite

The corallites of the Poritidae, as a rule, closely adjoin each other, and have a polygonal shape in cross-section (cerioid polyps). *Porites rus, P. densa* and *P. lichen*, in which a small amount of coenosteum is situated between rows of corallites, are the exception. Corallites of these species often have a round shape . *Porites* coenosteum morphologically seems to be a many-rowed (reticular) corallite wall (see the following section). The wall composing of many rows (reticular wall) along the entire perimeter of corallites is a stable feature, and in this case, it has a taxonomic importance at the species level together with some other features. In the other *Porites* species corallite walls become reticular only in the corallite corners and between corallites at the colony margin. Thus, the presence of coenosteum, developed in various degrees in *Porites* species, is not a qualitative feature and seemingly is not a basis for recognition of monospecies subgenera within the genus *Porites*.

Wall

A porous wall is a typical feature of the Poritidae family corals. In the Poritidae walls are formed by vertical elements – trabeculae, connected by horizontal cross connections – synapticulae (synapticulotheca, Fig. 51). The porosity of the wall relates to the fact that trabeculae are situated at some distance from each other, which is equal to their diameter or less. If wall trabeculae are placed close together, the wall still remains porous due to the presence of depressions on trabecular surfaces. A wall can be multirowed or single-rowed, and in the latter case it is formed by one row of trabeculae (Fig. 51, c). A part of a wall trabecula, protruding over the upper synapticular ring, is called a wall denticle. Denticles have a rod-shape or irregular shape, and as a rule, are granulated. In *Alveopora* wall denticles can be absent, if wall trabeculae do not protrude over wall synapticulae. In this case the wall margin is smooth. Granules are the ends of radial crystals forming a trabecula, and look like spines, small or large thorns, etc. (Fig. 51, f). Very different granules shapes can be observed within the same *Porites* colony. It is difficult to express quantitatively the degree of granulation of skeletal elements. Probably using the following terms will be quite satisfactory: abundant granulation, weak granulation, or granulation absent.

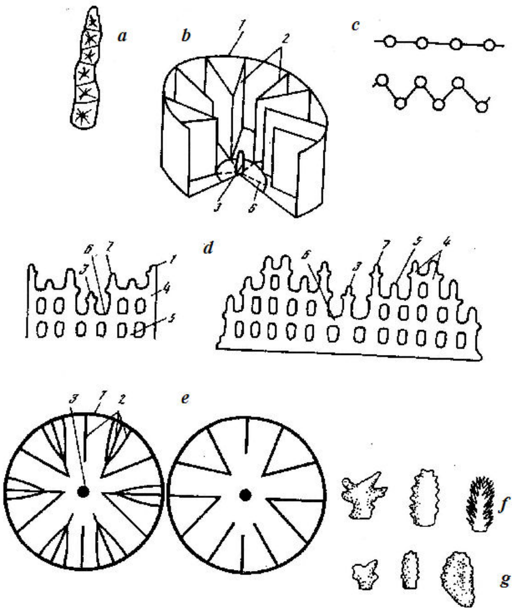


Fig. 51. Schema of structure a poritid corallites and its basic elements. *a* - simple trabeculae, *b* - the schema of a structure *Porites* corallites, c - single-row direct and zigzag corallite walls, cross-section, d - corallite of *Porites*, tangential section (on: Bernard, 1905), *e* - a septal configuration corallites of *Goniopora* (at the left) and *Porites*, *f* - various forms denticles of a *Porites* septa, *g* - various forms of a columella in *Porites* corallites. By figures are designated: 1 - wall, 2 - septa, *3* - columella, *4* - wall trabeculae, 5 – septal trabeculae, *6* - radii, 7 – paliform denticles

A single-rowed wall can be straight (if trabeculae are located along a straight line), or zigzag (if trabeculae are displaced from each other in a radial direction, Fig. 51, c). The outline of a corallite with a single-rowed wall is polygonal: in cross-section it is an elongated polygon with unequal sides (Fig. 52, A). In corallite corners the wall can consist of several rows of trabeculae, and becomes reticular there (multirowed, Fig. 51, d). In the opinion of Bernard (1905), this occurs due to the fact that the distance between corllites is farther than usual. Costal trabeculae of the primary corallite are able to develop and to be imbedded in the wall. If the distance between corallites even greater, then additional rows are imbedded along the entire wall.

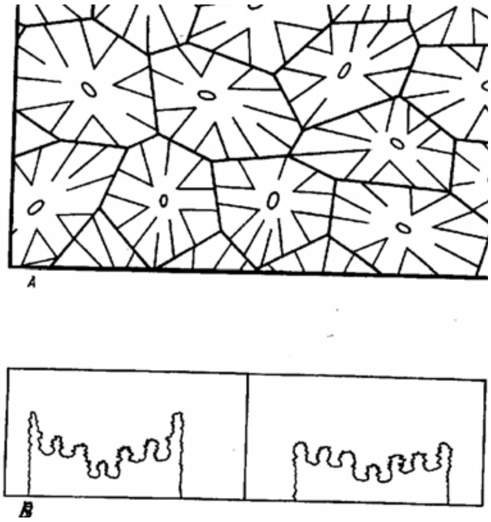


Fig. 52. Orientation of septa in a *Porites* corallites (A), (B) - a corallite with high (at the left) and low (on the right) walls, tangential section

Vaughan (1907, 1918) showed that the theory of Bernard was based on the incorrect supposition that all trabeculae in the corallite ascend parallel to each other. In fact septa trabeculae are inclined towards the corallite center and are joined to the wall trabeculae at a very small angle. If corallites are drawn together very closely, only the internal part of the septum is developed. If the outer part of the septum is also developed, corallites turn out to be separated by a spongy tissue called coenosteum (Vaughan, 1907). It is necessary to note that the points of view of Bernard and Vaughan virtually coincide: a multirowed wall is a result of development of septacostal trabeculae, which becomes possible when corallites are at some distance from each other. Species such as *P. densa* and *P. lichen* have mainly a multi-rowed corallite wall: groups of four to ten corallites are separated from each other by coenosteal ridges, analogous to a multi-rowed wall by its construction. One particular type of wall was described by Gardiner (1898) under the name “trimurate”. This term is still being used (Veron and Pichon, 1982, and others). But already Bernard (1905) rightly noted that the wall in this case has a single row, and the illusion of two additional rows is created by well-developed outer synapticular rings of neighboring corallites (Fig. 53).

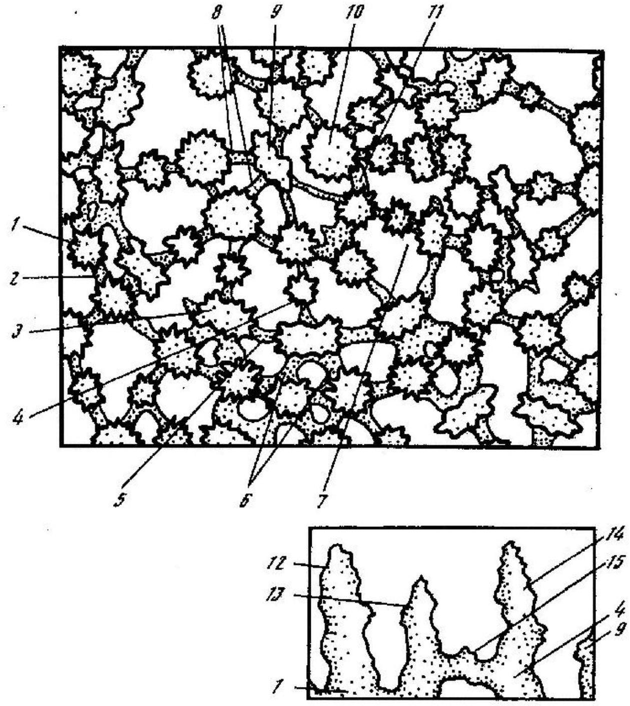


Fig. 53. Cross-section section a *Porites* corallite (from above); a structure of septum, tangential section (from below). By figures are designated: 1 - wall trabeculae, 2 - wall synapticulae, *3* - expanded wall a denticle of septum, *4* - septal trabecula, 5 - wall (external) a synapticular ring, 6 - the split septum, 7 - not split septum, *8* - radii, 9 - columella, *10* - an internal septal trabecula, *11* - palar (internal) synapticular ring, *12* - wall denticles, *13* - septal denticle, *14* - paliform denticles, *15* - swelling on the crosspiece between septal trabeculae

The following designations have been used for describing the construction of a corallite wall: narrow, thin, pointed, wide, thick, etc. (Bernard, 1905; Vaughan, 1907, 1918; Crossland, 1952; Veron and Pichon, 1982). Such designations may be subjective, and it is difficult to use them for identification of material in collections. Besides, the wall thickness usually varies within the same colony depending on the degree of calcification of the skeleton at different sites on the colony surface. That is why, when describing the walls of the Poritidae, the author recommends indicating the number of trabecular rows forming the wall instead of its thickness.

Depending on how high the distal septum margin is where it joins the wall, the wall can be low or high (Fig. 52, b). If the septum margin and the wall are the same height, i. e. the tips of septal and wall denticles are at the same level, the calice is not pronounced. Wall height and wall denticles, calice depth, as well as the sizes of other vertical elements of the corallite, can be connected with the environmental conditions the colony lived in (Foster, 1979; 1980). That is why such morphological features as wall height, height of wall denticles and septa denticles, columella height, etc. cannot be used for diagnostics at any taxonomic level. It is preferable to use more stable features of a qualitative nature, which represent a combination of several morphometric characteristics (Tesakov, 1974). For example, wall denticles are higher than septa denticles or at the same level with them.

The walls of *Goniopora* are arranged in the same way and represent the result of the joining of outer septal trabeculae, and not by just one ring of cross connections, but by several rings, and in all cases the wall is multi-rowed. Corallite wall is difficult to differentiate visually in such species, where its margin is almost at the same level with the distal septa margins (*G. stutchburyi, G. somaliensis* have a low wall).

Vietnamese *Alveopora* always have a single-rowed corallite wall, which is easily distinguished due to the partial reduction of septa.

Septa

Septa are radial barriers, dividing a corallite cavity into interseptal spaces (loculi). Internal and upper (distal) margins of septa are distinguished. The septa of the Poritidae consist of one row of trabeculae. Typically for the Poritidae the porosity of the septa is the result of combining depressions on the surfaces of neighboring trabeculae and of fall-out of some sclerodermites (growth interval: Bendukidze and Chikovani, 1962).

The free upper ends of septal trabeculae are called septal denticles (Wells, 1956). The sizes and shapes of septal denticles in the corallites of the Poritidae vary from thin, slightly ornamented, rod-shaped denticles to irregularly branched denticles (Fig. 51, f). If a septum bears more than one denticle, then internal ones (which are close to the corallite center) are usually rod-shaped, whereas outer ones (which are placed near the wall) are irregularly shaped and thickened peripherally. In Bernard's opinion (1905), in the corallites of *Porites* all trabeculae are parallel to each other. As a result both septal and wall denticles are arranged vertically. Other researchers (Crossland, 1952; Veron and Pichon, 1982), after Vaughan (1907), consider that septal trabeculae diverge from the wall at a very acute angle. As a result septal denticles are inclined towards the corallite center. However it can be seen in tangential sections of corallite tubes (for example in *P. solida, P. australiensis, P. lobata, P. lutea, P. rus,* and *P. densa*) that septal and wall trabeculae are parallel to each other for a distance of not less than 12-15 mm of a corallite tube's length: this corresponds approximately to 10 years of living and skeletal building by a polyp. The point of merger of septal trabecula with wall trabecula was not found by the author in such sections. In any case, trabeculae remain parallel in corallite tube for a considerable length. Septal denticles are oriented vertically without an evident incline towards the corallite center (Fig. 51, f).

At the same time spike-like outgrowths, inclined towards the corallite center, are often observed along the septal margin. This may be explained in the following way. Septal trabeculae are arranged at a small distance from each other, and connected by horizontal cross connections, which are formed in points of contact between neighboring trabeculae. If internal trabeculae grow slower than outer septal trabeculae, then the free ends of horizontal connections can be seen along the septal margin. They are inclined towards the corallite center, often almost horizontal, and spike-like (*Goniopora stokesi, Porites densa*) or irregular and scale-shaped (*Porites lichen*). As a result the septal margins of many *Porites* and *Goniopora* look finely dentate as pointed out by Vaughan (1907, 1918), and Veron and Pichon (1982). Scale-shaped outgrowths inclined towards the corallite center are often visible on the wall too. A scale-shaped projection can be seen in a tangential section of a corallite to be only the initial stage of formation of a horizontal cross connection between the wall and septum. It is not the end of a septal trabecula and, therefore, is not a septal denticle. Swellings, not connected with septal trabeculae, and not being denticles, can be sometimes be found on horizontal interseptal cross connections (Fig. 52, B).

Judging by descriptions from publications, *Porites* septa can be thin, thick, tapered, etc. (Vaughan, 1907, 1918; Veron and Pichon, 1982). However, in all cases a septum is formed by one radial row of trabeculae. Depending on the degree of skeleton calcification, septal trabeculae can be thin and almost smooth, of a normal thickness, or reinforced and abundantly ornamented. In the latter case septal surfaces are almost completely covered by lateral septal granules and denticles, and septa look thick, massive, etc. In the Poritidae septa are sometimes bifurcate or trifurcate - split into two to three branches between the outer septal denticle and the wall (see Fig. 53). In this case the septum becomes wedge shaped. Septal denticles at the point of dividing are always tangentially thickened and of irregular shape (Fig. 51, f; 53). The distal septal margin of the Poritidae is more or less inclined towards the corallite center, and the corallite depth depends on it. In some species the distal septal margin is almost horizontal throughout the entire colony (*P. rus, P. cylindrica*), and the outer denticles are at the same level with the septal denticles. As a result calices are not pronounced. The same thing is observed near the growth margin of most *Porites* colonies. Near the wall septa are connected by an outer synapticular ring (see Fig. 53). This ring is often not complete. In corallites with a deep calice the ring is, as a rule, fragmentary and merges with the wall, whereas in shallow corallites it is almost complete and is away from the wall. The inner synapticular ring, in its turn, connects septa at the base of pali-like septal denticles (see Fig. 53) and can often be incomplete. No uniformity in the development of these synapticular rings, which could have been used as a feature to distinguish species, was observed. The degree of development of rings varies greatly within the same colony, and is obviously connected only with the level of skeleton calcification.

Goniopora synapticular rings, connecting septa, are numerous, and no uniformity was observed in their arrangement. In *Alveopora* synapticular rings are not developed in corallites.

Internal septal margins are fused bilaterally symmetrically according to the Pourtales plan (Fig. 54) in all *Porites* species treated here. Lateral septal pairs and the dorsal septum are always detached. The ventral septum and two neighboring septa of the second order which compose a ventral triplet of septa can have free or fused internal margins (Fig. 54). Fusion of septa of the ventral triplet is used as an important taxonomic feature of the genus *Porites* (Bernard, 1905; Vaughan, 1907, 1918; Veron and Pichon, 1982; etc.). Bernard (1905) and Veron and Pichon (1982) propose that these septa can be fused by different ways, including a horizontal cross connection between internal septal margins (Fig. 54, b). However this cross connection is often a fragment of the internal synapticular ring or a result of intergrowth of lateral surfaces of well-calcified septal trabeculae, when carinae – vertical rows of granules - are developed on their lateral surfaces. In such cases every septum of a triplet retains a complete number of trabeculae, and such a triplet probably should not be considered fused.

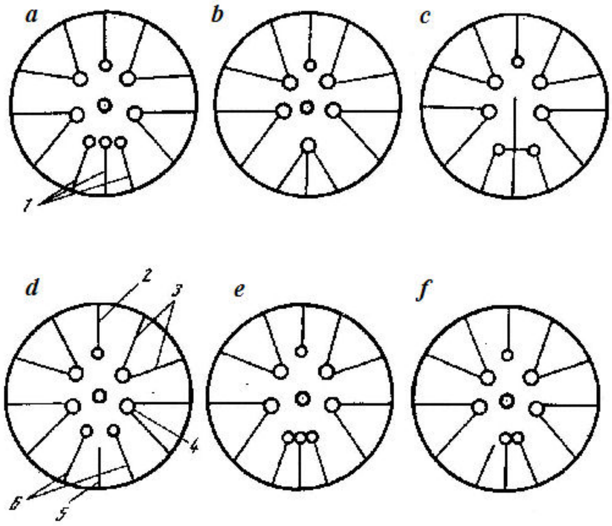


Fig. 54. Variants of association of septa at *Porites* corallites. Fused (two top on the right) and not fused triplets. By figures are designated: a – ventral triplet, b – dorsal directive septa, c – lateral pair septa, d – paliform denticle, e – ventral directive septa, f – lateral septa of triplet

It is an accepted point of view that pali are located at the internal septal margins of corallites in *Porites* – vertically arranged trabecular projections, developed between the internal septal margin and the corallite axial zone (Vaughan, 1907, 1918; Vaughan, Wells, 1943; Wells, 1956; Veron and Pichon, 1982). However, it can be clearly seen on a corallite tangential section that "pali" are not detached from the septum, and that is why they do not correspond to the definition of the term "pali", given by Vaughan and Wells (see Fig. 54). The terms "internal septal denticle" or " pali-like denticles" are preferable to consider. Such denticles differ from the neighboring denticles only by their height and diameter (Foster, 1986). The number of pali-like denticles varies in a random way. Sometimes pali-like denticles are not developed on one or more septa, including the septa of ventral triplet. Corallites with incomplete sets of pali-like denticles can be found irregularly throughout the entire colony.

Columella

The columella in *Porites* corallites is an axial structure in the form of a simple trabecula, similar in thickness to septal and wall trabeculae. The free tip of a columella can be poorly developed (in the form of a tubercle or a vesicle), or it can have the form of a rod or a lamina, granulated to various degrees (see Fig. 51, f).

Colony

The following forms of Poritid colonies are usually recognized: massive with a smooth surface, massive with protrusions at the colony base or along the entire surface, incrusting, plate-like, submassive with columnar elevations or branches; ramose or branching, branching with a flat base, irregularly branching, etc. (Bernard, 1905; Vaughan, 1907, 1918; Crossland, 1952; Veron and Pichon, 1982). Various colony forms are frequently found within the same species, for example, in *P. lichen*. Many of these forms are only variants of the main growth forms of Poritid colonies, since the development of three types of the key vertical elements – columnar protrusions, plates and branches - is connected with the shape of the growth area or conditions of living and development of a colony. It is more convenient to carry out the analysis of colony form variations taking into account growth proportions, proposed by Marfenin (1987) for the description of *Acropora* colony morphology (Fig. 55).

The initial stage for all forms is an incrusting colony, with maximal sizes which usually do not exceed several centimeters in diameter and three to five mm thick (Fig. 55, A). If vertical growth is absent, the colony remains as an incrusting colony, with a growth index which is usually close to 0 (Fig. 55, Б). An incrusting colony is usually not only the initial developmental stage, but can also the result of effect of ecological factors, for example, the lack of light (Tytlyanov et al., 1988). An incrusting colony follows the shape of substrate, for example, fouling a dead branch of *Acropora* (Fig. 55, B). When the rates of horizontal and vertical growth are comparable, a massive colony is formed, growth occurring throughout the entire surface occupied by soft tissues (Fig. 55, Г).

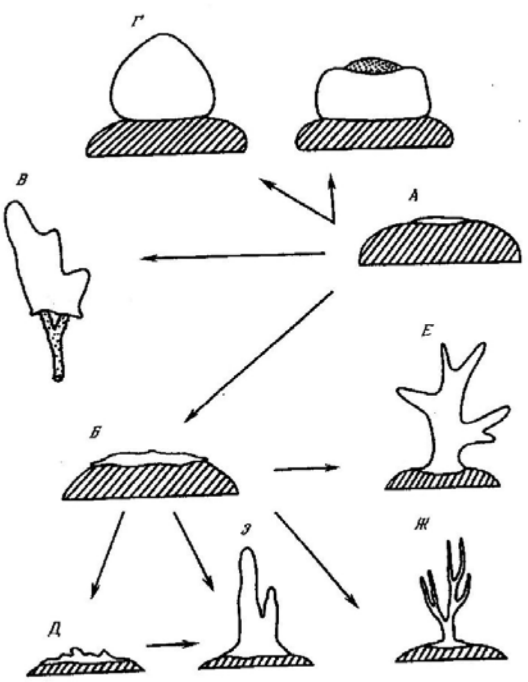


Fig. 55. Forms of poritid colonies and possible parities between them. Explanatories in the text.

As it grows, a massive colony steadily acquires a round form. Living tissue gradually dies at the periphery of a massive colony, i. e. at the place of the colony attachment to the substrate. Deposition of aragonite stops here. The colony grows only vertically and horizontally (laterally). The same thing happens with asymmetrical colonies. A so-called "microatoll" (Fig. 55, Г) is an ecotypical modification of a massive colony. In the central part of the colony soft tissues die due to the damaging effect of environmental factors at low tides (Sakai et al., 1986). Growth continues laterally and results in the formation of "microatolls" with a diameter of several meters and a height of less than one meter. Microatolls with a height of 20 cm and a diameter of 1.8 m were found at Bai Tu Long Archipelago in Vietnam by the author. The location of such colonies was confined to the intertidal reef zones – coastal channel and reef flat.

Development of vertical elements is connected to the presence of local growth zones. On an encrusting colony primary swellings are formed, then they produce laminae (from a band shaped growth zone), or columnar projections and branches (from an apical growth zone). Branches or columnar elevations can be of a different lengths due to correlation of the rates of the lateral and apical growth. Proportions of the thin columnar projections on *P. lichen* remind one branches, but they are not the same. They are chaotically divided into several unequal portions, and clear dichotomous branching is absent. Single- or multi-layered epitheca is usually formed at the base of columnar, branching, lamellar and massive Poritid colonies. This phenomenon is of environmental, not genetic nature, and is connected to the growth of colonies in sandy and silty environments (Crossland, 1952).

Variability of a Poritid corallite and the choice of taxonomically important features for inter-species diagnostics

The form and structure of corallite elements and colony are traditional diagnostic features of Scleractinian taxa of various ranks. Variations of morphological characteristics of Scleractinian are rather broad (Bernard, 1905; Vaughan, 1907, 1918; Gravier, 1911; Crossland, 1952; Veron and Pichon, 1976; Tesakov, 1978; Latypov, 1984; etc.). Poritid corals, especially *Porites*, are some of the most variable Scleractinians. It seems as if it is impossible to find two similar corallites in the same *Porites* colony. One can observe that corallites on the upper part of a colony and near its growing margin, facing the substrate, are the most different. Colony fragments of any Porites species, taken from its different parts, can be completely attributed to different species. Broad variability of characteristics have hampered taxonomic investigations of Scleractinia during the entire time they have been studied, and made Bernard (1905) abandon Linnaean nomenclature when describing the Poritidae.

Tesakov (1978) established taxa boundaries for the fossil corals called Tabulata, based on the biological concept of species and using stratigraphic population analysis and statistical methods for distinguishing species aggregates in a population. He stressed that when studying broad variations, it is better to not use absolute values of characteristics, but their proportions as coefficients, calculated in the same way for all characteristics. Two specimens, having different absolute values of characteristics, are often identical in their proportions. So, it is possible to analyze variability using simple biometrical methods, not applying multi-dimensional systems. The proposed method can be applied to extant Scleractinia, in which morphological characteristics are sufficiently stable, and which have only two to three characteristics displaying broad variability. When a great number of broadly variable characteristics are involved, apparently multidimensional systems of searching for correlations are necessary.

A. Foster (1979, 1980, 1985, 1986) investigated intra-colony and intra-species variability of a great number of quantitative and qualitative characteristics of Caribbean scleractinians. When studying the taxonomy of fossil Poritidae of the Caribbean basin, Foster (1986) first of all points out that fossil Poritidae, as well as modern ones, are characterized by the absence of discrete qualitative features and such a broad variability that it is very difficult to characterize them. Having established generic affiliation of the collected colonies by traditional qualitative and quantitative characteristics, she established the boundaries of species within these genera using a multi-dimensional statistical method. The data obtained by stratigraphy and population analysis were used with this purpose. The applied mathematical methods allowed her to compare features not separately but in a complex, to estimate the importance of separate features for species differentiation and in such a way to discuss their importance for classification.

In some cases Foster followed a traditional approach to the selection of some features for the analysis. Thus, construction of a corallite wall is used by her as a meristic characteristic "wall width" (mm), and is included in the statistical analysis with this definition together with the other features. However if we consider this feature as a qualitative one, i. e. the presence or absence of a wall reticulum (single or multiple rows of the wall), we will have a discrete qualitative characteristic of a species.

While establishing the taxonomic value of separate features, it is necessary to be guided by the following requirements.

1. Stable features are the most important for classification, especially qualitative ones, since quantitative and meristic features are more variable due to environmental conditions, and the limits of their variability often overlap in closely related species. For example, a column shape and the shape of outer denticles are highly variable features. Such features as the absence of granulation or wall configuration are stable only for some *Porites* species from the Gulf of Tonkin. However they can be used for diagnostics in combination with the other stable features.
2. Only genetically determined variability can provide material for taxonomic analysis.
3. In order to distinguish feature variability, determined by differences of genotypes, it is necessary to exclude inter-colonial variations of an ecology nature (it is necessary to compare samples collected in conditions that are more similar); to exclude intra-colonial age and pathologic variability; to exclude intra-colonial ecology variability, considering features of different colonies always in the same parts of the colony.

4. To consider quantitative and meristic features in a complex selected for analysis.

Proceeding in this way, it is possible to select taxonomically important features from the possible morphological features of *Porites* species (Table 3).

Investigating the nature of variability in Scleractinian, Zlatarsky and Estalella (1980) noted that variations on different levels can be ontogenetic, ecotypic and/or pathologic.

Intra-colonial ecotypic variability of corallites is displayed in Vietnamese Poritidae in a uniform way and affects such features as linear sizes and form of skeletal elements, and the degree of their ornamentation. On the upper part of a colony all corallite elements are vertically elongated and thinner than in the middle and lower parts (Fig. 56).

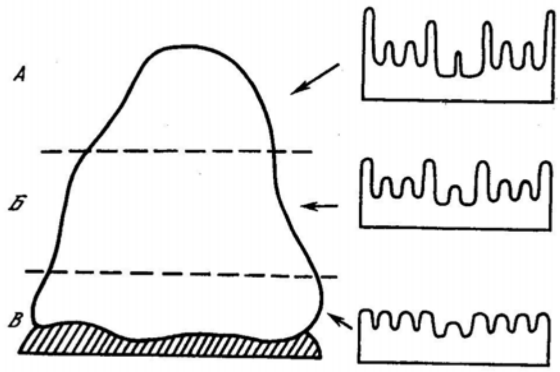


Fig. 56. Change of height and thickness of elements a *Porites* corallite in connection with its arrangement in a colony. Microhabit - A – top, Б - average, B - bottom

Thus, in *P. solida, P. australiensis,* and *P. lobata* the height of the wall, septal denticles, the columella, and the depth of the fossa located at the top of a colony are 1.2-1.8 times the same parameters of the corallites located in the middle parts of the colony, and 1.6-2.4 times the analogous parameters of the corallites from the lower parts of the same colony. Maximal intra-colony ecological variability can be observed in the lightly calcified skeleton in the upper part of the colony. Such colonies are often met on reefs, where corals are exposed to very little light, as, for example, at Bai Tu Long Archipelago. The wall and septa of lightly calcified skeleton are laminae-like, thin and often crooked. The column and denticles are transformed from rod-shaped into very thin needle-shaped or laminae-like. A columella is often absent, and synapticular rings are less developed. But horizontal meristic characteristics of a corallite (the diameter of the inner synapticular ring, the distance between the wall and outer synapticular ring, and the average length of septa) do not change. In the deeper habitats, at the margin of living tissue of a colony vertical corallite elements are shortened and, at the same time, of the maximal thickness. Colony skeleton here is the maximally calcified, and trabeculae and synapticulae diameter is maximal for given colony.

Table 3. Taxonomic importance of the main features of species of *Porites* genus from the South China Sea

Names of features	Description (by Vaughan, 1907, 1918 or Veron and Pichon, 1982)	Intra-colonial variability OG	PL	ME	Inter-colonial variability	Importance for taxonomy
Presence of coenosteum	Presence of coenosteum	--	--	--	--	Suitable as qualitative feature
Septa configuration	12 septa integrated bilaterally-symmetrically according to Pourtales plan	++	+-	--	--	Suitable as qualitative feature
Presence of lateral reinforcements of corallite structures	Scale-like reinforcements of septa, walls, outer septal denticles	++	+-	--	--	Suitable as qualitative feature
Shape of septa	Septa are bent in the plane perpendicular to the corallite axis	--	+-	--	--	Suitable as qualitative feature
Ornamentation of skeletal elements	All elements are ornamented or only some of them	++	+-	+-	--	Suitable as qualitative feature
Ventral triplet	Fused or not	+-	+-	--	--	Suitable as qualitative feature
Colony shape	Massive, encrusting, lamellar, branched	+-	--	--	++	Not suitable
Colony surface	Smooth or with projections	--	+-	+-	++	Not suitable
Presence of columella	Developed, poorly developed, absent	++	+-	--	--	Suitable as qualitative feature
Columella shape	Rod-shaped, vesicular-like, lamina	++	++	++	++	Not suitable
Wall denticle shape	Rod-shaped, flattened laterally, vague form	++	++	++	++	Not suitable
Degree of development of synapticular ring	Complete or fragmentary	++	++	+-	++	Not suitable

Pali-like denticles shape	Straight, elongated, rod-shaped, vesicular	++	++	+-	--	Suitable as qualitative feature
Correlative sizes of pali-like denticles	All denticles of equal length and thickness or the larggest located before lateral pairs	++	++	--	--	Probably suitable as meristic feature
Number of pali-like denticles	Number of pali-like denticles	++	+-	+-	+-	Not suitable
Integrity of wall	Unbroken or broken wall	++	++	+-	+-	Not suitable
Thickness of skeletal elements	Thick, massive, well developed or thin, poorly developed	++	+-	+-	+-	Probably suitable as meristic feature
Wall configuration	Straight or zigzag	+-	+-	+-	+-	Suitable as qualitative feature

Note. OG is ontogenetic variability; PL is pathologic variability; ME is ecological variability in one colony; “--" means a stable feature; “+” designates that variations of the feature are not significant; “++” means that the feature is highly variable.

Horizontal linear characteristics of corallites remain the same as in the other parts of the colony. Due to the greater thickness of trabeculae and synapticulae it often seems that the diameter of the inner synapticular ring is smaller. However denticles and corresponding trabeculae occupy their usual position. Radii that merge laterally are usually reinforced as much, forming a small area at the base of the columella. The nature and abundance of ornamentation are highly variable in a *Porites* colony. So, in the upper colony parts ornamentation (granulation) of skeletal elements is often absent in the lightly calcified skeleton, in the middle part of the colony ornamentation varies from rare tubercles to abundant needle-shaped bristles at various sites in the same colony, and in the lower microhabitats ornamentation is always abundant. In the latter case granules sometimes are so dense that they merge with each other. This gives the impression that skeletal elements are drastically reinforced and have no ornamentation. However many qualitative features do not display any intra-colony variability. These are single or multiple rows of the wall, presence of coenosteum, configuration of the ventral triplet and others.

Branching and columnar colonies retain the same pattern of corallite variability: in branching colonies the upper parts includes tips of the branches, the middle parts – its lateral surfaces, and the lower one – a branch surface facing the substrate.

The intra-colonial ecotypic variability of corallites is connected with different growth rates of the skeleton and the degree of its calcification in different parts of a colony. Environmental heterogeneity is also one of the multiple reasons for that. So it is a difficult question whether we think that just on the lateral colony surfaces (in the middle part), morphological peculiarities of a species are represented undistorted. However, for morphological analysis it is necessary to compare corallite construction in different species in order to distinguish only genotypic differences. For that it is necessary to exclude from the range of corallite variability variation of an ecological nature and to compare corallites always from the same parts of different colonies.

Ontogenetic variability of the corallites of Poritids has little affect on such features as the thickness of trabeculae and denticles and the number of rows forming the wall, but greatly affects the number of septa, denticles, and corallite sizes. Thus, in *Porites* and *Goniopora* a recently budded corallite contains two to three and four to six septa instead of 12 and 24 respectively. In such corallites a columella or inner synapticular ring is often absent and septa are shortened – they are formed by one-two trabeculae instead of three to four in *Porites* and 10-16 in *Goniopora*.

Pathologic variability of Poritid corallites is connected with the presence of cirripedia, polychaetes, or bivalve mollusks on the colony surface, and expressed in the following changes:

a) some elements are absent, and geometrical proportions of a corallite are changed. For example, a columella is not developed when drilling epibionts settle in the center of the corallite. The diameter of a inner ring in *Porites* corallites increases, and septal length and thickness of pali-like denticles decreases 1.5-2.0 times;
b) skeletal elements twist without changes in their sizes and qualitative characteristics;
c) a considerable deformation of a corallite appears up to the partial or complete transformation of it or a group of corallites into unorganized reticulum.

The fourth type of corallite variability is connected with the fact that its shape in cross section is usually asymmetric and has the form of an irregular polygon. Septa in a corallite are oriented in a random way with respect to the largest diameter. In this connection septal length varies, but the distance between their internal margin and the columella remains the same. Such variability can be called topologic. It includes also variations of the corallite size (and its elements) depending on whether it is situated on a flat area of the colony or in a depression between the branches or surface elevations, where the corallite diameter, length of septa, thickness of trabeculae and other meristic parameters decrease 1.2-2.0 times.

Can a feature, displaying variabilities of different natures, be suitable for classification under the sufficiently stable condition within a population? Yes, where inter-colonial ecological variability is not too great. It is only necessary to clear up the nature and limits of intra-colonial variability for every species. Ontogenetic, pathologic, intra-colony ecological and topologic variability, should be excluded. This will reduce the range of intra-population variability of features. Features in which this variability is small or close to zero, are stable enough and can be applied in diagnostics of species of the genus *Porites*. The same can be also applied to features, known from published papers and requiring more detailed interpretation (Tables 4, 5), from which it is also necessary to select taxonomically important features.

Table 4. Interpretation of features of Porites species from the South China Sea

Name of feature	Feature by Vaughan, 1907; Veron and Pichon, 1982	Designation and proposed interpretation
Disposition of septal margin regarding corallite wall	Septa start somewhat lower or at some distance or much lower than wall margin	HW – wall height from tips of wall denticles t the point of septa attachment
Corallite diameter	Corallite diameter	CD – mean values between minimal and max corallite diameters (through its center)
Presence of divided (bi- or trifurcated) septa	Septa are often divided, only some septa are divided	NB – number of divided septa in the corallite
Number of pali-like denticles	Number of pali-like denticles	NP – number of palomorphic denticles in corallite
Degree of development of wall denticles	Thin, thick, massive, etc.	S – diameter of wall denticles
Degree of development of septal denticles	Thin, thick, massive, etc.	SD – diameter of septal denticles
Degree of development of pali-like denticles	Well developed, poorly developed, thin, etc.	SP – diameter of pali-like denticles
Degree of development of palimiorphic denticles of other septa	denticles of lateral pairs are largest, others are less developed	DPD – diameter of the pali-like denticle of t dorsal directive septum
		DPL – diameter of pali-like denticles of the lateral ventral septum
		DPV – diameter of the pali-like denticle of th ventral directive septum
Corallite wall thickness	Wall is thick, thin, massive, with sharp margin, narrow, etc	SW – diameter of wall synapticulae (+ numbe trabeculae rows if wall is multi-row)
Thickness of septa	Septa are narrow, thin, massive, tapered, etc.	SS – diameter of septal synapticulae
Degree of development of outer synapticular ring	Well developed, massive, poorly developed, etc.	SX – diameter of synapticulae of outer synapticular ring
Degree of development of palar ring	Well developed, massive, poorly developed, etc.	SY - diameter of sunapticulae of inner synapticular ring
Degree of development of columella	Well developed, high, rod-shaped, poorly developed, granule-shaped	HC – columella height from tip to the point o radii attachment
Proportion of height of pali-like denticles and wall height*	denticles reach the level of wall margin, not reach, etc.	HPX – difference between wall height and he of pali-like denticles of lateral pair of septa
Degree of development of pali-like denticles	High, well-shaped, well developed, poorly developed, etc.	HPY – height of pali-like denticles of lateral of septa
Depth of fossa	Fossa is deep, of medium depth	HPZ – distance from pali-like denticle basis t corallite basis
Radius of inner synapticular ring**	-	L1X – distance from column to pali-like denticles of dorsal septum (to inner ring)
Distance between inner and outer synapticular rings	-	L1Y – length of dorsal septum from inner rin synapticulae to outer
Disposition of outer ring regarding wall	Outer ring is closely brought together with wall, merge, separated by space	L1Z – length of dorsal septum from outer synapticular ring to wall
Number of trabeculae forming septum	-	NT – number of trabeculae in septum, directl

		connected with septal length
Number of wall trabeculae (number of wall denticles)	-	NTW
Number of radii	-	NR
Width of interseptal loculi	Width of interseptal loculi	WI – connected with thickness of septa, duplicates SS and SD
Inclination of upper margin of septum	Septa are steeply inclined or smoothly descend to corallite basis	HW, HPZ, HPX+HPY+HPZ should be used instead
Degree of development of outer synapticular ring	Well developed, poorly developed, complete	SX parameter should be used
Degree of development of septa	Septa are well developed or short	Replace by the feature "septal length" = LX+LY+LZ
Depth of corallite	Deep, of medium depth, shallow fine, surface	Replace by sum of parameters HPX+HPY+H

Note. "-" means that a feature is not discussed in the literature; "*" - degree of development of denticles significantly varies; except for pali-like denticles of lateral pairs of septa, that is why HPX, HPY, HPZ parameters should be considered only for the latter; "**" - parameters of the rest of the septa are measured in the same way: L2X, L2Y, L2Z – septum of lateral pair, L3X, L3Y, L3Z – directive ventral septum, L4X, L4Y, L4Z – lateral ventral septum; the nature of variability of these parameters is the same as of L1X, L1Y, L1Z.

In this work, for the selection of stable quantitative and metric features a limiting value of CV=30% was accepted. For example, the length of a septum depends upon its location inside an asymmetric polygonal corallite, but variations of septal length in a large number of measurements turns out to be not too large. At the same time the length of straight sections of a polygonal wall varies so much (more than 3 times) that initially it was not considered as a possible feature. As a result, it is necessary to note that establishing the reasons for and limits of variability of a feature at all levels (corallite, part of colony, the whole colony, population, species) allows us to find stable qualitative features even in such a difficult group from taxonomic point of view as *Porites*. The conclusion about the stability of discrete quantitative features of *Porites* agrees with the opinion adopted in taxonomy earlier (Mayer, 1971). Stable quantitative and meristic features exist in recent *Porites*, but for taxonomy they must be used in a complex.

Differentiation of phenotypically similar* Porites *species by quantitative and meristic features

Porites solida, P. lobata, P. australiensis and *P. lutea* can serve as examples of species with similar morphological features. They belong to the most widely spread species of *Porites* on coral reefs. However differentiation among them and identification of collection material has always been very difficult. Corallites and colonies of these species are quite similar. Using a morphological method it is possible to specify definitions of features and easily enough to identify *P. lutea* by the presence of the fused ventral triplet of septa (Table 6). It is not possible to find qualitative features between the three other species. Differentiation by one or two quantitative or meristic features is not possible, since the limits of variability of features of these species overlap (Table 7).

Foster (1986) showed in examples of fossil Caribbean Poritidae that it is possible to differentiate the species by a complex of quantitative and meristic features. Application of methods of multi-dimensional statistical analysis allowed the author to find reliable "gaps" between groups of objects (colonies and corallites), which turned out to be disconnected in time and space by the results of stratigraphy. It permitted her to state that separate groups are different Poritid species. In the Vietnamese waters spatially isolated Poritid populations are quite unlikely. That is why it is necessary to choose features for making a decision on the taxonomic level. From the entire spectrum of variability of features it is necessary to select variation which is connected only with differences in genotypes, and then to solve the following problem: to verify the possibility of differentiating *P. solida, P. lobata,* and *P australiensis* by a complex of features, using variability which is determined by genotype differences while avoiding intra-colonial ecotypic and inter-colonial ecotypic variability. First of all the

Table 5. Selection of taxonomically important features for species of *Porites* from the South China Sea

Feature	Intra-colonial variability			Inter-colonial variability	Fitness for taxonomic analysis
	OG	PL	ME		
HW	++	21	23	28	Probably suitable as a meristic feature
CD	++	51	18	18	The same
NB	++	++	6	7	Often not suitable. Variations within microhabitats >50%
NP	++	++	7	8	Suitable as a qualitative feature. Variations in microhabitats <18%
S	++	36	19	20	Suitable as a meristic feature
SD	+-	17	13	14	The same
SP	++	21	20	24	The same
DPD	++	32	36	37	Not suitable, variations in microhabitats >46%
DPL	++	29	31	32	The same
DPV	++	34	34	34	The same
SW	++	++	12	12	Suitable as a meristic feature
SS	+-	13	18	19	The same
SX	+-	16	11	16	The same

SY	+-	12	13	14	The same
HC	67	48	61	68	Not suitable
HPX*	13	37	26	28	Suitable as a meristic feature
HPY	++	31	23	24	The same
HPZ	++	42	18	20	The same
L1X**	++	31	19	21	The same
L1Y**	++	21	24	26	The same
L1Z**	++	18	21	26	The same
NT	++	the feature is analogous to the sum of parameters LY+LZ			
NTW	41	34	29	40	Not suitable
NR	++	28	31	calculation is often impossible	The same

Note. Figures are averaged values of the coefficient of variation of the feature in *Porites* from the Gulf of Tonkin, in %; * - the degree of development of pali-like septal denticles varies highly, with the exception of those of lateral pairs of septa, which is why HPX, HPY and HPZ parameters are considered only for the latter; ** - parameters of the other septa are measures in the similar way: the figure 2 between letters means a septum of a lateral pair, figure 3 – directive ventral septa, 4 – lateral ventral septa, the character of variability is the same as in L1X, L1Y and L1Z. most stable features, suitable for statistical analysis, were selected. These features are quantitative and meristic characteristics (parameters) of corallites, designated by symbols CD, LX1, LX2, and so on (Fig. 57, Table 7). Features which are correlated with each other were not used in the analysis. Parameters, which are a linear combination of other parameters, were also excluded. For example, "corallite depth" can be presented as a sum of HPX, HPY and HPZ. But these parameters bear information not only about the corallite depth, but also about the height of pali-like denticles, the difference between the height of these denticles and the wall, and the depth of the corallite. That is why the choice was made in favor of HPX, HPY and HPZ, and the parameter "corallite depth" was not used.

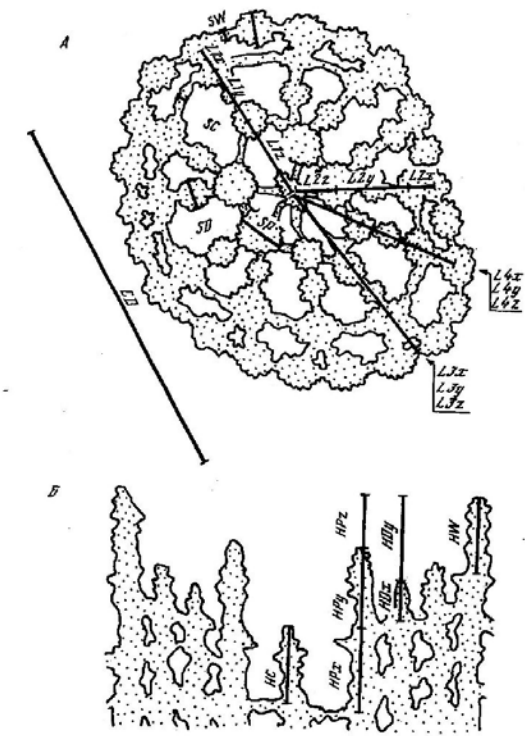


Fig. 57. Straight-line characteristics of a *Porites* corallite, the schema. A – cross-section section, B – tangential section. Explanatories in the text and in tables 3-5

Distinguishing genotypic variability.

The samples were collected from a flat area on the reef-flat of Mieu Island (Nha Trang Bay, South China Sea), which allows the exclusion inter-colonial ecotypic variability. Colonies were not older than 20 years, of a similar size and age, formed by larvae, and settled on dead colonies of other corals. All parameters were measures on the lateral surface in the middle part of each colony, i. e. within the limits of the same colony parts, which allowed us to exclude intra-colonial

Table 6. The proposed method of unification of features of Porites species from the South China Sea

Feature	*P. solida*	*P. lobata*	*P. australiensis*	*P. lutea*
Wall	Single row, straight	Single row, straight or zigzag	Single row, straight or zigzag	Single row, straight or zigzag
Ventral triplet	Not fused	Not fused	Not fused	Fused by one common trabecula
Pali-like denticles	Equal in size to the other denticles	Equal in size or slightly higher than septal denticles	Higher and thicker than septal denticles	Higher than septal denticles
Ornamentation	Weak	Abundant	Abundant	From weak to abundant

variability of features. If we exclude age and pathologic variability, the limits of variability will probably be determined only genetically. Characteristics of every coral participate in the analysis separately in order to take into account the variation of corallites within the same part of the colony. This variability can be called topological as it is connected with the irregular and asymmetric form of corallites. After the preliminary species identification of a colony (see Table 5) inter-species distinctions of CD, L1X, L1Y, …, NP parameters were interpreted using a discriminant analysis (SYSTAT 4.0, Wilkinson, 1987). Corallites of each species were given indices: *P. lobata* – “a”, *P. australiensis* – “b”, *P. solida* – “c” (Fig. 58). From the results of the one-dimensional P-test, values of L2Z, L3X, L4X, S, SY variables were excluded out of the analysis as invalid at the 5% significance level. This does not significantly reduce the classification capacity of discriminators: canonical correlations are decreased from 0.975 and 0.901 to 0.970 and 0.872 for the first and second discriminant factors respectively.

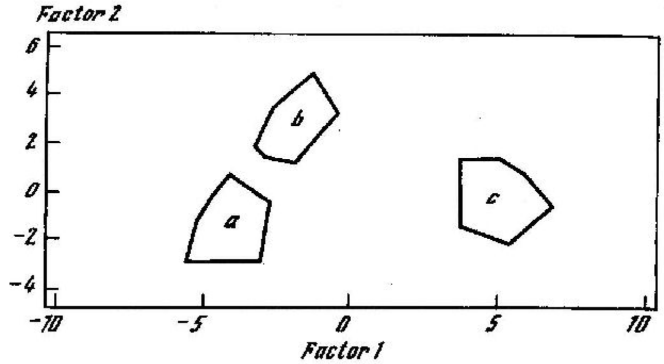


Fig. 58. Groups of colonies *Porites lobata* (a), *P. australiensis* (b), *P. solida* (c) sample from Mjeu Island, Nha Trang Bay, discriminated to attributes which variability is determined genetically

Discriminant analysis of the other variables (see Table 7) showed that the objects (corallites and colonies) were classified in closed groups, which have no overlap (Fig. 58). It confirms that all objects (corallites and colonies) were correctly identified (Klekka, 1989). Since the values of canonical correlations are high (0.970 and 0.872), both of the discriminators obtained are connected strongly with the groups of objects, and these groups are well distinguished by the selected variables. The variables L3Z, L4Z, SD, SW, and HC are of little significance for the classification of objects, whereas the variables CD, L1X, L2X, L2Y, L4Y, HPX, HPY, HPZ, HW, and NP are the most important (Table 8).

Interpretation of the obtained results.

Using this method we can reliably classify colonies of three phenotypically similar massive species of *Porites.* This is due to the fact that these methods allow us to compare samples not by just one or two features, but on the basis of a large complex of features. Since neither ecotypic, age, nor pathologic variation were considered in the analysis, the groups of objects (corallites and colonies) revealed are probably isolated genetically, i. e. these groups are species: *P. solida, P. lobata,* and *P. australiensis*.

Table 7. Characteristics of corallites (features) in *Porites* colonies, involved in the statistical analysis

Designation	Feature
CD	Mean value between maximal and minimal corallite diameter
L1x	Distance from the columella to the palus-like denticle of the dorsal septum
L1y	Length of dorsal septum from inner synapticular ring to outer synapticular ring
L1z	Length of dorsal septum from outer synapticular ring to wall
L2x	Distance from columella to palus-like denticle of lateral pair of septa
L2y	Length of septum of lateral pair from inner synapticular ring to outer ring
L2z	Length of dorsal septum from outer synapticular ring to wall
L4x	Distance from column to palus-like denticle of directive septum of ventral triplet

L4y	Length of directive septum from inner synapticular ring to outer ring
L4z	Length of directive septum from outer synapticular ring to wall
SD	Diameter of septal denticles
SP	Diameter of pali-like denticles
SW	Diameter of wall synapticulae
SX	Diameter of synapticulae of outer synapticular ring
HC	Height of columella up to the point of radii attachment
HPX	Difference between wall height and height of palus-like denticle of lateral pair of septa
HPY	Height of palus-like denticle of lateral septa pair
HPZ	Height of septum from palus-like denticle basis to corallite basis
HDX	Height of septal denticle
HDY	Difference between wall height and septal denticle height
HW	Height of wall up to the point of septum attachment
NB	Number of divided septa in corallite
NP	Number of pali-like denticles in corallite

Table 8. Mean values of meristic parameters of *Porites* corallites (Mieu Island, reef-flat) used in the discriminant analysis (1 stage) as variables.

Variables	*P. lobata*	*P. australicnsis*	*P. solida*
CD, мм	1.256 (±0.131)	1.452 (±0.101)	1.739 (±0.091)
Llx	0.233 (±0.016)	0.265 (±0.048)	0.360 (±0.030)
Lly	0.239 (±0.055)	0.221 (±0.038)	0.351 (±0.100)
Liz	0.158 (±0.057)	0.188 (±0.065)	0.274 (±0.053)
L2x	0.169 (±0.018)	0.202 (±0.041)	0.248 (±0.008)
L2y	0.308 (±0.048)	0.243 (±0.034)	0.260 (±0.022)
L2z	0.196 (±0.059)	0.210 (±0.051)	0.257 (±0.028)
L3x	0.258 (±0.025)	0.250 (±0.000)	0.250 (±0.000)
L3y	0.263 (±0.038)	0.239 (±0.063)	0.255 (±0.028)
L3z	0.162 (±0.065)	0.204 (±0.068)	0.258 (±0.041)
L4x	0.173 (±0.016)	0,184 (±0.062)	0.249 (±0.005)
L4y	0.308 (±0.061)	0.242 (±0.033)	0.244 (±0.029)
L4z	0.186 (±0.055)	0.207 (±0.057)	0.296 (±0.068)
SD	0.090 (±0.032)	0.074 (±0.019)	0.070 (±0.013)
SP	0.094 (±0.026)	0.102 (±0.032)	0.070 (±0.013)
SW	0.068 (±0.011)	0.069 (±0.019)	0.055 (±0.013)
SX	0.054 (±0.016)	0.061 (±0.023)	0.068 (±0.012)
HC	0.138 (±0.026)	0.171 (±0.030)	0.224 (±0.054)
HPX	0.130 (±0.036)	0.198 (±0.066)	0.339 (±0.042)
HPY	0.202 (±0.057)	0.231 (±0.052)	0.160 (±0.029)

HPZ	0.132 (±0.028)	0.137 (±0.086)	0.407 (±0.104)
HDX	0.115 (±0.019)	0.133 (±0.021)	0.150 (±0.025)
HDY	0.108 (±0.037)	0.110 (±0.063)	0.282 (±0.088)
HW	0.139 (±0.026)	0.205 (±0.050)	0.444 (±0.091)
NB, number	4.857 (±1.878)	3.476 (±1.806)	3.571 (±1.434)
NP	5.286 (±0.644)	6.857 (±0.910)	6.095 (±0.301)

Note. Standard deviations are given in parentheses.

The results of the discriminant analysis point to a greater phenotypic and probably genetic closeness between *P. lobata* and *P. australiensis* species than between either of them and *P. solida*. Presumably *P. lobata* and *P. australiensis* are closer to each other phylogenetically. Since the groups of *P. lobata* and *P. australiensis* are situated closely to each other in n-dimensional Euclidean space (though are not overlapping), it is possible that they are genetic morphs of the same species; or, more likely, they are discrete species descended together with *P. solida* from the same ancestor, but they diverged later than *P. solida*. Without a study of holotypes and paratypes any revision here is impossible, but application of biochemical and other taxonomic methods should clarify the status of these species.

Table 9. Importance of features (variables) for inter-species discrimination (according to the values of standardized canonical coefficients SCC and canonical loads COR)

Variables	Factor 1		Factor 2	
	SCC	COR	SCC	COR
CD	0.413	0376	-0.260	-0.051
Llx	0.161	0.230	0.069	0.096
Lly	0.255	0.152	0.105	0.094
Liz	0.051	0.200	-0.194	-0.007
L2x	-0.020	0.234	-0.390	-0.160
L2y	0.159	0.075	0.029	0.037
L2z	0.257	0.167	0.090	-0.024
L3x	-0.354	-0.064	0.387	0.207
L3y	-0.175	-0.026	0.074	0.143
L3z	-0.015	0.187	-0.174	0.047
Lx4	0.222	0Д12	0.269	-0.121
L4y	0.007	-0.115	0.371	0.220
L4z	0.032	0.235	0.146	0.157
SD	0.171	-0.102	0.007	0.048
SP	-0.325	-0.173	-0.197	-0.264
SW	-0.167	-6.077	0.286	0.100
SX	0.085	0.019	-0.170	-0.183
HC	0.328	0.204	-0.115	0.001
HPX	0.282	0.403	-0.028	-0.026

HPY	-0.010	-0.093	-0.873	-0.421
HPZ	0.375	0.468	0.347	0.209
HDX	-0.211	0.093	-0.004	-0.043
HDY	0.087	0.360	0.095	0.182
HW	0.470	0.471	-0.115	-0.141
NB	-0.090	-0.098	0.347	0.060
NP	-0.031	-0.051	-0.597	-0.245

Variables which had differences that were small for discrimination between species, can be divided into two groups. The parameters L3Z and L4Z can be placed in the first group. The parameter L2Z, which was excluded from the analysis earlier, should be added to them. Such parameters characterize a distance between an outer synapticular ring and a corallite wall (see Fig. 57). Due to the asymmetric corallite shape these parameters are subjected to random variation and vary without pronounced species-specificity. Another group of variables (SD, SW, HC) has approximately similar values for all three species (see Table 9). These variables primarily express the phenotypic closeness of these species, and that is why they contribute little to classification. The most important parameters for classification characterize the most striking features of the phenotype of each species: the corallite diameter (CD), the outer synapticular ring diameter (L2Y, L4Y) and the pali ring diameter (L2X), as well as the degree of reduction of the dorsal septum (L1X), the wall height (HW), the number of denticles (NP) and their sizes (HPX, HPY, HPZ). In order to classify the rest of the samples of this collection or any other collection, meeting the same requirements, it is possible to confine the study to just these parameters, which makes identification easier.

Both of the two discriminators function have a good connection with variables, and can be used for classification of the other samples of the collection from some other areas with similar dwelling conditions. For classification of samples from areas with different environmental conditions the obtained discriminators are not suitable, as features probably will vary more broadly due to the addition of ecotypic variation.

Variation of features, produced by genotypic differences, and inter-colonial ecotypic variation.

Additional sampling of *P. solida, P. lobata, P. australiensis* provided material: seven preliminarily identified colonies of each species were added to the available groups of samples. Additional colonies were taken from the areas which represent the greatest range of ecological conditions of *Porites* habitats in Vietnam: from cool turbid waters in the northwestern part of the Gulf of Tonkin to clear, warm waters at Katuik Island. As a result of one-dimensional F-test S, SS, SY variables were excluded from the analysis as they did not reach the 5% significance level.

Further, the discriminant analysis showed that the objects were classified in groups, corresponding to the species (Fig. 59), and 95% of corallites of *P. lobata* and *P. australiensis* were included in their own groups. The *P. solida* group was separated from other groups, while the *P. lobata* and *P. australiensis* groups overlapped slightly in the n-dimensional Euclidean space, where n is the number of variables, equal to 26 (Table 10).

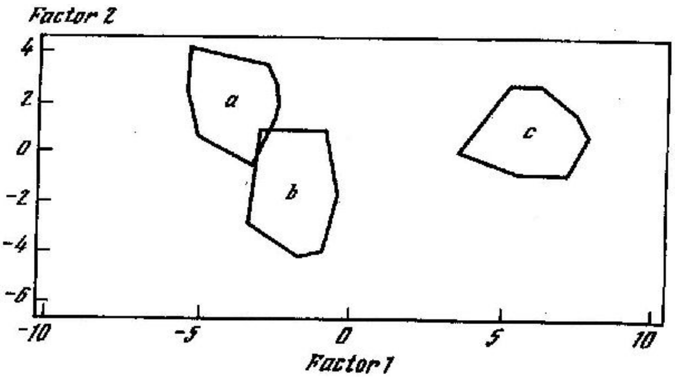


Fig. 59. Discrimination of groups colonies *Porites lobata* (a), *P. australiensis* (b), *P. solida* (c) from various areas of Vietnam.

At the same time λ-statistics of Wilks in this case is close to 0 (0.013 with a maximal value of 1.000). This means that centroids of the groups are well separated, and the degree of object dispersion within groups was small. Discrimination of groups in this case is reliable, and all variables participate in it efficiently. The value of the τ-statistics was high (0.949 with a maximal value of 1.000), and suggests correct classification in about 95% of cases for this

Table 10. Mean values (± standard deviation) of meristic parameters of corallites, used in the discriminant analysis (2 stage) as variables

Varying s	*P. lobata*	*P. australiensis*	*P. solida*
CD	1.311 (±0.147)	1.434 (±0.101)	1.781 (+0.117)
Llx	0.260 (±0.057)	0.375 (±0.048)	0.361 (±0.030)
Lly	0.256 (±0.052)	0.253 (+0.062)	0.348 (+0.080)
Liz	0.160 (±0.051)	0.184 (±0.066)	0.267 (±0.043)
L2x	0.183 (±0.028)	0.213 (±0.036)	0.249 (±0.009)
L2y	0.297 (±0.054)	0.282 (±0.062)	0.258 (±0;019)
L2z	0.175 (±0.057)	0.196 (±0.051)	0.253 (±0.023)
L3x	0.276 (±0.047)	0.247 (±0.021)	0.249 (±0.007)
L3y	0.267 (±0.039)	0.243 (±0.051)	0.251 (±0.024)
L3z	0.156 (±0.052)	0.169 (±0.084)	0.269 (±0.046)
L4y	0.313 (±0.059)	0.260 (±0.049)	0.247 (±0.027)
L4z	0.184 (±0.051)	0.177 (±0.061)	0.307 (±0.060)
SD	0.093 (±0.030)	0.084 (±0.022)	0.069 (±0.013)
SP	0.104 (±0.024)	0.121 (±0.035)	0.068 (±0.013)
SW	0.079 (±0.020)	0.068 (±0.020)	0.062 (±0.017)
SX	0.057 (±0.017)	0.072 (±0.027)	0.065 (±0.012)
HC	0.132 (±0.028)	0.149 (±0.038)	0.213 (±0.050)
HPX	0.144 (±0.041)	0.188 (±0.057)	0.330 (±0.039)
HPY	0.183 (±0.053).	0.253 (±0.058)	0.162 (±0.027)
HPZ	0.123 (±0.034)	0.135 (±0.077)	0.424 (±0.085)

HDX	0.123 (±0.019)	0.131 (±0.020)	0.143 (±0.022)
HDY	0.117 (±0.034)	0.120 (±0.051)	0.328 (±0.092)
HW	0.145 (±0.026)	0.239 (±0.071)	0.439 (±0.075)
NB	6.154 (±2.300)	5.167 (±2.844)	3.833 (±1.231)
NP	6.282 (±1.255)	7.056 (±0.826)	6.083 (±0.368)

collection. Canonical correlations have high values (0.974; 0.858), therefore the groups are well distinguished by the selected variables. The parameters CD, HPX, HPY, HDY, and HW are the most important for classification, and the parameters L1Z, L2Z, L3Z, L2Y, SD, HDX, and NB are the least important (Table 11).

Table 11. Importance of features (variables) for inter-specific discrimination of *Porites* (2 stage) according to the values of standardized canonical coefficients SCC and canonical loads COR.

Variables	Factor 1		Factor 2	
	SCC	COR	SCC	COR
CD	0.596	0.453	0.176	0.165
Llx	0.304	0.400	0.003	-0.014
Lly	0.152	0.196	0.153	-0.181
Llz	-0.112	0.214	0.035	-0.006
L2x	0.422	0.311	0.046	0.123
L2y	0.143	-0.101	-0.366	-0.379
L3z	0.188	0.169	-0.094	0.070
L4y	-0.086	-0.125	-0.494	-0.278
L4z	-0.297	0.204	0.032	-0.037
SD	-0.043	-0.080	0.080	-0.127
SP	-0.148	-0.122	0.302	0.156
SW	-0.212	-0.104	-0.081	0.086
SS	-0.128	-0.046	0.315	0.153
SX	0.334	0.079	-0.350	0.042
HC	0.006	0.231	-0.026	0.072
HPX	0.098	0.449	0.237	0.061
HPY	0.270	-0.124	0.467	0.221
HPZ	0.552	0.402	-0.329	-0.227
HDX	-0.265	0.159	0.144	0.103
HDY	-0.008	0.305	-0.056	-0.180
HW	0.430	0.540	-0.236	-0.070
NB	-0.038	-0.062	-0.307	-0.158
NP	0.068	0.068	0.697	0.532

***Interpretation of the results*.**

The introduction of inter-colonial ecotypic variation causes the values of meristic characteristics to change, and the range of their variation to widen. This is consistent with modern concepts about the effect of environmental conditions on linear characteristics of scleractinian skeletons (Foster, 1979, 1980, 1985). The increase in variation makes species distinctions more difficult, but not greatly. Groups “a” and “b” slightly overlap. Exclusion of any number of variables, even insignificant ones, will reduce the ability to distinguish species further. The increase in the variation of features increased the number of weak variables. In the first stage of the analysis the parameters L2Y and HDX did not display topological variation, only genetic variation, and that is why they remained among the most stable and species-specific features. In the second stage, with introduction of samples from different biotopes, these parameters probably mostly displayed the effects of differences in the living conditions of the colonies.

The corallite diameter (CD), height of the wall (HW), sizes of denticles and depth of fossa (HPX, HPY, HPZ) remain the most important characters as before. Now they have wider variation limits, but remain the most species-specific when considering them in a complex with the other parameters. The groups are arranged in multi-dimensional Euclidean space in such a way that a hypothesis that *P. lobata* and *P. australiensis* are phenotypically closer to each other than to *P. solida* was supported. The values of λ-statistics of Wilks, τ-statistics and canonic correlations are somewhat decreased when a greater number of samples are classified. However, these parameters are so close to perfect, that the reduction of the ability to distinguish the species will be very slight.

In conclusion it is necessary to note one more thing. The results of analysis were that 100% of the samples in the first stage and 95% of samples in the second stage were preliminarily identified correctly. Therefore, in order to identify other samples of the same species it is possible to use brief diagnostic descriptions (see Table 4), in which numerical values of the key parameters can be introduced for greater reliability. It is not necessary to use the algorithm obtained in the results for identification of new samples. Multi-dimensional discriminant analysis allowed us to reveal statistically reliable gaps between groups of colonies, identified as *P. solida, P. lobata, and P. australiensis*. Discrimination of groups by features, produced by genetic differences, becomes only slightly weaker when ecotypic variation is added. Discrimination of *P. solida, P. lobata* and *P. australiensis* is possible by quantitative and meristic features. Obviously, *P. solida, P. lobata and P. australiensis* are independent species. Morphological methods provide completely reliable results when qualitative and meristic features are used together. The results obtained can be supplemented with the results of genetic analysis, biochemical investigations and so on.

3.6.3. Family Poritidae Gray, 1842[2]

[2] We provide more detailed descriptions of Poritidae and Dendrophylliidae in connection with the revision of many morphological and taxonomic characters.

Colonial corals. The formation of colonies occurs by the way of extratentacular budding. Corallites are close together, with a small amount of coenosteum between them. The walls of corallites are formed of clearly detached trabeculae, connected by synapticulae (synapticulotheca). Septa consist of a row of vertical trabeculae, of which internal trabeculae form septal denticles. In *Alveopora* septa are reduced.

Genus *Porites* Link, 1807

Type species – *Porites polymorphus* Link, 1807 = *Madrepora porites* Pallas, 1766, in part.

Diagnosis. Colonies are massive, ramose, or encrusting. Corallites are up to 2 mm in diameter. The usual number of septa, arranged in two cycles, is 12. The ventral directive septum and lateral septa of the second cycle (ventral triplet of septa) can be fused along the internal margin. The arrangement of septa is bilaterally symmetrical. Septa consist of one to four trabeculae, and internal trabecula form a denticle. The axial structure is a columella, consisting of a single simple trabeculum.

Note. The genus *Porites* separated from *Goniopora* during the Eocene by the reduction of the 3rd cycle of septa (Bernard, 1903; Foster, 1986).

Porites solida (Forskål, 1775)

Fig. 60 - 1

Madrepora solida Forskål, 1775

Porites solida (Forskål): Klunzinger (1849, pars), Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Calices are deep, and the wall*s* are high, single-rowed, straight, and uninterrupted. Wall reticulum and coenosteum are absent. The septal arrangement is standard, uniform, and the ventral triplet is not fused. Septa are straight, without lateral extensions, normal in length, and their distal margin is almost horizontal. Pali-like denticles are equal or less in height and diameter to the other denticles. The columella is rod-shaped. Synapticular rings are fragmentary, and the fossa is deep.

Description. Colonies are massive, with a smooth surface or encrusting with elevations. Skeletal elements are moderately or abundantly ornamented with spines or needles,.

Wall denticles are moderately thick, irregularly shaped, and situated at a distance from each other which is equal or slightly less than their diameter. The wall is high. Distal septal margins are almost horizontal, and denticles are rod-shaped uniform in size. Pali-like denticles are rod-shaped or flattened, and often absent on directive septa. Septal thickness is equal or slightly less than the width of interseptal loculi, and some septa are divided at the wall. The internal margin of the dorsal septum is at a greater distance from the columella than the margins of the other septa. The fossa is deep, and the columella and palar ring are recessed. The outer synapticular ring is at some distance from the wall, and never fuses with it. The columella is slightly granulated, not high, sometimes flattened, developed in all corallites and connected with septa by three to five thin radii. Radii are never connected to each other.

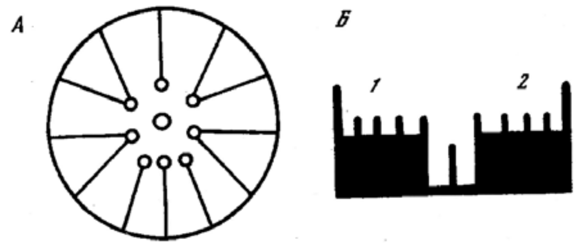


Fig. 60-1a. *Porites solida*, septal configuration (A), structure of the dorsal septum (B, 1) and septa of lateral pairs (B, 2)

Intracolonial variation. In the upper parts of a colony all corallite elements are vertically elongated, retaining their proportions. Skeleton here is weakly calcified, and elements are thin, lamellar, curved and nearly free of ornamentation, and the columella is often absent. In the lower parts of a colony the corallite depth is minimal, and the thickness of skeletal elements is retained or somewhat increased. The outer synapticular ring and septa between them and the wall are laterally extended, often fused in an unbroken ring along the wall. Proportions of the horizontal sizes of the elements, excluding manifestations of pathologic, topologic and age variation, are retained throughout the entire colony.

Similar species. *P. lobata* has weakly developed pali.

Common in various zones of the reef.

Location. Bai Tu Long Archipelago, Ze, Culao Cham, Re, Ca Thuik and Phu Quy Islands, Tien Sha Peninsula, reefs of Khanh Hoa Province, and Nam Zu Islands, depth 0-24 m.

Distribution. Tropical zone of the Indo-Pacific.

Porites lobata Dana, 1846

Fig. 60 - 2, C15 - 1

Porites lobata Dana, 1846: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. The calice is not deep, the wall is low, with a single row, straight or zigzag, uninterrupted, and in angles between corallites is often reticular. Coenosteum is absent. The septal arrangement is standard, uniform, and the ventral triplet is not fused. Septa are straight without lateral extensions, their distal margin is slightly inclined towards the corallite center. The thickness of pali-like denticles is greater than of the other septal denticles, and their height is almost the same. The column is rod-shaped. The fossa is not deep. Synapticular rings are usually fragmentary.

Description. Colonies are massive with a smooth surface or columnar projections. Skeletal elements are moderately ornamented (tubercles, spines or sparse needles). Wall trabeculae and denticles are moderately thick, and denticles are irregularly shaped or rod-shaped, often are brought together, but do not merge. The wall is not high. Distal septal margins are inclined towards the corallite center. Septal thickness is moderate or greater than the width of interseptal loculi, and some septa are divided at the wall. Septal denticles (one to four per septum, usually two to three) are vertical, rod-shaped, moderately thick and tall. The internal margin of the directive septum is at a greater distance from the columella than the other septal margins. The Palus-like denticles of lateral pairs are the largest, and palus-like denticles of the directive septum are sometimes thinner than the other denticles or absent. The fossa is not deep, and the columella is not high, but is rod-shaped, granulated in the same degree as the other elements, and rarely absent. Radii (three to six in number) are moderate in thickness, and never connect to each other. The outer synapticular ring is at some distance from the wall.

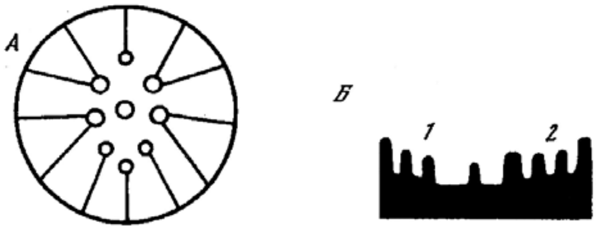


Fig. 60-2a. *Porites lobata*, septal configuration (A), structure of the dorsal septum (B, 1) and septa of lateral pairs (B, 2)

Intracolonial variation is similar to that in *P. solida*. In the lower parts of a colony the thickness of septa, walls and wall rings is often 1.5 times larger. Interseptal loculi are almost overlapped by lateral septal granules.

Similar species. *P. australiensis* is distinguished by taller pali, especially on the lateral pairs of septa.

Usualy the most common *Porites*. Frequently a dominant species of lagoons and some fringing reefs.

Location. Bai Tu Long Archipelago, Ze, Re, Culao Cham, Ca Thuik, Phu Quy, Namsu Islands, reefs of Tien Sha Peninsula and Khanh Hoa Province, depth 0-35 m.

Distribution. Tropical zone of the Indo-Pacific.

Porites australiensis Vaughan, 1918

Fig. 60 - 3, C15 - 2

Porites australiensis Vaughan, 1918: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Corallite walls are not high, have a single-row, are straight or zigzag, often reticular in angles between corallites, and uninterrupted. Coenosteum is absent. The septal arrangement is standard, uniform, and the ventral triplet is not fused. Septa are straight, without lateral extensions. Pali-like denticles are taller and thicker than the other septal denticles. The columella is rod-shaped or laminar. The fossa is not deep. Synapticular rings are usually fragmentary.

Description. Colonies are massive with smooth or tubercular surfaces. Skeletal elements are granulated moderately or abundantly with tubercles, spines or needles. Wall denticles are moderately thick, rod-shaped or irregular, or flattened, and do not fuse. The wall is high or not high. Septal thickness is equal to the width of interseptal loculi or greater, and some septa are divided at the wall. Septal denticles (one to four per septum) are vertical. Internal denticles are rod-shaped, outer ones are irregularly branching. The internal margin of directive septa is often at a greater distance from the columella than the other septa margins. The palus-like denticle of the dorsal septa is sometimes smaller than septal denticles or absent. Pali-like denticles of lateral pairs are the tallest and the thickest in comparison with the other pali-like denticles. The fossa is not deep. The outer synapticular ring is sometimes complete, and not fused with the wall. The columella can be different shapes: a granule, low rod or a plate, ornamented in the same way as the other elements, or rarely absent. There are 3-5 radii which are sometimes laterally extended and connected at the base of the fossa.

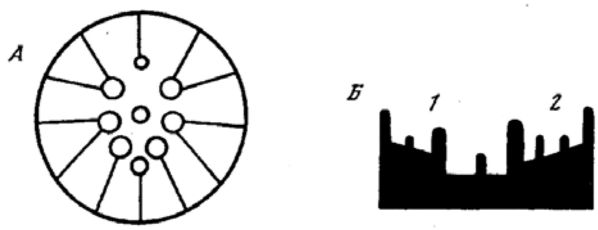


Fig. 60-3a. *Porites australiensis*, septal configuration (A), structure of the dorsal septum (B, 1) and lateral pairs of septa (B, 2)

Intracolonial variation is similar to that in *P. lobata*.

Similar species. *P. lobata* has weakly developed septa in the lateral pairs.

Common in various zones of reefs.

Location. Bai Tu Long Archipelago, Ze, Re, Culao Cham, Ca Thuik, Phu Quy and Namsu Islands, reefs of Tien Sha Peninsula and Khanh Hoa Province, depth 0-24 m.

Distribution. The tropical zone of the Indo-Pacific.

Porites lutea Edwards and Haime, 1860

Fig. 60 - 4

Porites lutea Edwards and Haime, 1860: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. The corallite wall is low, single-rowed, straight or zigzaged, and sometimes interrupted. Reticulum and coenosteum are absent. The septal arrangement is standard, uniform, and the ventral triplet is fused. Septa are straight, without lateral extensions, and their distal margin is slightly inclined towards the corallite center. Pali-like denticles are higher than the other septal denticles. The columella is a granule or rod-shaped. The outer synapticular ring is fragmentary, and the palar ring is almost not developed. The fossa is not deep.

Description. Colonies are massive with smooth or tubercular surfaces. Skeletal elements are slightly or moderately granulated (tubercles or spines). Denticles on the wall are moderately thick, irregularly shaped or flattened, sometimes are fused and in some wall areas are fused into a perforated lamina. The wall is not high. The distal septal margins is slightly inclined towards the corallite center, denticles are straight, rod-shaped or irregular, and equal-sized. Septa thickness is equal or less than the width of interseptal loculi, and some septa are divided at the wall. Internal septal margins are at a uniform distance from the columella. Only occasionally is the dorsal septal margin is farther from the column. Pali-like septal denticles are of a uniform height, rod-shaped, and usually their free ends are at the level of the tips of the wall denticles. The thickness of pali-like denticles is equal or slightly greater than the thickness of the other septal denticles. The ventral triplet is fused in more than 90% of corallites. If the triplet is not fused, then the internal margin of the directive septum of the triplet is farther from the column than margins of the other septa, or internal septal margins of the triplet are closely brought together and are at a uniform distance from the column. The fossa is not deep. The wall ring is separated from the wall. The columella is not tall, but is developed almost in all corallites, and weakly granulated. The three to five radii are never connected laterally.

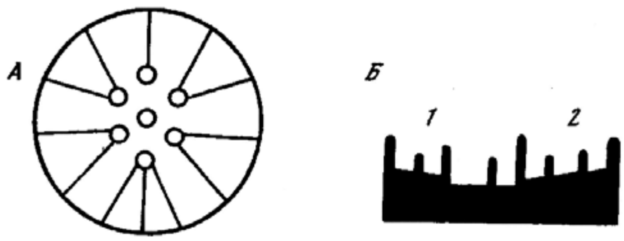


Fig. 60-4a. *Porites lutea*, septal configuration (A), the structure of the dorsal septum (B, 1) and lateral pairs of septa (B, 2)

Intracolonial variation is similar to that in *P. solida*.

Similar species. *P. australiensis* has thicker walls and five tall and three short pali.

Common in various zones of reefs. Can form monospecific stands and large colonies.

Location. Bai Tu Long Archipelago, Ze, Re, Culao Cham, Ca Thuik and Namsu Islands, reefs of Tien Sha Peninsula and Khanh Hoa Province, depth 0-24 m.

Distribution. The tropical zone of the Indo-Pacific.

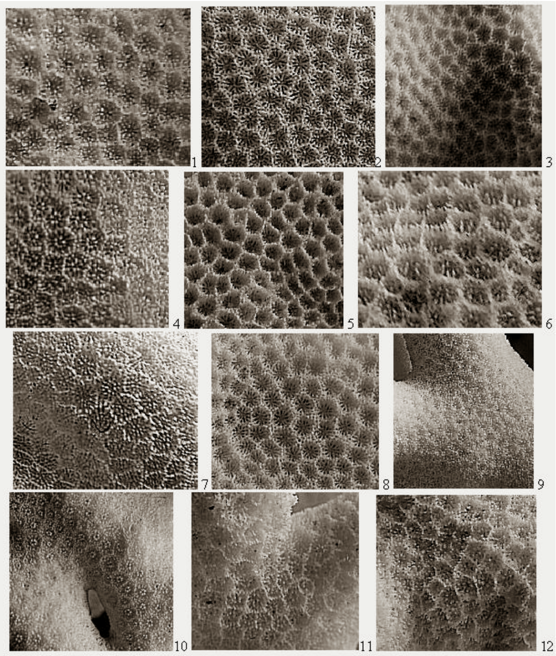


Fig. 60. Appearance of corallites. 1- *Porites solida*, spec. 1/95187, Mjeu Island; 2 – *P. lobata*, spec. 1/95188, Bai Tu Long Archipelago; 3 – *P. australiensis*, spec. 1/95189, Ze Island; 4 – *P. lutea*, spec. 1/95190, Katuik Island; 5 – *P. murraensis*, spec. 1/95191, Cham Island; 6 – *P. mayeri*, spec. 1/95192, Bai Tu Long Archipelago; 7 – *P. stephensoni*, spec. 1/95193, Thu Island; 8 – *P. densa*, spec. 1/95194, Namsu Islands; 9 – *P. cylindrica*, spec. 1/95195, Khanh Hoa Province; 10 – *P. nigrescens*, spec. 1/95196, Cham Island; 11 – *P. annae*, spec. 1/95197, Katuik Island; 12 – *P. lichen*, spec. 1/95198, Thu Island

Porites murrayensis Vaughan, 1918

Fig. 60 - 5

Porites murrayensis Vaughan, 1918: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. The corallite wall is high, single-rowed, zigzaged, and uninterrupted. Reticulum and coenosteum are absent. The septal arrangement is standard and uniform. Ventral triplets are not fused. Septa are straight, without lateral extensions, and their internal margins are at uniform distances from the columella, and the internal margins are equal or slightly less than the septal length. Distal septal margins are inclined towards the corallite center at an angle of 60-70º. Pali-like denticles are equal or absent. The columella is absent or is granule-shaped. The degree of development of the outer synapticular ring is highly variable. The palar ring is well developed and closed. The fossa is very shallow or is not pronounced.

Description. Colonies are massive, with a smooth surface. Skeletal elements are weakly ornamented with spines or the finest tubercles. Wall denticles are thin, rod-shaped, and brought together to fuse laterally, often to the point that wall perforations disappear. The wall is high. The septal denticle at the wall is short, rod-shaped, is close to the wall, and usually developed only on some septa. In well-calcified colonies outer denticles of all septa are developed and fused in a closed synapticular ring. The tips of wall denticles are situated almost at the same level with outer septa denticles in such a way that the wall looks like it has three rows. Distal septal margins are steeply inclined towards the corallite center and arranged with horizontal spike-like projections, which are free ends of cross connections between septal trabeculae. Because of the great inclination of septa, pali-like denticles begin almost at the bottom of the corallite, and the fossa is very shallow or not pronounced. Pali-like denticles are usually not developed on the dorsal septum and ventral triplet. Septa are thin, often laminae-like, and undivided. The outer synapticular ring is situated much higher than the palar ring, and does not merge with the wall. The columella is ornamented with the finest tubercles. Three to four thin radii are developed, usually not connected to each other.

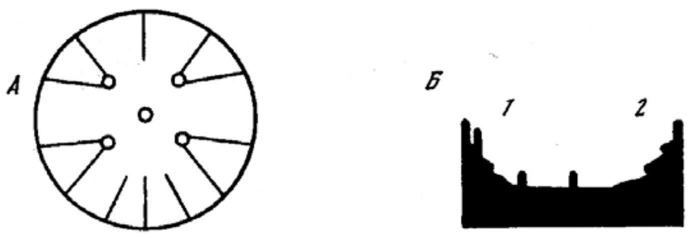


Fig. 60-5a. *Porites murrayensis*, septal configuration (A), structure of the dorsal septum (B, 1) and lateral septal pairs (B, 2)

Intracolonial variation is similar to that in *P. lobata*.

Similar species. *P. lobata* has longer septa and larger corallites. *P. stephensoni* is distinguished by its deeper corallite without a columella.

Common in various zones of reefs.

Location. Bai Tu Long Archipelago, Ze, Re, Culao Cham, Ca Thuik, Phu Quy, Namsu Islands, reefs of Tien Sha Peninsula and Khanh Hoa Province, depth 1-8 m.

Distribution. The tropical zone of the Indo-Pacific.

Porites mayeri Vaughan, 1918

Fig. 60 - 6

Porites mayeri Vaughan, 1918: Veron (1986)

Diagnosis. The wall is high, single-rowed, zigzaged, and in angles between corallites is often reticular. Coenosteum is absent. The septal arrangement is standard, uniform, and the ventral triplet is fused or unfused. Septa are straight, without lateral extensions. Pali-like denticles are several times higher than the other septal denticles. Distal septal margins are inclined towards the corallite center at an angle of 60-70º. The outer synapticular ring is complete, but the palar ring is fragmentary. The fossa is deep.

Description. Colonies are massive, with a smooth surface. Skeletal elements are slightly granulated with tubercles or rarely with spines. Wall denticles are irregularly shaped, thin, spaced at a distance equal to or greater than their diameter, and never fuse. The wall is high, and the corallite is deep. Distal septal margins are steeply inclined towards the corallite center, and the one to two denticles are of irregularly shaped, and of uniform size. Septal thickness is significantly smaller than the width of interseptal loculi, and some septa are divided at the corallite wall. Internal septal margins are at a uniform distance from the columella. Pali-like denticles are of a uniform height and rod-shaped, and usually their tips almost touch the wall margin. Pali-like denticles are thicker than the other septal denticles. The ventral triplet is not fused or is fused at the base of the deep fossa. The outer synapticular ring is at some distance from the wall and situated high in the corallite, at the base of the outer septal denticles, which in their turn are situated at the level of wall denticles, so that the wall looks like it has three rows. The columella is tall (slightly shorter than the pali-like denticles), flattened, and ungranulated. There are three to five radii, which are thin and never fuse.

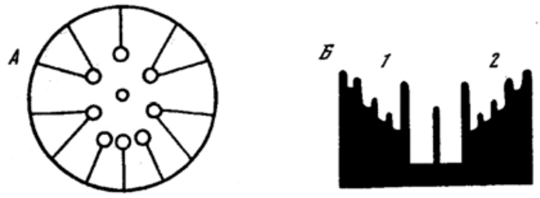


Fig. 60-6a. *Porites mayeri*, septal configuration (A), structure of the dorsal septum (B, 1) and lateral septal pairs (B, 2)

Intracolonial variation is similar to that in *P. lobata*.

It is distinguished from the similar species *P. stephensoni* and *P. murrayensis* by the deep corallite and tall columella.

Relatively common, usually on reef slopes.

Location. Bai Tu Long Archipelago, Ze, Culao Cham, Re and Phu Quy Islands, and reefs of Khanh Hoa Province, depth 2-8 m.

Distribution. The Great Barrier Reef of Australia, and Vientam.

Porites stephensoni Crossland, 1952

Fig. 60 - 7

Porites stephensoni Crossland, 1952: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. The corallite wall has a single row of denticles, and is straight, uninterrupted, and high. Reticulum and coenosteum are absent. The septal formula is standard, uniform, and the ventral triplet is not fused. The septa are straight, without lateral extensions, their internal margins are at uniform distances from the columella, and their margins are slightly shorter than their length. Distal septal margins are inclined towards the corallite center at an angle of 50-60º. Pali-like denticles of lateral pairs are rod-shaped, higher and thicker than the other septal denticles, and the pali-like denticles of the other septa are less developed or absent. The columella is a short rod or absent. The outer synapticular ring is not developed, but the palar ring is complete. The fossa is not deep.

Description. Colonies are massive, with a smooth surface. Skeletal elements are modetarely ornamented with widely spaced spines. Wall denticles are of a medium thickness, rod-shaped, often flattened and laterally fused. The wall is high. Septal denticles are situated lower than wall denticles, and the wall never looks like it has three rows. The outer denticles of septa are at some distance from the wall and developed only on some septa. Septa thickness is almost equal to the width of interseptal loculi. The wall is vestigial in approximately in 60% of corallites. Three to five thin radii are developed.

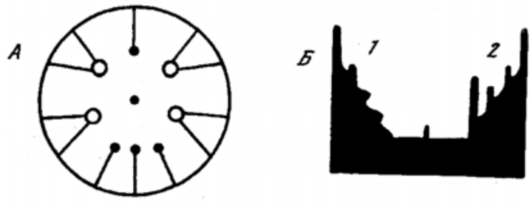


Fig. 60-7a. *Porites stephensoni*, septal configuration (A), structure of the dorsal septum (B, 1) and lateral pairs of septa (B, 2)

Intracolonial variation is similar to that in *P. solida*.

Similar species The wall in *P. mayeri* never looks like it has three rows.

Uncommon, but is found on the majority reefs.

Location. Bai Tu Long Archipelago, reefs of Tien Sha Peninsula, Culao Cham, Ca Thuik and Namsu Islands, and reefs of the Khanh Hoa Province, depth 2-6 m.

Distribution. The Philippines, the Great Barrier Reef of Australia, and Vientam.

Porites densa Vaughan, 1918

Fig. 60 - 8

Porites densa Vaughan, 1918: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. The calice is deep, the wall is of a medium depth, single-rowed, straight, and reticular in angles between corallites. The coenosteum is absent. The septal arrangement is standard, uniform, and the ventral triplet is fused. Distal septal margins are inclined towards the corallite center at an angle of 50-60º. Septa are straight, without lateral extensions, at a uniform distance from the corallite axis. Pali-like denticles as a rule are not developed. The fossa is not pronounced. The columella is in the form of a short rod or absent.

Description. Colonies are massive, with slightly pronounced prominences. Skeletal elements are ornamented with a few tubercles. Wall denticles are irregularly shaped and widely spaced or rod-shaped, flattened, and closely spaced. The wall is elevated. Outer septal denticles are situated lower than the wall denticles. The outer synapticular ring is well developed, complete, and at some distance from the wall. Septal thickness is equal to the width of interseptal loculi. Septal denticles are short, irregularly shaped, and uniform in size. The inner synapticular ring is complete, and situated at the base of inner septal denticles.

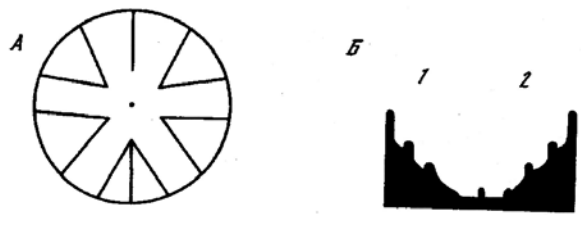


Fig. 60-8a. *Porites densa*, septal configuration (A), structure of the dorsal septum (B, 1) and lateral pairs of septa (B, 2)

Intracolonial variation. On the top of a colony wall denticles are flattened and merge laterally in a thin uninterrupted ridge. At the colony base denticles on the corallite wall are spaced at a distance equal to their diameter, and densely ornamented.

Location. Bai Tu Long Archipelago, and Namsu Islands, depth 4-12 m.

Distribution. The Great Barrier Reef of Australia, and Vientam.

Porites cylindrica Dana, 1846

Fig. 60 - 9, C15 - 5

Porites cylindrica Dana, 1846: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. The wall is low, single-rowed, straight, uninterrupted, and in angles between corallites sometimes reticular. Coenosteum is absent. The septal arrangement is standard, uniform, and the ventral triplet is fused. Septa are straight, with only small lateral extensions. Their internal margins reach almost to the columella, but the dorsal septum margin is more distant. Distal septal margins are horizontal, and all corallite denticles are of a uniform height and at the same level. The palus-like denticle of the dorsal septa is equal in thickness to the other denticles, but the pali-like denticles of the other septa are thicker. The columella is rod-shaped and short. The outer synapticular ring is complete, but the palar ring consists of short fragments. The fossa is not deep.

Description. Colonies are branching, with minor protrusions on the branch surface, with the lower branch surfaces covered with epitheca, and the branches anastomosing in different ways. Skeletal elements are abundantly ornamented with spines or dense needle-shaped bristles. Wall denticles are thick, irregularly shaped, adjacent but not fusing.

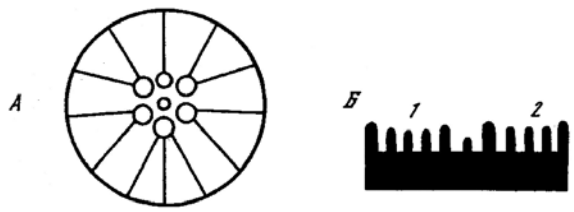


Fig. 60-9a. *Porites cylindrica* septal configuration (A), structure of the dorsal septum (B, 1) and lateral pairs of septa (B, 2)

The wall is difficult to differentiate visually because of its low height. All three to four septal denticles are of an uniform height, and often irregularly shaped. Septa are so abundantly ornamented, that interseptal loculi are almost closed. The ventral triplet has a shortened directive septum, and in approximately in 20% of corallites it is not fused. The outer synapticular ring is complete, laterally extended and is usually fused with the wall, forming a wall shelf. The columella is abundantly ornamented, sometimes flattened, and connected to the septa by two to four thin radii.

Intracolonial variation is expressed only in the increase of calcification and thickness of skeletal elements in the direction from branch tips towards bases. The greatest calcification is observed on branch surfaces facing the substrate.

Similar species *P. nigrescens* has thinner branches and a fused ventral triplet at the base of the fossa.

Common on upper reef slopes and lagoons except in the Gulf of Tonkin, and can form monospecific stands.

Location. Khanh Hoa Province, Re, Con Dao, Namsu and Ca Thuik Islands An Thoi Archipelago, depth 5-8 m.

Distribution. The tropical zone of the Indo-Pacific.

Porites nigrescens Dana, 1848

Fig. 60 - 10, C15 - 6

Porites nigrescens Dana, 1848: Veron and Pichon (1982) cum syn., Veron (1986)

Porites suppressa Crossland, 1952

Diagnosis. The wall is low, single-rowed, straight, and uninterrupted. Coenostium is absent, septa arrangement is standard, uniform, and the ventral triplet is not fused in 80% of the corallites. Septa are straight, without lateral extensions. Their internal margins reach close to the columella, but the margin of the dorsal septum is more distant. Distal septal margins are horizontal. The palus-like denticle of the dorsal septum as a rule is absent, and pali-like denticles of the other septa are considerably thicker and slightly higher than the other septal denticles. The columella is rod-shaped and short. The fossa is not pronounced.

Description. Colonies are branched, branches are thin, the lower parts of branches are covered by epitheca, and branches anastomose. Skeletal elements are abundantly ornamented with needle-like bristles. Wall denticles are thick, rod-shaped, and are adjacent but do not merge. All septal denticles are equal in length. Interseptal loculi are almost closed because of the abundant ornamentation of the septa. The ventral triplet is fused at the base of the fossa. The outer synapticular ring is well developed, as a rule it is complete, and it is close to the wall, but usually does not fuse with it.

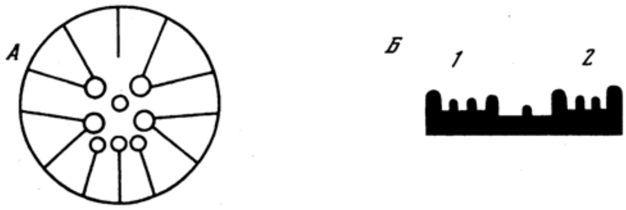


Fig. 60-10a. *Porites nigrescens*, septal configuration (A), structure of the dorsal septum (B, 1) and lateral pairs of septa (B, 2)

Intracolonial variation is similar to that in *P. cylindrica*, depth 8 m.

Similar species *P. cylindrica* has less excavated corallites, thicker branches and the ventral triplet is free.

Less common than *P. cylindrica*, can form monospecific settlements on upper reef slopes and lagoons.

Location. Culao Cham, Re, Khanh Hoa Province, Con Dao, Tho Chu, Ca Thuik, and the Spratly Isalands, and the An Thoi Archipelago, depth 2-12 m.

Distribution. The tropical zone of the Indo-Pacific.

Porites annae Crossland, 1952

Fig. 60 - 11

Porites annae Crossland, 1952: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Calices are not deep, the wall is single-rowed, straight, uninterrupted or interrupted, and reticular in angles between corallites. Coenosteum is absent. Septa are straight, often laterally widened, and their distal margins are inclined towards the corallite center at an angle of 10-15º. The septal arrangement is standard, and the ventral triplet is fused or unfused. Pali-like denticles are higher and thicker than the other denticles. The columella is usually absent. The fossa is not deep. The synapticular rings are fragmentary.

Description. Colonies are branched with encrusted bases. Branches anastomose with forming different aggregations. Skeletal elements are moderately or abundantly ornamented with spines. The wall is not high. Wall denticles are irregularly shaped, medium thickness, separated by distances less than their diameter, and do not merge. Internal septal denticles are rod-shaped, wall denticles are irregularly shaped and tangentially extended.

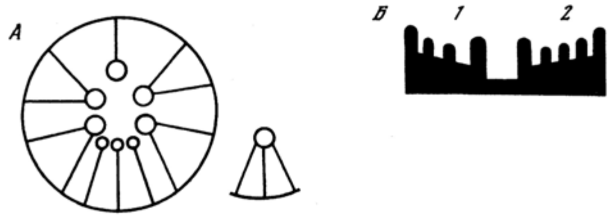


Fig. 60-11a. *Porites annae*, septal configuration (A), structure of the dorsal septum (B, 1) and lateral pairs of septa (B, 2)

The palimorphic denticles of the ventral triplet are the smallest on septa. The internal margin of the dorsal septum is usually farther from the corallite axis than the other septal margins. Fragments of the outer synapticular ring, the wall, and part of septa often merge in a wall brown, masking the division of some septa at the wall. The palar ring is sometimes complete, usually laterally extended, and forms a platform together with laterally merging radii. In 10-15% of corallites a small slightly granulated columella of irregular shape is developed in the center of this platform.

Similar species *P. lichen* is distinguished by its larger corallites.

Uncommon, found on isolated islands of South China Sea.

Location. Khanh Hoa Provonce, Re, Ca Thuik, Islands, depth 4-12 m.

Distribution. Eastern coast of Australia, and South Vietnam.

Porites lichen Dana, 1846

Fig. 60 - 12

Porites lichen Dana, 1846: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Corallite wall is single-rowed, low, uninterrupted or interrupted, zigzaged, and reticular in angles between corallites. Series of four to twelve corallites arranged in a row are separated by ridges of coenosteum. The septal arrangement is standard but variable, and the ventral triplet is usually fused. Septa are twisted and laterally extended. Their distal margins are slightly inclined towards the corallite center. All septal denticles are of a similar size and irregular shape. Synapticular rings vary in their development, and the fossa is not deep.

Description. Colonies are lamellar, encrusting, massive, and/or branched with anastomizing branches. Skeletal elements are slightly granulated with fine tubercles and widely spaced spines. Wall denticles are irregularly shaped, moderately thick, spaced at a distance not more than their diameter, and sometimes fuse. Calices are moderately deep. Septal denticles are irregularly shaped with no more than one per septum. Very often scale-shaped projections develop of the internal side of the wall, which are not denticles.

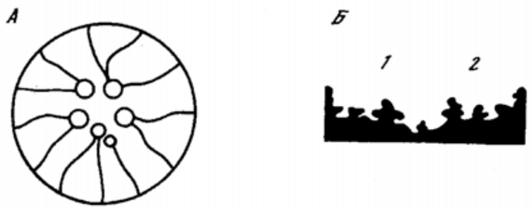


Fig. 60-12a. *Porites lichen*, septal configuration (A), structure of the dorsal septum (B, 1) and lateral pairs of septa (B, 2)

Septa are as thick or thicker than the width of interseptal loculi, and some septa are divided near the wall. Internal septal margins are at a uniform distance from the columella. The pali-like denticles of lateral pairs are usually taller and thicker than the other septal denticles, while the pali-like denticles of the other septa are equal to or smaller than septal denticles. The ventral triplet is fused in more than 40% of the corallites. The outer synapticular ring is usually complete and fuses with the wall, forming a shelf. The palar ring is fragmentary. The columella is short, irregularly shaped, and slightly granulated, but often absent. There are two to six radii which are laterally extended, and some of them fuse.

Intracolonial variation is similar to that in *P. lobata*.

Similar species *P. annae* and *P. vaughani*. Wall and calice characters are closest to *P. annae*.

Common, frequently a dominant species of lagoons and reef slopes.

Location. Bai Tu Long Archipelago, Tien Sha Peninsula, Ze, Ca Thuik and Phu Quy Islands, and the reefs of Khanh Hoa Province, depth 0-14 m.
Distribution. Tropical zone of the Indo-Pacific.

Porites vaughani Crossland, 1952

Fig. 60 - 13

Porites vaughani Crossland, 1952: Veron (1986)

Porites (Synarea) vaughani Crossland: Veron and Pichon (1982) cum syn.

Diagnosis. The corallite wall is low, straight, single- or multi-rowed, with series of corallites that are separated by ridges of coenosteum. Septa are twisted and laterally extended. The septal arrangement is standard, and the ventral triplet is usually unfused. Distal septal margins are inclined towards the corallite center at an angle of 60-70º. Pali-like denticles are uniform in size, taller and thicker than the other septal denticles. Synapticular rings are fragmentary, and the columella has a shape of a miniature tubercle or is absent. The fossa is not deep.

Description. Colonies are massive or encrusting, with a hilly surface and a multilayer epithera. Skeletal elements are ornamented with abundant spines. The wall is uninterrupted. Calices are significantly deep due to the great inclination of the septa. Wall denticles are irregularly shaped, and often flattened laterally. Septa are at a uniform distance from the corallite center and bear a single irregularly shaped (parietal) denticle, situated significantly higher than pali-like denticles.

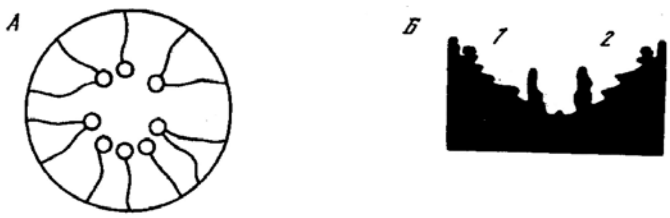


Fig. 60-13a. *Porites vaughani*, septal configuration (A), structure of the dorsal septum (B, 1) and lateral pairs of septa (B, 2)

Almost horizontal spiky projections, which are not denticles, can be seen on the distal septal margin. Septa are as thick or thicker than interseptal loculi. The ventral triplet is fused in less than 35% of the corallites. Pali-like denticles are tall, rod-shaped or irregularly shaped, and without ornamentation. Some septa divide at the wall.

Similar species *Porites annae* has the ventral triplet fused in more than 40% of its corallites.

Rare, found on isolated islands in the South China Sea.

Location. Re, Ca Thuik, Phu Quy and the Spratly Islands, depth 6-12 m.
Distribution. Eastern coast of Australia, and the South China Sea.

Porites rus (Forskål, 1775)

Fig. 60 - 14, C15 - 7

Madrepora rus Forskål, 1775

Porites rus (Forskål): Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Calices are not pronounced, and every corallite is surrounded by a reticular coenosteum. The septal formula is standard, uniform, and the ventral triplet is fused. Septa are straight, of a normal length, without lateral extensions, and distal margins are horizontal. Pali-like denticles are of a uniform height, but slightly thicker than the other septal denticles. The columella is absent or in the form of a miniature deep-seated granule. Synapticular rings are usually complete. The fossa is not deep.

Description. Colonies are massive, with elevations, often formed by secondary fouling of substrate irregularities. In such cases peripheral parts of a colony are lamellar, with epitheca. Skeletal elements are moderately ornamented. Coenosteum is regular, without elevations, and in its construction it is analogous to a multi-rowed wall. Denticles on its surface and all corallite denticles are of a uniform size and are located at the same level in such a way that a calice is usually not pronounced or has a minimal depth.

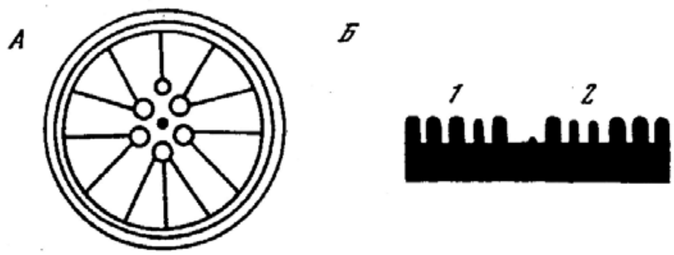


Fig. 60-14a. *Porites rus*, septal configuration (A), structure of the dorsal septum (B, 1) and lateral pairs of septa (B, 2)

Septal denticles are short, thick, and rod-shaped. Septa thickness is greater than the width of interseptal loculi. The internal margin of the dorsal septum is farther from the corallite axis than from the margin of the other septa, and sometimes it does not bear a pali-like denticle. The outer synapticular ring is at some distance from the wall, not merging with it. If a columella is absent, then radii merge with each other, forming a platform.

Intracolonial variation is minimal. In the peripheral parts of a colony the outer synapticular ring usually fuses with the wall, forming a wall shelf.

Similar species *Montipora undata* and *M. porites* can be confused with this species underwater.

Common and may be a dominant species of lagoons and upper reef slopes.

Location. Bai Tu Long Archipelago, Tien Sha Peninsula, Ze, Re and Namsu Islands, and the reefs of Khanh Hoa Province, depth 1-10 m.

Distribution. The tropical zone of the Indo-Pacific.

Porites mordax Dana, 1846

Fig. 60 - 15a

Porites mordax Dana, 1846: Vaughan (1918) cum syn.,

Diagnosis. Calices are not deep, the wall is single-rowed, straight, interrupted, and low. Reticulum and coenosteum are absent. The septa arrangement is standard, and the ventral triplet is usually fused. Septa are curved with minor lateral extensions, of a normal length, and the distal margin is slightly inclined. Pali-like denticles are a similar size or smaller than the other septal denticles. The columella is irregularly shaped, but often absent. The outer synapticular ring is complete, but the palar ring is fragmentary and curved. The fossa is not deep.

Description. Colonies are massive, with projections. Skeletal elements are not ornamented, but on septal denticles there are a few tubercles. Wall denticles are moderately thick, short, irregularly shaped, and located at a considerable distance from each other. The outer synapticulae are thick even in cases when wall denticles are reinforced. The wall in some areas is an uninterrupted low ridge. The wall of the same corallite in other places can have breaks. Distal septal margins are almost horizontal, and denticles are irregularly shaped, and not high. Septa thickness is equal or less than the width of interseptal loculi. Scale-shaped lateral extensions of septa often mask division of the septa at the wall. Septa are twisted and the distance from their internal margins to the columella varies. The outer synapticular ring is distant from the wall, but it is extended laterally and often merges with it, forming a wall shelf. Fragments of the palar ring are thin, and developed only between two to three septa. The columella is ornamented with widely spaced tubercles and connected to septa by one to three thin radii.

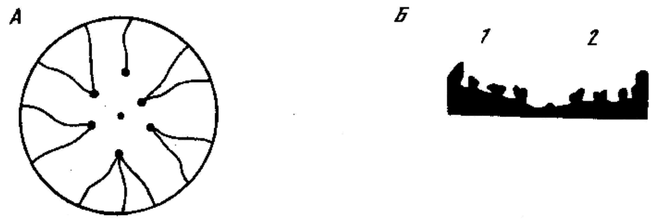


Fig. 60-15a. *Porites mordax*, septal configuration (A), structure of the dorsal septum (B, 1) and lateral pairs of septa (B, 2)

Intracolonial variation. Variations in the sizes and proportions of corallites are insignificant. On the peripheral parts of colonies, at the soft tissue margin, scale-like lateral extensions of septa and walls are more pronounced and spread from the corallite wall up to half the way to the center.

Similar species. *P. lichen* has a similar septal configuration of its corallites but is distinguished by its lamellar, encrusting, and/or branched colonies with anastomizing branches.

Rare, known only from the shallow water of the Gulfs of Tonkin and Thailand.

Location. Bai Tu Long and An Thoi Archipelagos, depth 1-8 m.

Distribution. Hawaii, and Vietnam.

Porites sp. 1

Fig. 61 - 3

Diagnosis. The calice is not deep, the wall is low, single-rowed, straight, and uninterrupted. Reticulum and coenosteum are absent. The septal arrangement is standard, uniform, and the ventral triplet is not fused. Septa are straight, without lateral extensions, of a normal length, and their distal margin is almost horizontal. Pali-like denticles are uniform in thickness, but slightly taller than the other septal denticles. The columella is rod-shaped. Synapticular rings are fragmentary. The fossa is not deep.

Description. Colonies are lamellar, with a smooth surface; a single layer of epitheca is developed. Lamina margins are often folded upwards from the substrate. Skeletal elements are moderately ornamented with spinules. Wall denticles are of a moderate thickness, rod-shaped, separated by a distance equal or slightly less than their diameter, and do not fuse. Septal denticles are rod-shaped, and of uniform size. Pali-like denticles are sometimes absent on directive septa. Septa thickness is equal or slightly greater than the width of interseptal loculi, and some septa divide at the wall. The internal margin of the dorsal septum and sometimes of the directive septum of the triplet are farther from the columella than the margins of the other septa. The outer synapticular ring is separated from the wall and never merges with it. The columella is slightly granulated, rod-shaped, not high, developed in all corallites and connected with septa by three to five thin radii which never fuse with each other.

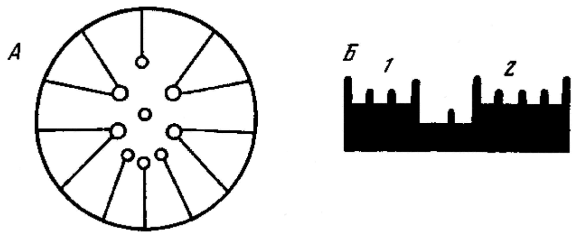


Fig. 61-5a. *Porites* sp. 1, septal configuration (A), structure of the dorsal septum (B, 1) andd lateral pairs of septa (B, 2)

Intracolonial variation is minimal. Areas of weakly calcified skeleton were not observed.

Note. This species is closest to *P. lobata* forma *centralis* Vaughan, 1907. The latter species is distinguished by the fact that the margins of its lamellar colonies are folded downwards, and secondary folding, accompanied by formation of multi-layer epitheca, is observed. In addition, corallites of *P. lobata* f. *centralis* often have a complete outer synapticular ring, and septa are composed of two trabeculae. Similarly shaped colonies of *P. discoidea* Studer, 1901 and *P. shauinslandi* Studer, 1901 differ in the configuration of the ventral triplet and the steep slope of septa towards the floor of the calice.

Location. Re Island, depth 8 m.

Distribution. South Vietnam.

Porites sp. 2

Fig. 61 - 3a

Diagnosis. Calices are moderately deep, the wall is high, single-rowed, straight, sometimes with gaps, and reticular in angles between corallites. The septal arrangement varies. Septa are curved, laterally extended, and the distal margins are slightly inclined. Pali-like denticles are equal in height or higher than the other septal denticles. The columella is irregularly shaped, and often absent. The outer synapticular ring is complete, and the palar ring is fragmentary and twisted. The fossa is not deep.

Description. Colonies are branched, branches anastomose with the formation of various aggregates. Skeletal elements are ornamented with widely spaced tubercles. Wall denticles are high, compressed, medium thick, adjacent, and often merge laterally, forming a high sharp imperferate ridge. Due to the large diameter corallites and slight inclination of septa, calices appear shallow. Septa thickness is equal or more than the width of interseptal loculi. The one to two septal denticles are irregularly shaped and short. Scale-shaped projections, which are not denticles, can be often seen on the wall. Internal septal margins are at uniform distances from the columella, except for the dorsal septum. The ventral triplet is fused in more than 50% of the corallites. The fossa is moderately deep and indefinite shape. The outer synapticular ring is usually complete and often fuses with the wall, forming a wall shelf. The columella is short, irregularly shaped, almost unornamented, and absent in more than 30% of the corallites. The two to four radii are laterally extended, and some fuse with each other.

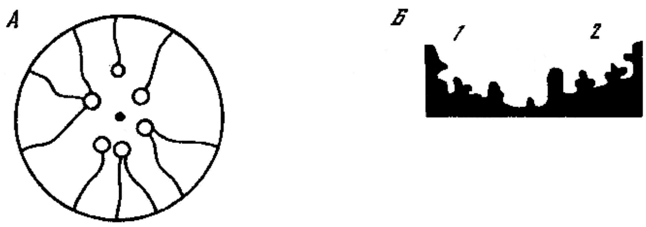


Fig. 61-3a. *Porites* sp. 2, septal configuration (A), structure of the dorsal septum (B, 1) and lateral pairs of septa (B, 2)

Intracolonial variation is similar to that in *P. lobata*.

Note. This specimen was previously identified as *Porites limosa* Dana, 1846 (Latypov and Dautova, 1996). Additional study of the morphology of branched *Porites* species from South China Sea will be required, with more field work and additional specimens collected.

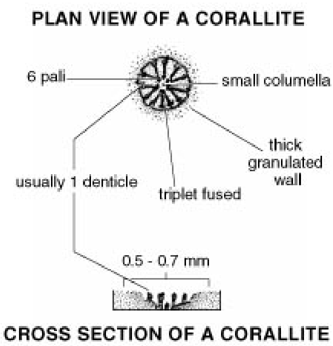
Location. Bai Tu Long Archipelago, Ze, Ca Thuik and Phu Quy Islands, Tien Sha Peninsula, and reefs of Khanh Hoa Province, depth 6 m.

Distribution. Hawaii and Vietnam.

Porites monticulosa Dana, 1846[3]

Fig. C15 - 4

Description. Colonies are massive, columnar, laminar, branching or encrusting and are usually less than one metre across. They are commonly mixtures of these growth-forms. Corallites are separated into groups by ridges.



Colour. Usually brown or blue.

Similar species *Porites rus* tends to form branches whereas *P. monticulosa* tends to be massive or form plates.

Known from South Vietnam.

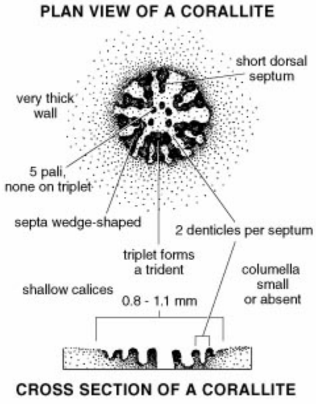
Location. Reefs of Khanh Hoa Province, depth 10 m.

Distribution. Common in the Indo-Pacific.

Porites deformis Nemenzo, 1955

Fig. C15 - 3

Description. Colonies are thin basal laminae and nodular branches that fuse into clumps. Branches anastomose with the formation of different aggregations. Corallites are superficial and branch surfaces are smooth. Skeletal elements are moderately or abundantly ornamented with spines. The wall is not high. Wall denticles are of an irregular shape, medium thickness, situated at a distance less than their diameter, and do not merge. Paliomorphic denticles of the ventral triplet are smaller than on other septa. The internal margin of the dorsal septum is usually farther from the corallite axis than the other septa margins are. Tentacles are sometimes extended during the day.



[3] The description and figures of three following species are resulted in part on Veron, 2000

Colour usualy pale brown.

Similar species. Corallites are similar to those of *P. rus*, which is distinguished by its more branched colonies.

Uncommon, usually on reef slopes.

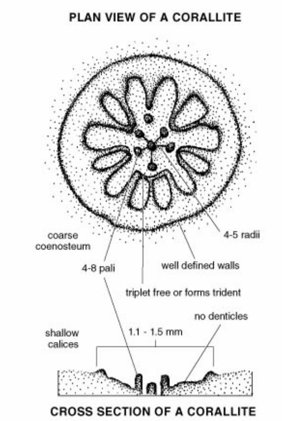
Location. Reefs of Khanh Hoa Province, and the Spratly Islands, depth 6-10 m.

Distribution. Uncommon in the South-Western Pacific.

Porites attenuata Nemenzo, 1955

Fig. C18 - 5

Description. Colonies are sturdy fused branches with rounded tips. Corallites are moderately excavated. The coenosteum is coarse. Skeletal elements are abundantly ornamented with needle-like bristles. Wall denticles are thick, rod-shaped, and are adjacent but do not fuse. All septal denticles are uniform in length. Interseptal loculi are almost closed because of abundant ornamentation on the septa. The ventral triplet is fused at the base of the fossa. The outer synapticular ring is well developed, and as a rule it is complete, close to the wall, but not often fusing with it.



The color usually mustard or bright yellow-green, also pale brown.

Similar species. *P. cylindrica* has finer branches and less excavated corallites.

Relatively common at South Vietnam, usually on reef slopes.

Location. Reefs of Khanh Hoa Province, Con Dao and the Spratly Islands, depth 4-12 m.

Distribution. Common in the South-Western Pacific.

Genus *Goniopora* de Blainville, 1830

Type species – *Goniopora pedunculata* Quoy and Gaimard, 1833.

Diagnosis: Colonies are massive or encrusting. Corallite diameter is more than 2 mm. The number of septa sometimes varies, but is usually 24, arranged in three cycles. Septa consist of more than three trabeculae, and on the internal trabecula a pali-like denticle can develop. The axial structure is filled columella.

Goniopora stokesi Edwards and Haime, 1851

Fig. 61 - 4

Goniopora stokesi Edward and Haime, 1851: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Calices are deep (3-6 mm). The spongy columella is wide, and occupies from 0.5 to 0.75 of the corallite diameter. Septa are fused according to the standard model. Pali-like denticles are not developed.

Description. Colonies are massive, with multi-layer epitheca. A high (3-5 mm) and thick (1.5-2.5 mm) wall in combination with a large corallite diameter (3-6 mm) allows this species to be easily distinguished from the other Vietnamese *Goniopora*. Colonies which are engaging in asexual reproduction by producing polyp balls, have even smaller corallites (2-3 mm diameter) with thinner (1 mm) and lower (1-3 mm) walls. However, such corallites also have a wide spongy columella with a flat distal surface, occupying almost the entire calice floor.

Intracolonial ecotypical variation of corallite sizes and elements is minor.

Similar species *G. lobata* has thicker walls, which as a rule consists of one row of trabeculae, and longer septa.

Common, may be a dominant species and form large stands.

Location. Bai Tu Long Archipelago, Ze, Re, Culao Cham, Ca Thuik, Phu Quy and Namsu Islands, reefs of Tien Sha Peninsula and Khanh Hoa Province**,** depth 2-18 m.

Distribution. The tropical zone of the Indo-Pacific.

Goniopora lobata Edwards and Haime, 1860

Fig. 61 - 5, C17 - 3

Goniopora lobata Edwards and Haime, 1860: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Calices are deep (2-3.5 mm). Septa are arranged in 3 cycles and fused according to the standard model. Pali-like denticles are not developed. The columella occupies up to 0.5 of a calice diameter, and is not divided into fragments.

Description. Colonies are massive, without projections on the surface, and with multi-layer epitheca. Corallite diameters are not more than 4 mm, and the wall height is not less than 3 mm. The thickness of walls, septa, and pali varies little. The wall as a rule consists of one row of trabeculae, which are 1 mm thick on the average. Septa steeply fall to the floor of the fossa and are ornamented along the margin with short spines inclined towards the corallite center. Wall denticles are not developed. Septa of the first cycle are long and almost reach the corallite axis, whereas septa of the second and third cycles are very short – in a form of vertical dentate ridges. Skeletal elements are moderately ornamented with fine tubercles.

Intracolonial variation is insignificant, on different colony sides a medium corallite diameter may differ by a factor of 1.5 times.

Similar species. *G. columna* has large columellae and septa are different lengths within one corallite. *G. stokesi* has high ragged walls and broad columellae.

Common, may be a dominant species which forms large stands.

Location. Bai Tu Long Archipelago, Ze, Re, Culao Cham, Ca Thuik, Phu Quy and Namsu Islands, reefs of Tien Sha Peninsula and Khanh Hoa Province, depth 2-16 m.

Distribution. The tropical zone of the Indo-Pacific.

Goniopora stutchburyi Wells, 1955

Fig. 61 - 6

Goniopora stutchburyi Wells, 1955: Searle (1956), Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Calices are shallow and up to 1.1 mm deep. Septa are fused into three to six groups with a varying number of septa in each group. Pali-like denticles are not developed. The columella is made of one to two trabeculae.

Description. Colonies are massive, with a single-layer of epitheca. Corallite diameter is not more than 5 mm. The wall is single-rowed, it is at least 1 mm thick. Wall denticles are short, irregularly shaped, and densely ornamented with fine tubercles. The corallite wall is not elevated above the septa, and outer septal denticles are situated practically at the same level as the wall denticles. Septa descend very declivous to the corallite floor, whereas septal trabeculae are well developed and end as septal denticles of irregular shape, ornamented by fine spines. Internal septal denticles in some corallites are higher than the other septal denticles, but usually all septal denticles are of a similar size. Septa are long and almost reach the columella, which consists of a short rod or a granule of irregular shape.

Intracolonial variation is not pronounced, probably because of small colony sizes.

Similar species. *G. djiboutensis* has only massive, round colonies without projections on the surface. Could be confused with *Porites*.

Relatively common. Reef slope and lagoon.

Location. Bai Tu Long Archipelago, Tien Sha Peninsula, Ze, Ca Thuik and Namsu Islands, depth 4-8 m.

Distribution. India, Malaysia, the western coast of Australia, and the South China Sea.

Goniopora tenuidens Quelch, 1886

Fig. 61 - 7

Rhodaria tenuidens Quelch, 1886

Goniopora tenuidens (Quelch): Vaughan (1918), Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Calices are moderately deep (2-3 mm). Septa are arranged in two to three cycles, and the standard model of fusion is not pronounced. The columella is spongy and on the calice floor it extends for less than half of a corallite diameter. Three to six pali-like denticles are developed.

Description. Colonies are massive, with multi-layered epitheca. Corallite diameter is not more than 3.2 mm. Wall height not less than 3 mm. The thickness of wall, septa, and pali varies. In well calcified colonies wall thickness reaches 2 mm, otherwise it is less than 1 mm. Wall denticles are short, irregularly shaped, and densely ornamented with fine tubercles. The corallite wall is elevated over the septa by 1-2 mm and consists of one to three, but usually two rows of trabeculae. Septa fall steeply to the corallite floor, and septal trabeculae are not high. As a result on the corallite wall only rows of short spiky projections can be seen, and the wall seems very high. Pali-like denticles are always thicker than septal denticles and rise over their margin and the columella surface. The first two cycles of septa reach the corallite axis, and the third cycle of septa are very short and are in the form of vertical dentated ridges. Septal denticles are short, straight, rod-shaped, and moderately ornamented with fine tubercles.

Intracolonial variation is expressed in the fact that corallite elements at the colony periphery are thicker (approximately 1.25-1.5 times), and the corallite diameter is not changed. The wall is lower and less perforated at the colony periphery.

Similar species. *G. norfolkensis* has no paliform lobes.

Uncommon, known in lagoons and upper reef slopes.

Location.Bai Tu Long Archipelago, Tien Sha Peninsula, Ze, Re, and Namsu Islands, depth 6-8 m.

Distribution. The tropical zone of the Indo-Pacific.

Goniopora pandoraensis Veron and Pichon 1982

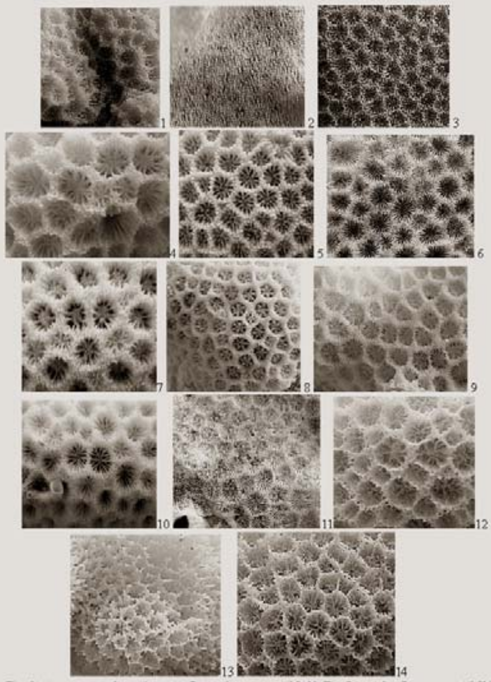


Fig. 61. Appearance of corallites 1 – *P. vaughani*, spec. 1/95199, Thu Island; 2 – *P. rus*, spec. 1/95200, Mjeu Island; 3 – *P.* species 1; 4 – *Goniopora stokesi*, spec. 1/95204, Cham Island; 5 – *G.lobata*, spec. 1/95205, Ze Island; 6 – *G. stutchburyi*, spec. 1/95206, Bai Tu Long Archipelago; 7 - *G. tenuidens*, spec. 1/95207, Ze Island; 8 – *G. pandoraensis*, spec. 1/95208, Ze Island; 9 – *G. fruticosa*, spec. 1/95209, Ze Island; 10 – *G. columna*, spec. 1/95210, Thu Island; 11 – *G. djiboutiensis*, spec. 1/95211, Thu Island; 12 – *Alveopora allingi*, spec. 1/95212, Bai Tu Long Archipelago; 13 – *A. marionensis*, spec. 1/95214, An Thoi Archipelago; 14 – *A. verrilliana*, spec. 1/95213, Re Island

Fig. 61 - 8

Diagnosis. Calices are moderately deep (1-2.5 mm). Septa are arranged in two orders. six palomorphic denticles are developed. The columella is rod-shaped or flattened.

Description. Colonies are massive, round, without protrusions on the surface, not more than 10 cm in diameter. As a rule the corallite wall is single-rowed, only in angles between corallites it becomes reticular. The wall is very low, and septa almost reach its upper margin. The distal septal margin is inclined towards the base of the calice at an angle of not more than 45º. Septal trabeculae are not tall, which is why a row of subhorizontal spines, being free ends of cross connections between septal trabeculae, can be often observed along the septal margin. Palimorphic denticles are well developed, rod-shaped, and ornamented by fine tubercles. Skeletal elements are sparsely ornamented by fine tubercles or spines.

Intracolonial variation. Corallite sizes within a colony vary not more than two to one. The thickness of skeletal elements varies slightly. At the growth margin of a colony near the epitheca, corallite depth becomes minimal, and the thickness of skeletal elements varies little.

Similar species *G. columna* has larger columns and larger corallites.

Rare, usually on reef slopes.

Location. Ze, Re and Namsu Islands, depth 4-8 m.

Distribution. The Great Barrier Reef of Australia, and Vietnam.

Goniopora fruticosa Saville-Kent, 1893

Fig. 61 - 9

Goniopora fruticosa Saville-Kent, 1893: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Calices are not deep (1.5-2.5 mm). Septa are arranged in two orders. Six pali-like denticles are developed. The columnella is rod-shaped.

Description. Colonies with projections on the surface. Projections are irregular in shape, twisted, dichotomously dividing as they grow, with thickness of 0.8-2 cm. The colony base encrusts the substrate, following its shape. Multi-layer epitheca is developed. The corallite wall is low, and septa begin almost at its upper margin. Wall denticles are irregularly shaped, twisted, and short. Septa fall straight to the floor of the calice, and subhorizontal spines, being free ends of cross connections between septal trabeculae, can be observed along the septal margin.

Intracolonial variation. The height of a corallite wall is maximal at the projection tips. At the base of the colony the height of a corallite wall is less than 1 mm. Corallite outlines on the surface of projections are oval, whereas at the colony base they are round.

Distinguished from *G. stuchbury* which has somewhat similar corallites by irregularly shaped projections on the colony surface.

Rare.

Location. Ze Island and Tien Sha Peninsula, depth 7-8 m.

Distribution. The Great Barrier Reef of Australia, Malaysia, and the South-China Sea.

Goniopora columna Dana, 1846

Fig. 61 - 10, C15 - 8

Goniopora columna Dana, 1846: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Calices are deep (2-6 mm). Septa are not arranged in cycles or orders, and are different lengths within a single corallite. Pali-like denticles are not developed. The columella is spongy, not divided into fragments, and with a width of 0.5-0.75 calice diameter.

Description. Colonies are massive and round. Corallite diameters are 3-4 mm. Skeletal elements are moderately ornamented with fine tubercles. The corallite wall is 2-3.5 mm high, consists of two to three rows of trabeculae, and wall denticles are rod-shaped and twisted. Septal length varies depending the columella width, their margin is steeply inclined towards the calice base and is ornamented by spiky excrescences. One to two layers of epitheca are developed.

Intracolonial variation. The thickness of corallite elements varies depending on the degree of skeleton calcification. At the top of a colony corallites have their maximal depth, and the wall and septa are thinner than in corallites near the growth margin of the colony.

Similar species. See *G. stokesi* and *G. lobata*.

Common, can form single species stands.

Location. Bai Tu Long Archipelago, Tien Sha Peninsula, Ze, Culao Cham, Ca Thuik, Phu Quy and Namsu Islands**,** depth 2-14 m.

Distribution. Tropical zone of the Indo-Pacific.

Goniopora djiboutiensis Vaughan, 1907

Fig. 61 - 11

Goniopora djiboutiensis Vaughan, 1907: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Calices are moderately deep (1.5-2.5 mm). Septa are fused according to the standard model, uniform in size, and short (approximately 0.5 of a calice radius). Pali-like denticles are not developed. The columella is spongy, with a width up to 0.5 of a calice diameter.

Description. Colonies are massive, round, without projections on the surface, 10-25 cm in diameter. Corallite walls consist of two to three rows of trabeculae, and wall denticles are in the form of spines and tubercles. Walls are very low, since septa diverge from their upper margin and fall steeply towards the base of the calice. Septal denticles are absent, and the septal margin is ornamented by spiny projections. Skeletal elements are ornamented with fine spines. Pali-like denticles are completely absent. The growth margin of a colony is elevated above the substrate, lamellar, and ornamented by multi-layer epitheca from below.

Intracolonial variation is expressed only in a reduction of calice depth at the growth margin of a colony.

Similar species. *G. columna* has large oral cones but is distinguished by septa not being arranged in cycles or orders.

Common in various reef zones.

Location. Phu Quy and Namsu Islands**,** depth 2-18 m.

Distribution. Tropical zone of the Indo-Pacific.

Genus *Alveopora* de Blainville, 1830

Type species. *Madrepora daedalea* Forskål, 1775; s.d. Wells (1936).

Diagnosis. Massive colonies, columnar, encrusting. Corallite diameter more than 2 mm. Septa reduced to subhorizontal thin rods, and septal trabeculae almost undeveloped. Columella absent.

Note. The internal ends of septal rods form an interlacing network along the corallite axis, reminding one in appearance of a spongy columella.

Alveopora allingi Hoffmeister, 1925

Fig. 61 - 12

Alveopora allingi Hoffmeister, 1925: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Corallite diameter three to six mm. Single-rowed wall, highly perforated. Coenosteum absent. First cycle septa interlace at their ends, often forming columellae of different widths. Second cycle septa reach half of a corallite radius.

Description. Massive colonies with multi-layer epitheca at their base. Skeletal elements are not ornamented. Wall denticles are rod-shaped, often twisted in the plane of the wall, and moderately thick. Wall trabeculae are almost twice as thick as the other skeletal elements of a corallite and are significantly twisted in the plane of the wall. Walls are high (0.5-0.75 mm). At the colony margin, near the epitheca, the wall is low (0.2-0.25 mm). Sepa are composed of rods which are thin, twisted, and their internal free ends are bent upwards. Intracolonial variation of wall and septal thickness and columella width are minimal. Corallite diameter varies somewhat.

Similar species *A. catalai* has branching colonies and larger corallites.

Usually uncommon, mainly on reef slopes.

Location. Bai Tu Long Archipelago, Ca Thuik, Phu Quy and Namsu Islands, depth 4-12 m.

Distribution. Eastern Australia, Samoa, the Philippines, Maldives, and Vietnam.

Alveopora marionensis Veron and Pichon, 1982

Fig. 61 - 13

Alveopora marionensis Veron and Pichon, 1982: Veron (1986)

Diagnosis. Corallites have a diameter of 2-3 mm. Walls are single-rowed, and moderately perforated. Coenosteum is absent. First cycle septa (a set of six) are as short as half of a corallite radius in the upper part of the calice, but in the deeper part of a calice, at the distance of 2-3 mm from the wall margin, they become longer and are fused on their internal ends, but do not interlace. The columella is not pronounced. Second cycle septa are always short, up to 0.5 corallite radius.

Description. Colonies are massive and round. On the wall margin, free ends of wall trabeculae – wall denticles – can be seen. They are short, rod-shaped, and almost straight. Wall trabeculae are slightly thicker than the other skeletal elements, and insignificantly twisted. Septa are composed of rods which are subhorizontal and almost untwisted. Their internal ends are not bent upwards. Ornamentation of skeletal elements is absent. A multi-layered epitheca is developed at the colony growth margin.

Intracolonial variability is insignificant, only corallite sizes vary, not more than two to one.

Similar species *A. verrilliana* is columnar, producing several knob-shaped projections fused at a common colony base. Polyp shapes and colors are distinctive.

Rare.

Location. Tien Sha Peninsula, Ze Island, and the reefs of Khanh Hoa Province, depth 2-8 m.

Distribution. The Great Barrier Reef of Australia, and Vietnam.

Alveopora verrilliana Dana, 1872

Fig. 61 - 14

Alveopora verrilliana Dana, 1872: Veron and Pichon (1982) cum syn., Veron (1986)

Diagnosis. Corallite diameters are 1.5-2 mm. The wall is single-rowed, highly perforated, and with a dentate margin. Coenosteum is absent. Septa are short (0.25-0.75 corallite radius), and their number varies. In the depth of a calice at the distance of 2 mm from the calice margin some septa are elongated and fused by their internal margins. The columella is not pronounced.

Description. Colonies are not large: up to 10 cm diameter, columnar, with several knob-shaped projections fused at a common colony base. A multi-layered epitheca can be seen near the growth margins of a colony. Ornamentation of skeletal elements is absent. The margin of a corallite wall is dentate, since free ends of wall trabeculae are seen. Wall denticles are rod-shaped, straight or slightly twisted. Synapticulae and trabeculae of corallite walls are uniform in thickness.

Intracolonial variation is connected with the arrangement of corallites on the colony surface. Corallites, situated in depressions between branches, are slightly smaller in diameter and oval shaped.

Similar species *A. fenestrata* is distinguished by its growth-form and larger corallites.

Usually uncommon, mainly on reef slopes.

Location. Tien Sha Peninsula, and Re Island**,** depth 6-8 m.

Distribution. Hawaii, the Great Barrier Reef of Australia, and Vietnam.

3.7. Dendrophylliidae

The corals, described in this Chapter of the monograph, are assigned to Dendrophyliidae and known under the name “turbinarians”. Due to their large corallites and mainly funnel-shaped colony form, they are easily recognized either under water or in collections. Turbinarians are usually found in the medium to deep parts of a reef slope, though they can be found in all reef zones. Having large beautiful corallites with a large number of tentacles, and forming very large colonies, they make colorful living flowerbeds in the twilight zone of a reef slope among other scleractinians, which spread their tentacles only at night. Unlike most other scleractinians, turbinarians spawn in autumn, when water temperature drops, releasing gametes for external fertilization. The unusual spawning time may be one of the main factors in the success of turbinarians at high latitudes and in turbid eutrophicated waters, where they compete with algae for area and light. This can be seen in the example of Vietnamese turbinarians, which have an especially wide distribution on the reefs of the Gulfs of Tonkin and Siam, where they are abundant in shallow waters from 1 to 6 m, and at a depth of 3-4 m they can form compact populations, covering reef surfaces for hundreds of square meters. Water temperature in the northern Gulf of Tonkin drops in winter down to 16º C, and visibility in both gulfs rarely exceeds 1.5-2 m due to the great quantity of silt.

The wide distribution of Dendrophylliidae in Vietnam, which can be found from the tideland of the littoral to the bottom of a reef slope, and from the northern part of the Gulf of Tonkin to the southern end of Vietnam, including the Gulf of Siam, allowed us to investigate in vivo and to collect a vast amount of material on variation in these corals. Having some experience in investigation of modern and fossil corals, having studied in detail the morphology of the mentioned scleractinians, we propose an improved, partially extended terminology for description of morphological features, and the most stable (important) taxonomical features, revealed during their functional and taxonomic evaluation. Species diagnoses for all described corals are proposed for the first time.

3.7.1. Taxonomic history

The generic name “*Turbinaria*” for funnel-shaped Dendrophyliidae was offered for the first time by L. Oken (1815), but almost for a half a century it was not recognized among taxonomists of that time. A year later J.B. Lamarck (1816) did not accept this name, including the most typical turbinarians *Madrepora crater* Pallas and *M. cineraccens* Ellis & Solander (in the current interpretation *Turbinaria mesenterina*) and 4 other species in the *Explanaria* genus. Two other species – *T. palifera* and *T. stellulata* – were attributed by him to the *Astraea* genus. A. Schweigger (1820) accepted Lamarck’s generic name “*Explanaria*”, but gave it his own definition and introduced only two species – *E. crater* and *E. cinerascens*. Ten years later H. Blainville (1830) replaced Lamarck's *Explanaria* by the new name *Gemmipora*, thinking that Lamarck's name did not correspond to funnel-shaped corals with distinctly protruding nodular corallites. He included in this genus four previous (*crater, mesenterina, peltata, palifera*) and one new species – *G. fungiformis*. Soon K. Ehrenberg (1834) revised turbinarians, mixing partially Lamarck's *Explanaria* with Blainville's *Gemmipora*. He proposed to retain the name *Turbinaria* for small cup-shaped corals (*T. cupila, T. peltata, T. microstoma*), and to keep the name *Explanaria* for big non-cup-shaped corals, including 7 species in this group. Only one of these 7 species – *E. cinerascens* – could be included in the *Turbinaria* genus. But its type species is absent, and it is not possible to identify it by its picture provided by Ellis and Solander (Veron and Pichon, 1980). J. Dana, based on the number and orientation of tentacles of living corals and their budding pattern, attributes seven *Turbinaria* species (four previous – *peltata, crater, cinerascens, palifera* – and three of his own new ones – *patula, frondens, brassica*) to the *Gemmipora* genus, which is synonymous to Oken's *Turbinaria*, in order not to mix them with similar generic names *Turbinalia-Turbinola*, introduced by Lamarck.

Only in the classical work of Milne-Edwards and Haime (1848-51), in which a new classification for all corals was validly offered, funnel-shaped Dendrophylliidae with a well developed spongy columella were returned, and this time forever, to their generic name *Turbinaria*. Later on coral researchers mainly accepted the content offered earlier of this genus with the addition of some remarks and new species (Verrill, 1865; Klunzinger, 1879; Studer, 1880; Duncan, 1884; Quelch, 1886; Bourne, 1888; Ortmann, 1890). At the very end of the 19th century the fundamental multivolume monograph of H. Bernard "Catalogue of Madreporaria" was published, devoted to the investigation and revision of all the corals kept in the British Museum of Natural History (1896). A good proportion of the second volume of this monograph is devoted to *Turbinaria*. Bernard critically analyses the early taxonomic history of this genus and considers in detail strong and weak points in his opinion of the *Turbinaria* taxonomy of the previous researchers. He repeatedly takes note of the fact that early taxonomists did not have plentiful material at their disposal and did not always have initial or terminal growth stages of *Turbinaria* colony formation. Flat leaf-shaped or foliate colonies were common in some collections, whereas funnel-shaped ones were common in others. In his opinion, these were the reasons for disagreements on the names of these corals. Then he examines in detail the morphological characteristics of corallite elements, as well as that of colonies as a whole, and their interrelations, and tries to make a taxonomic estimation of some features. Actually Bernard was the first to make an attempt to take account of the data on intra-species variability in coral taxonomy. Taking into account peculiarities of corallite construction (structure) and distinctions in colony shapes, he subdivided all known 80 *Turbinaria* species into nine non-taxonomic groups from funnel-shaped through foliate and laminae to bifacial ones, and referred more than 20 species to synonyms. At present Bernard's monograph also remains a fundamental work, being a well illustrated catalogue of *Turbinaria* species, supplied with valuable remarks on their morphology, history and distribution. From the theoretical methodological point of view, it was one of the very first publications containing the idea of intra-species variability in corals. Bernard's study of Poritid corals considered in the same way, and obtaining still more data on variation in these scleractinians, and which made him to refuse the Linnaean nomenclature, was, as mentioned above, the beginning of the discussion about the problem of coral species which has continued to this day.

Modern coral taxonomists have not have any doubts about the status of the genus *Turbinaria*. However, its composition has sometimes been revised. Revisions were mainly relocations of some species to synonyms of other species, described earlier, more rarely – to later or newly described species (Gravier, 1911; Crossland, 1941, 1952; Yabe & Sugiyama, 1941). New species were described, old species were re-described and their validity or synonymy was discussed again (Yabe & Sugiyama, 1941; Wells, 1954, 1958; Nemenzo, 1962; Scheer & Pillai, 1974). Veron and Pichon (1980), based on the great amount of available information and taking into account the fact that more than a half of nominal *Turbinaria* species are found in Australia, not only described these corals, but also to a great extent revised the entire genus. They stressed that *Turbinaria*, despite their seeming simplicity, remain to be corals difficult to identify, since they do not have any conservative skeletal characteristics and have extremely broad variation both in the fine skeletal structure of the calice and in the colony growth form. Veron and Pichon consider that Australian species of *Turbinaria* provide a sufficiently complete view of the whole complex of species of this genus for the entire Indo-Pacific. In their description they reduce a large number of nominal *Turbinaria* species down to nine valid species (eight old names and a new one *T. heronensis* Wells, 1958), providing an extensive synonymy and remarks for every species. As usual, these authors gave a lot of attention to the analysis of intra-species variability of skeletal characteristics and growth forms of coral colonies from different biotopes, but unfortunately they did not try to estimate somehow the taxonomic value of one or another feature. The wide variation of morphological characteristics described by these authors, which practically extend from one description to another, makes it difficult, as well as for Potididae, to identify many species, despite beautiful and numerous coral photos.

3.7.2. Terminology, morphological and taxonomic featureds

The analysis of morphology and the structure of skeletal elements of a corallite and a colony as a whole for *Turbinaria* has not been made on the modern level until the present, not to mention the absence of a taxonomic estimation of featureds value. Below we provide a more detailed description and analysis of morphological and taxonomic features of these corals. A number of terms for characterization of skeletal elements of *Turbinaria* are introduced for the first time.

Corallite

Turbinaria corallites have a conical and cylindrical-conical shape. They project over the coenosteum surface more or less, and in some colony areas corallites can be embedded. In many *Turbinaria* a uniform orientation of corallites in rows parallel with the upper colony margin can be traced, in some species this is not distinct, and in the others it can be totally absent or be observed only at the very edge of a colony. The shape and size of corallite cones, the degree of their tilting on the colony surface and the height of their projection over the coenosteum are variable even within the same colony, and still more variable on intra- and interspecies levels. They can be elongated and regularly conical, inclined with one side shortened and another side elongated, low widely conical and cylindrical, or very high. Size and shape of the upper margin of the calice – an orifice, usually called "aperture" in *Turbinaria* - is variable in the same way. Aperture sizes can vary within the same colony by a factor of 2.5-3 times, and its shape – from regularly round to narrow elliptical to slit-like. In this respect one can only agree with the opinion of Bernard, who wrote about the hopelessness of searching for any satisfying single-valued characteristic of turbinarian calice variations (Bernard, 1896, p. 19). The density of corallites (their number per colony area unit), which together with corallite shape and their size can serve in a number of cases as a taxonomic feature at the inter-species level, can be considered the most stable morphological feature. The synapticulate wall of all *Turbinaria* species is similar in its structure and differs only by its thickness, with variations within the same colony which are comparable with interspecies variations and do not allow us to use this feature at the species level.

Septa

The septa of *Turbinaria* are well developed vertical thin laminae of different lengths: from less than a half of a corallite radius to two thirds of a corallite radius. Lateral septal surfaces are ornamented with different densities of granules, denticles or spines. Axial septal margins can be either almost smooth or dentate with fine spines, granules, saw-shaped denticles or large variously shaped wide teeth with flat tips. Such features as septal length, degree of granulation of the lateral surface and more rarely dentition on the axial margin both separately or especially in combination with each other can be used as inter-species differences.

The number of septa and the nature of insertion of new septa in different parts of the colony, and especially in different species, are the most variable features. The total number of septa in *Turbinaria* varies from 12 to 64. Numerous measurements show that more than 24-36 septa can be observed only in two species – *T. patula* and *T. stellulata*, and only in single cases in very large corallites and not in every colony. More than 36 septa can be found only in *T. peltata* in separate vertically protruding corallites having a diameter which is twice that of the other corallites of the colony. The majority of corallites of this species (92%) have no more than 24 septa. The number of septa of the other species is within the range of 14-24. In one group of species this value deviates towards smaller numbers – 14-18 septa, whereas in another group it deviates towards larger values – 16-20 septa. So for instance, the number of septa in *T. mesenterina* varies from 12 to 18, but two thirds of corallites have 14-16 septa. In another species, *T. patula*, the number of septa in three cycles varies from 16 to 24, whereas three fourths of all measurements show the presence of 18-20 septa. The bulk of corallites of all *Turbinaria* species (88%) have 16-18 septa in three incomplete cycles (Fig. 62).

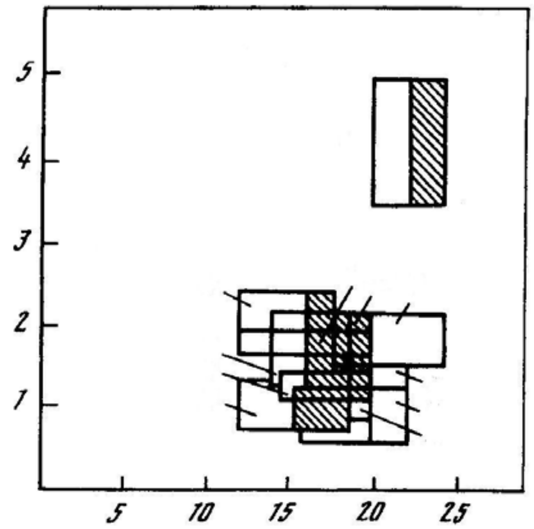


Fig. 62. Dimensional-quantitative structure of septal device of *Turbinaria*. Rectangulars – various of a *Turbinaria* species specify the shaded parts more than 60 % of septa of the given size. On an axis abscissa number of septa, on an axis of ordinates the sizes of internal diameter of cup, mm

The configuration plan of the septa and topography of insertion of new higher cycle septa older than the second cycle, uniting *Turbinaria* as a whole with their similarity, differ by a rather large diversity of morphological characteristics. Septa can be oriented radially in all six sixtants or only in opposing ones, and in the main sextant they can be plumose. First cycle septa can differ by their sizes from the other septa, or be equal to them. The directive septum can be detached from the neighboring higher cycle septa by a fossulate formation, and differs very little from them. Septa can have an arrangement similar to the Pourtales plan (1871) with two to three cycles, but they do not differ by orders and can have a clear cyclicity of insertion of regular higher cycle septa, and pronounced first cycle septa.

The reason for such diversity is the following. Growth of *Turbinaria* colonies takes place at their upper peripheral margin. Along this peripheral margin new corallites are formed, and mainly two cycles of septa are established in them. So, the structure of the septal apparatus of every separate corallite takes place already at this stage. New septa are produced mainly in entocoelic cavities (Bernard, 1896; Wells, 1956), and that is why, as in many Scleractinia with the accented bilateral symmetry, the first septa of the third and fourth cycles can be laid only between mesenteries of corresponding cycles. The first four pairs of mesenteries of the third cycle appear in *Turbinaria*, as in corals with dorso-ventral plan of metasepta insertion (Wells, 1956), only in the main quadrants in immediate proximity to the directive septa. Only after the appearance of the first series of mesenteries (as well as septa) of the third cycle of mesenteries (as well as septa) of the second series of the third cycle will be formed. The overwhelming majority of *Turbinaria* do not have a complete set of septa of three cycles. Only in *T. peltata* are three complete cycles of septa completed in corallites along the peripheral margin of a colony, and later septa are not inserted. In other species (*T. stellulata, T. patula,* etc.) two cycles of septa are formed in the colony periphery, and later additional septa are inserted only in a few corals, as colony diameter increases. And, finally, in the third group of *Turbinaria* species insertion of septa takes place even after peripheral corallites are left farther and farther away from the colony margin. In non-peripheral corallites insertion of a few new higher cycle septa, mainly at the stage of the third cycle, can occur only in points, located in main quadrants at both sides of the directive septa (Fig. 63-1). Since the growth of most corallites and formation of their septal apparatus takes place mainly earlier, and the increase of corallite sizes or appearance of new corallites is limited by neighboring polyps, sets of septa of the third and later cycles are not completed. Insertion of several higher cycle septa of the first series of the third cycle rarely includes more than four to six septa, and only in newly budding corallites or corallites increasing their diameter. Only separately protruding corallites 1.5-2 times larger than average can have complete sets of septa of three to four cycles.

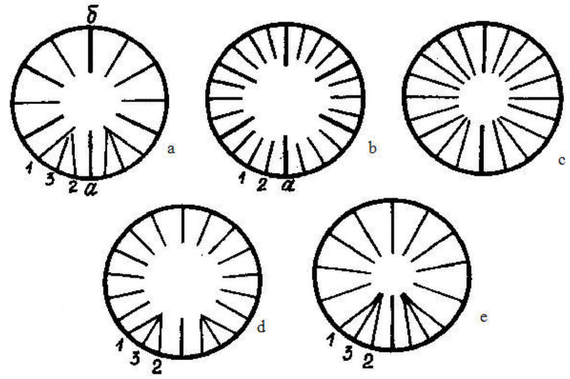


Fig. 63. The order insertation septa of various cycles (**a**); 1, 2, 3 - partitions of the first, second and third cycles, protosepta are allocated by fatter; insertation and orientation of septa: b - on the first type, **c** - on the second type (it is advanced three incomplete cycles of the septa, again inserted methasepta approach the axial ends), d - on the third type (it is advanced three incomplete cycles of the septa, again inserted septa merge axial the ends), **e** - on the fourth type (it is advanced three incomplete cycles of septa)

These peculiarities of the formation of the mesenterial and septal apparatus explain the fact that the bulk of corallites of all *Turbinaria* species usually have 16-18 septa. This is also a reason for uniformity of sizes of all septa of all cycles and interseptal intervals, which only grow uniformly or remain unchanged. For the same reason the septal orientation similar to Pourtales Plan, when septa of the higher cycles (fifth, fourth) have to fuse with the lateral surface of the lower cycle septa (fourth, third), can be present or absent. The Pourtales Plan is not clearly observed in *Turbinaria* species. Firstly, they have no septa of the fourth cycle, except for *T. peltata*. Secondly, new inserted septa of the third cycle become closer, not fusing, or fuse with neighboring septa by their axial ends, but do not fuse with the lateral surface of the earlier cycle septa. Besides, in *Turbinaria* septa of the second and third cycles fuse, whereas according to the Pourtales Plan axial ends of the second cycle septa and their lateral surface remain free.

Peculiarities of higher cycle septal insertion and their morphology together with different septal lengths create different structures of septal apparatus for *Turbinaria*. There are four types of insertion and orientation of the septal apparatus:

1. Septa along the entire calice are oriented radially with a tendency toward spiral twisting. The first and second cycles differ by length, and the insertion of new septa does not occur or is observed only in single corallites (Fig. 63-2).
2. Septa are oriented radially in the directive sextants. Cycles differ very little. Septa which are the closest to the directives, become closer, and sometimes fuse at the point of connection with columella. Insertion of septa of the third cycle is observed in the minority of corallites (Fig. 63-3).
3. Septa in the opposite quadrants are radial, and in the directive they are plumose. Higher cycle septa neighboring to the main septa fuse by their axial ends. Insertion of septa of the first series of the third cycle is developed in the majority of corallites (Fig. 63-4).
4. Septa in the opposite quadrants are radial, whereas in the directive they are plumose. Higher cycle septa neighboring to the lower cycle septa fuse on their lateral surface in the axial end. Insertion of septa is not limited to either the peripheral margin of the colony or by the cycle of their formation, and can be observed in all places of a colony (Fig. 63-5).

All studied *Turbinaria* are characterized by one of these types of formation of septal apparatus with their variations in septal length, number, degree of merging of axial ends of septa (Fig. 64), being next to the directive septa, and the character of granulation of septal surfaces.

Peculiarities of septal insertion and their morphology, despite their considerable variability, in certain complex combinations, are species-specific and quite limited by qualitative and quantitative bounds with gaps between species, which allows us to elaborate appearance diagnoses and schemes of construction of septal apparatus, offered below with their description.

Columella

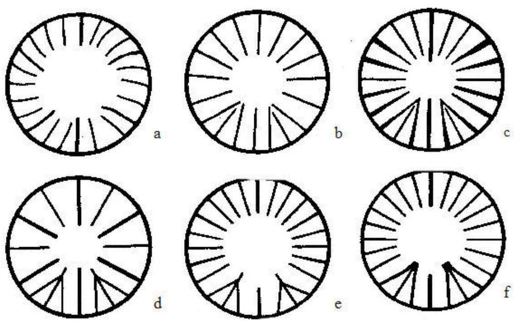


Fig. 64. Insertation septa at various of *Turbinaria* species. a – *T. patula*, b – *T. crater*, c – *T. contorta*, d – *T. stellulata*, e – *T. radicalis*, f – *T. bifrons*

In all *Turbinaria* the columella is well developed and often occupies about one third of a calice. It is usually deeply embedded in the calice. It is usually a spongy but rather dense structure, formed by vertical irregular laminae, variously bent and interlacing with each other. Sometimes laminae are long and smooth, if so then they are clearly spirally twisted. If laminae are not numerous, they can be arranged in one row between the directive septa and even merge in a styliform column. In most *Turbinaria* columella formation starts after a corallite is no longer at the peripheral margin of a colony. Neighboring corallites, depending on their sizes and age, can have a large hilly columella or a row of linearly elongated twisting laminae. That is why it is necessary to be especially careful using morphological features of columella construction for taxonomic purposes at the species level.

Colony

Whereas it is rather easy to recognize colony forms of all *Turbinaria* as a whole, it is not always possible to distinguish unambiguously one or another colony form at the species level. Bernard, describing 58 *Turbinaria* species in his work, divided them into eight groups depending on the colony form.

1. Funnel-shaped colonies, weakly modified, retain their form during the entire growth period.
2. Corymbose, flat cups, which can have both concave and convex shape.

3-4. Two foliate, which can be both foliose or in a shape of palm leaves; they both can be wavy at the periphery.

5. Mesenteriform, wide low craters, complicated with folded, frill-like and other projections.
6. Lamelliform.
7. Glomerate, reinforced cup-like colonies in the form of balls growing on each other.
8. Bifrontal: colonies are the same as mesenteriform, but have corallites on both surfaces of projections, and two species – as differently convoluted colony forms (Bernard, 1896).

Bernard noted that all *Turbinaria* at their initial growth stage have a crateriform colony. Our observations on numerous Indo-Pacific reefs confirm this conclusion. Small colonies of different *Turbinaria* (with a height of 25-30 mm and diameter of 30-50 mm) have a crater form of different proportions depending on biotope. Under the conditions of limited illumination at the base of the reef slope such craters have a widely conical shape and become almost flat (Fig. 65). Analysis of the great amount of original material and the published data (Bernard, 1896; Yabe & Sugiyama, 1941; Crossland, 1952; Nemenzo, 1962, 1981; Veron & Pichon, 1979; Sheppard & Sheppard, 1991) permitted us to come to the conclusion that all the various growth forms of *Turbinaria* colonies can be reduced to five groups.

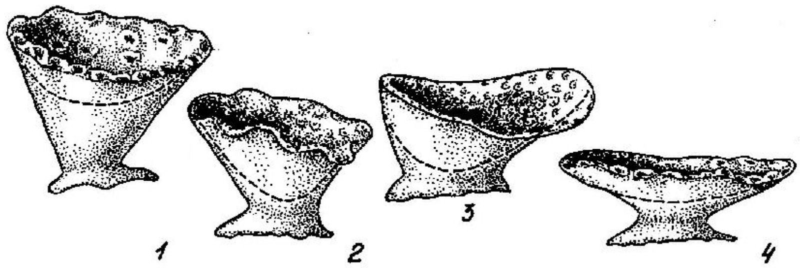


Fig. 65. Initial growth phases of a *Turbinaria* colonies. 1 – *Turbinaria peltata*, low part of reef slope, depth 9 m; 2 – *T. bifrons*, a site too, reef slope, depth 5 m; 3 – *T. radicalis*, Bai Tu Long Archipelago, reef slope, depth 6 m; 4 – *T. peltata*, Namsu Island, depth 35 m. The dashed line designates a configuration and depth of a calix

1. Funnel-shaped. Regular high craters with steep walls and corallites only on the internal surface are peculiar to two *Turbinaria* species. These craters can be grown together almost completely, leaving a slit-like opening or half-open part (Fig. 66, a). Projections in the form of a semi-crater or a swallow's nest can be formed inside the colony on one of the sides.

2. Funnel-shaped -scalloped. Most *Turbinaria* have a colony in the form of a wide low crater with variously bent (folded, wavy, scalloped, etc.) margins with corallites only on one internal surface of the crater. Crater morphology is extremely variable: the width of the angle of its opening, equal or different height of opposite sides, round or as if compressed from two sides, elliptical, wavy or folded upper margins. This colony growth form with its numerous transitional variations is typical for five to six *Turbinaria* species, which cannot be distinguished from each other by this feature (Fig. 66, b)

3. Bifacial. A complicated colony form with numerous horizontal and vertical projections of different shapes, including crateriform, with corallites on both sides of lamina. It is typical for only for two *Turbinaria* species (Fig. 66, c).

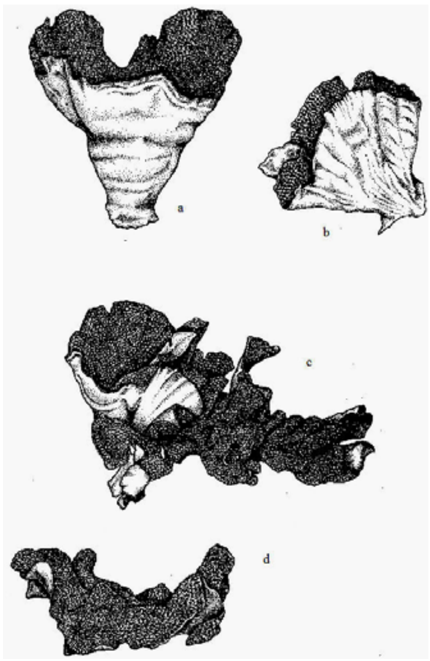


Fig. 66. Forms of a *Turbinaria* colonies. a – funnel-form *Turbinaria crater*, Chuong Island, depth 9 m; b – funnel festoon-form *T. mesenterina*, Thom Island, dept 11 m; c – bifacial *T. bifrons*, Chuong Island, depth 12 m; d – plate-encrusting *T. contorta*, Chuon Island, depth 6 m.

4. Loop-like. Flat-crateriform to horizontal, with a smooth surface. Colonies can be regularly round or shapeless. With even or wavy and folded many-tier margins, or with numerous variously oriented projections to formation of vertical pseudo-branches with very large corallites on one side of the colony surface. This colony growth form is species-specific.

5. Leaf-like. Encrusted or leaf-shaped colonies in the form of palm or fern leaves, wide and long with weakly protruding numerous corallites only on one surface. Such growth forms are typical for two to three *Turbinaria* species (Fig. 66, d, 67-3).

The following names can be used rather unambiguously in taxonomy: the loop-like colony form with large corallites, typical only for one Turbinaria species, and the bifacial one, which is typical for two species. Thus, colony forms of the Poritidae and *Turbinaria* are rather variable within the same species. A correlation between colony form and dwelling conditions is shown, as well as the presence of transitional variants between different forms. So, in the majority of cases colony form cannot be used as a taxonomic feature for identification of species of such corals.

3.7.3. Family Dendrophylliidae Gray, 1847

Genus *Turbinaria* Oken, 1815

Type species – *Madrepora crater* Pallas, 1766.

Diagnosis. Crater-shaped, funnel-shaped or flattened, often foliaceous, large colonies. Corallites are large and middle-sized with porous synapticulothecal walls, protruding, and densely covering the reticular coenosteum. Three, usually incomplete, cycles of equally sized septa are developed, which differ little by orders, three metasepta, neighboring the directive septa, are usually distinguishable, and are brought closer at the axial ends, where they often fuse. The columella is well developed.

Turbinaria peltata (Esper, 1794)

Fig. 65 - 4, 68 - 1,2, C7 - 1

Madrepora peltata Esper, 1794

Turbinaria peltata (Esper): Edwards and Haime (1860), Veron and Pichon (1980) cum syn., Nakamori (1986),Veron (1986), Sheppard and Sheppard (1991)

Diagnosis. Septa of three cycles, distinguished by orders, oriented radially, the first cycle of septa are distinguished by their greater sizes, axial ends of all septa are equally spaced from each other. Septal granulation is moderate throughout their entire surface, including the axial margin. Septal number is 24-36, their length reaching two thirds of a corallite radius.

Description. Colonies are large, reinforced, lamellar, round or irregular, often multi-tier, with variously bent margins and vertical projections, which can be in the form of cylinders with solitary corallites or in the form of thick subbranches up to 90 mm tall. Separate projecting corallites can extend for more than 20 mm above the colony surface with a diameter of 5-10 mm. The colony skeleton is thick and dense. Corallites are large and round, with a diameter of 5-6 mm, single corallites can reach 10 mm diameter. They project slightly over coenosteum, and the external wall, as a rule, protrudes farthest. Individual corallites can extend for 5-10 mm and single corallites, are always large (6-10 mm, up to 20 diameter). Corallites are mostly at a distance of 6-20 mm from each other, but they can merge with each other, primarily along the upper margin of the colony. Calice walls are vertical and thin.

Three cycles of septa are developed, which differ very little in length and configuration. The third cycle septa are slightly shorter in the upper calice. All septa merge with the columella at the base of the calice, and their lateral surfaces are densely granulated with fine spines. Axial septal margins are even and vertical. Two higher cycle septa next to the directive septa are always shorter than it. Septa rarely exceed one fourth of the corallite diameter in length. In large, outstanding corallites, septa of the fourth and fifth cycles can be developed, and in that case the total number of septa can reach 64. A tendency to spiral curling of all septa can be seen in many corallites. The first cycle of septa are slightly thicker and longer than all higher cycle septa. The columella is moderately recessed in the calice, it is large, prominent, and morel-shaped , often with clearly pronounced spiral curling of the long slightly granulated laminae which it is made of. The coenosteum is formed of densely situated thin laminae, evenly dentate, arranged in parallel rows or not in rows. Colony shape is very changeable from a regular thick disk to subbranched vertical projections with variously bent peripheral margins, often multi-tiered, and scale-shaped. Columella structure is variable in the same way. It can be not very dense, compact with directly oriented ribs or even lamina, or very dense, large with clear axial curling. It differs from all the other *Turbinaria* by the large sizes the corallites and variable colony shape.

The color of living corals is mainly of pale-yellow and shades of yellow-brown.

Similar species *T. patula* has smaller corallites focused in subparallel rows.

Common and may be a dominant species.

Location. Distributed everywhere from the Gulf of Tonkin to the Gulf of Siam, depth from littoral down to 42 m.

Distribution. Widely known throughout the entire Indo-Pacific from Africa to Japan and the Marshall Islands.

Turbinaria patula (Dana, 1846)

Fig. 67 - 11,12

Gemmipora patula Dana, 1846

Turbinaria patula (Dana): Quelch (1886), Veron and Pichon (1980) cum syn., Veron (1986)

Diagnosis. Septa are of three incomplete cycles, weakly distinguished by orders, arranged radially with a tendency to spiral curling, first cycle septa are slightly prominent in length, and the axial ends of all septa are regularly spaced from each other. Granulation is absent, and the axial margin is notched with large wide teeth. The number of septa is 18-20, and their length is rarely more than a half of a corallite radius.

Description. Subvertical foliose colony in the form of a semi-unfolded funnel with steep sides. Its upper margins are bent in the form of big wavy folds, and the lateral sides can be turned outside the colony in the form of a sharp fold. There is an additional peak-shaped projection inside the colony. The coral skeleton is of a medium thickness, becoming thinner upwards, and is porous.

Corallites are of medium sizes, being 3-4 mm in diameter, conical, and clearly projecting obliquely and upwards. They densely cover the colony surface (6-10 per cm^2, being weakly arranged in irregular rows, subparallel lines of growth of the upper colony margin. Calices are round and open, moderately deep with an aperture of about 2 mm. 18-20 septa of three cycles are developed, which are equal in length, rarely exceeding half of a corallite radius. They are steeply inclined or subvertical with thin internal margins, noticeably dentate. The lateral surfaces of septa are smooth. Fusing of septa on their axial ends is observed very rarely, mainly in the mature stages of individual corallites. First cycle septa are slightly distinguishable by their sizes among the other septa. In many corallites a tendency to spiral curling of the septa can be observed. The columella is a large hill, and consists of bent, merging finely dentate laminae. The arrangement of corallites, their number per area unit, and their height over the coenosteum surface are slightly variable.

The color of living corals is shades of pale-yellow-brown or green.

Similar species *T. peltata* has larger corallites with distinct columellae and *T. frondens* has smaller corallites, which project upwards less clearly.

Uncommon, usually on reef slopes.

Location. Culao Cham, Thu, and the Namsu Islands, depth 4-9 m.

Distribution. Known in Vietnam, in the north and east of Australia, and Fiji.

Turbinaria frondens (Dana, 1846)

Fig. 67 - 7,8, C7 - 4

Gemmipora frondens Dana, 1846

Turbinaria frondens (Dana): Edwards and Haime (1860), Veron and Pichon (1980) cum syn., Veron (1986), Nakamori (1986)

Diagnosis. Septa are arranged radially, the directive septum is slightly larger than the other septa, and the axial ends of septa, next to the directive, come together to fuse, or fuse at the columella. Granulation is abundant with large long spines, and the axial margin is highly dentate. The septal number is 16-22, and their length is not less than a half of a corallite radius.

Description. Colonies are funnel-shaped, foliose and encrusting, as a rule, with variously bent peripheral margins. In funnel-shaped forms one side can be bent in a form of a palm leaf, this side is almost always lower than the other side or forms a fold-shaped overlap. Colony skeleton is mainly thin, more rarely of a medium thickness, and dense.

Corallites are fine, conical, distinctly projecting over the coenosteum, and their diameter varies from 1.6 to 2.8 mm. They evenly but not densely (7-12 per cm^2) cover the internal colony surface, not adjoining each other. Calices are round or slightly elliptical and deep, with vertical walls and an aperture of 1.2-2 mm diameter. In the base of a colony and in its concave parts corallites are immersed and have smaller sizes.

Eighteen to twenty-four septa in three cycles are present, almost not distinguishable by orders. They rarely reach the length of more than one fourth of a corallite diameter, internal septal margins are vertical, and all septa merge with the columella at the base of the calice. Lateral septal surfaces are uniformly covered by a few long spines. The directive septa are shorter than the other septa. Three septa, next to the directive, merge with each other at their axial ends, forming a noticeable fossa. The columella is elliptical or round, large (up to one third of a calice), spongy, often with prominent rows of teeth, which can merge in the directive lamina. The coenosteum is covered by short numerous spines, which have the shape of finely streaked longitudinal grooves or form a reticular structure on corallite walls. Colony growth forms and corallites sizes are highly variable depending on their situation in various colony parts, at the periphery, in the central area, or in convex or concave parts of the colony. They can be disorderly arranged, highly prominent or subimmersed, or slightly arranged in parallel rows.

The color of living corals is shades of brown and green.

Similar species *T. esenterina* has smaller corallites and does not form long tubular corallites.

Common in varios reef zones.

Location. Bai Tu Long Archipelago, Re, Namsu, Cham, Thu, Con Dao, and the Spratly Islands, depth from 2 to 40 m.

Distribution. Widely distributed in the Western Pacific from Japan to Fiji.

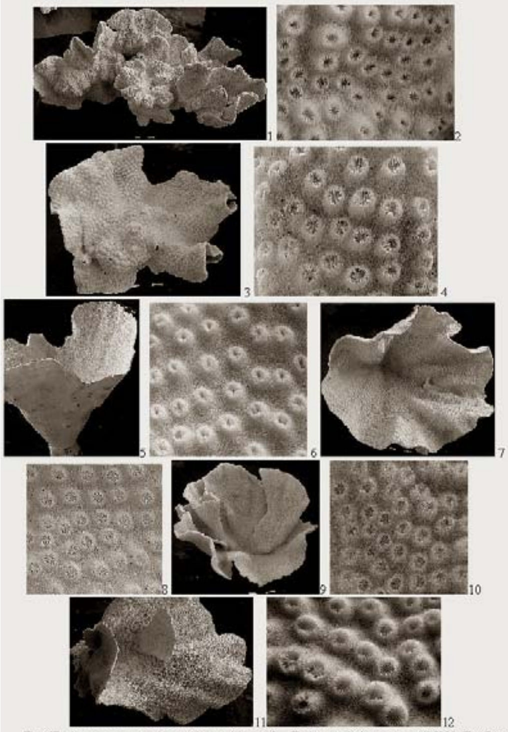


Fig. 67. Appearance colonies and its corallites. 1-2 – *Turbinaria bifrons*, spec. 1/95222, Thu Island; 3-4 – *T. contorta*, spec. 1/95226, Namsu Islands; 5-6 – *T. crater*, spec. 1/95223, Namsu Islands; 7-8 – *T. frondens*, spec. 1/95218, An Thoi Archipelago; 9-10 – *T. mesenterina*, spec. 1/95219, Namsu Islands; 11-12 – *T. patula*, spec. 1/95217, Con Dao Islands

Turbinaria mesenterina (Lamarck, 1816)

Fig. 67 - 9,10, C7 - 3

Explanaria mesenterina Lamarck, 1816

Turbinaria mesenterina (Lamarck): Brüggemann (1879), Veron and Pichon (1980) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986), Sheppard and Sheppard (1991)

Diagnosis. Septa are arranged radially, the directive septa are shorter than the other septa, the axial ends of septa, next to the directive, come closer together or fuse in a point at the columella. Granulation is abundant, with large spines, axial margins are uneven, and dentate with large separate teeth. The number of septa is 16-18, their length reaches up to three fourths of a corallite radius.

Description. Funnel-shaped colonies with subvertical walls, with numerous, variously bent and vertically oriented folds, with corallites on one side. The peripheral margin of the colony is always highly bent. The colony skeleton is thin, and dense.

Corallites are widely conical or tubular, distinctly projecting over the coenosteum, having a diameter of 2-3.5 mm. They densely cover (14-16 /cm²) the colony surface, often adjoining each other. They are not, as a rule, distinctly arranged in rows. Calices are deep and round, with an aperture of 1-2 mm diameter. 12-18 septa of three cycles are present, which can be distinguished by orders. They are long, up to ¾ of a corallite radius, almost all of them fuse with the columella. Septa of the first and second cycles are equal or almost equal in length, and directive septa are slightly longer. Septa of the third cycle are noticeably shorter and do not always have a complete set. The directive septum is always detached in a fossula between three neighboring metasepta, with come close together, almost fusing with each other's axial ends. All septa are evenly but not densely covered by fine granules. The columella is prominent and dense, elliptical, from pencil-shaped to lamellar. The columella can be often represented by a simple laminar ridge of separate spines. The coenosteum is porous and densely covered by numerous thin, highly spiny laminae. Most of the features are subject to a significant variability, especially variable is the character of the columella: from separate spines to spongy and hilly.

The color of living corals is pale-yellow-green or gray-brown.

Similar species *T. reniformis* is simpler, low, funnel-shaped with less sharply bent folds, and the septal apparatus is slightly granulated, and the axial ends of septa next to the directive septum, distinctly fuse.

Common in various reef zones.

Location. Distributed everywhere from the Gulf of Tonkin to the Gulf of Siam, depth 2-25 m.

Distribution. Widely known from the Red Sea and Western Africa to the Marshall Islands and Fiji.

Turbinaria reniformis Bernard, 1896

Fig. 68 - 5,6, C7 - 2

Turbinaria reniformis Bernard, 1896: Veron and Pichon (1980) cum syn., Veron (1986), Sheppard and Sheppard (1991)

Diagnosis. Septa are arranged radially and plumosely, the directive septa are slightly longer than the other septa, and the axial ends of septa next to the directive fuse with it.

Granulation is weak to moderate with fine spines, and the axial margin is slightly dentate. The number of septa is 16-20, their length is not more than half of a corallite radius.

Description. Colonies are flat funnel-shaped, dish-shaped, cup-shaped with wavy margins, often turning into folds. The colony skeleton is of a moderate thickness, and is dense.

Corallites are conical, slightly projecting over the coenosteum, having a diameter from 1.5 to 3 mm. They can very densely cover the colony surface and adjoin each other (up to 19 /cm^2), or be moderately spread out (7-9 /cm^2). In most cases corallites are arranged in rows, parallel to the peripheral colony margin, which can be distinctly observed. Calices are deep, cylindrical, with vertical walls and an aperture of a diameter from 0.6 to 2 mm.

Sixteen to twenty (more rarely 24) septa of three cycles, almost not distinguishable by length, are present. They are short, rarely longer than 0.5 mm, in the depth of the calice all of them fuse with the columella. Internal septal margins are even, thin, and vertical. Lateral surfaces are slightly or moderately dentate with fine denticles. Three septa, next to the directive septum, come together at their axial ends, which can fuse in one point at the columella. The columella is usually large, hilly, spongy, and situated deep in the calice. In a few corallites, sometimes in a part of a colony, the columella can be lamellar or even consist of a ridge of individual spines.

The coeneosteum is spongy, of low almost smooth laminae and teeth, moderately covering inter-corallite spaces. The size and structure of the columella and the density of colony coverage by corallites are the most variable characters.

The color of living corals is yellow-green.

Similar species. See *T. mesenterina*.

Relatively common, may form large stands.

Location. Bai Tu Long Archipelago, Namsu, Tho Chu, Re and Con Dao Islands, depth 3-25 m.

Distribution. Known at Nicobar and the Marshall Islands, reefs of Tonga Archipelago, the South-Western Australia, and Vietnam.

Turbinaria stellulata (Lamarck, 1816)

Fig. 68 - 7,8

Astraea stellulata Lamarck, 1816

Turbinaria stellulata (Lamarck): Quelch (1886), Veron and Pichon (1980) cum syn., Veron (1986)

Diagnosis. Septa are arranged radially in counter and plumosely in the main sextants, the first cycle of septa are almost not distinguished from the other septa, and the axial ends of septa, next to the directive, fuse with the longer higher cycle septa located between them. Granulation is weak with fine spines, and the axial margin is unevenly dentate. The number of septa is 14-18, their length reaches two thirds of a corallite radius.

Description. Lamellar, weakly funnel-shaped colonies, with various vertical nodular, lamellar projections and folds with wavy bent margins. The colony skeleton is thick and massive at the base and thin in its middle and upper parts. Corallites are weakly prominent, hilly, and have a diameter of 1.5-3 mm. They moderately or sparsely (6-12 /cm^2) cover the colony surface, very rarely adjoining each other, and are arranged in irregular subparallel rows. Calices are deep, open with vertical walls and an aperture with a diameter of 1-2.2 mm.

Fourteen to twenty-four septa of three cycles, not distinguished by orders, are present. They are short, and their internal margins are vertical or slightly inclined towards the periphery. Lateral septal surfaces are moderately or weakly covered by fine granules or spines. Septa in the cardinal quadrants are slightly shorter than the other septa. The columella is round or elliptical, hilly, and noticeably projecting. It can be narrow and lamellar. The coenosteum is porous with rare spiny laminae, as a rule, without any distinct orientation. The columella character and size, corallite height and density of their coverage are moderately variable.

The color of living corals is shades of yellow-brown.

Differs from the other *Turbinaria* by the most simple colony form.

Rare, are known only on reef slopes.

Location. Tho Chu, Namsu, and Phu Quy Islands, depth 2-15 m.

Distribution. Known on the reefs of the South China Sea, Australia and the Marshall Islands.

Turbinaria bifrons Brüggemann, 1877

Fig. 67-1,2

Turbinaria bifrons Brüggemann, 1877: Veron and Pichon (1980) cum syn., Nakamori (1986), Veron (1986)

Diagnosis. Septa are radial in counter sextants, the directive septa are shorter than the other septa, and septa next to the directive septum, fuse on their axial ends. Granulation is moderate with low spines, and the axial margin is finely dentate. The number of septa is 12-20, their length is not longer than half of a corallite radius.

Description. Colonies are of a variety of shapes, with numerous irregular vertical projections and folds in the form of straight or wavy bent laminae in very diverse shapes. Projections can be funnel-shaped or cup-shaped, with even or variously bent margins, or columnar or cubical shapes. As a rule, all projections and folds are covered by corallites on both sides. The colony skeleton is often bilayered, usually dense, firm, and thin on upper parts.

Corallite sizes and shapes vary depending on their location in different parts of the colony. In the center of the colony on prominent hilly and columnar projections they are conical, noticeably prominent, the largest (3-4 mm). On the base and on the lower part of cup-shaped and funnel-shaped projections small corallites (2 mm and smaller) are also immersed. The bulk of corallites are cylindrico-conical, moderately projecting, of a round or elliptical shape with a diameter of 2-3.5 mm. They rather densely cover the colony surface (11-16 /cm^2), rarely adjoin each other and are weakly arranged in subparallel winding rows on the upper vertical parts of a colony. Calices are deep to very deep, mainly open, with an aperture with a diameter of 0.75-2 mm. 12-20 equal sized septa, not distinguished by orders, are present. They rarely exceed a half of a corallite radius, and deep in the calice all septa fuse with the columella. Internal septal margins are steep and even. Lateral surfaces are intensely granulated with medium to large dentition. The directive septum is noticeably thinner and slightly shorter than the other septa. Three higher cycle septa, next to first cycle septa, fuse on their axial ends and are located noticeably feather-like towards it. The columella is elongated, oval-elliptical, immersed deeply in the calice, and sometimes projects in the form of a lamina or several ridges. The coenosteum is porous, rather densely covered by coarse laminae arranged in rows with moderately dentate edges. The colony shape is variable from the wide regular funnel to the very complicatedly divided colony with vertical projections.

The color of living corals is shades of brown-green.

Differs from all other species *Turbinaria* by development of bifacial lamina with corallites on both sides, except *T. conspicua,* which has bifacial fronds except for some fusing unifacial fronds.

Uncommon.

Location. Distributed everywhere from the northern part of the Gulf of Tonkin to the Gulf of Siam, depth 5-25 m.

Distribution. Known on the reefs of Japan, Vietnam and Australia.

Turbinaria crater (Pallas, 1766)

Fig. 67 - 5,6

Madrepora crater Pallas, 1766

Turbinaria crater (Pallas): Bernard (1896), Veron and Pichon (1980) cum syn., Faure (1962)

Diagnosis. Septa are arranged radially, only the directive septa are distinguished for their sizes, and the axial ends of septa next to the directive come close together and almost fuse. Granulation is intensive with fine denticles, and the axial margin is finely dentate. There are 14-18 septa, and their length is not more than a half of a corallite radius.

Description. Distinctly funnel-shaped colonies with steep walls (more than 45º), which are wavy and bent. In many specimens funnels are not closed completely, leaving a narrow slit. The coral skeleton is thin to very thin, and weakly porous, especially along the upper colony margin.

Corallites distinctly protrude, are widely conical, and have a diameter of 1.5-2.5 mm, very rarely 3 mm. They evenly, but not densely (6-8 /cm^2) cover the internal colony surface, weakly arranged in subparallel rows according to the growth of the upper colony margin. Calices are deep, with vertical walls, with an aperture of 1-2 mm diameter. As a rule, 18 equal-sized septa are developed, which are weakly distinguished by order. All septa merge with the columella at the base of the calice, reaching up to 2/3 of a corallite radius. Their internal margin is slightly inclined towards the periphery, slightly dentate and wavy. Lateral surfaces of septa are intensively granulated with fine denticles. Higher cycle septa of the counter sextants are shortened, located distinctly plumosely with respect to the main, longer and thicker first cycle septa. Higher cycle septa of the counter sextants are longer than the other septa. Three higher cycle septa, next to the directive, come together at their axial ends. Located between them, the septum of the third cycle is noticeably shorter. The columella is elongated-elliptical, dense, as a rule, with a lamellar directive projection, deeply recessed in the calice. The coenosteum is weakly porous and densely covered by thin straight or bent laminae, the upper margins of which are intensively to moderately dentate.

The color of living corals is gray, with shades of green and brown.

It differs from the most of *Turbinaria* by a regular funnel-shape colony, and the intensive granulation of septa by fine denticles.

Rare.

Location. Bai Tu Long Archipelago, Phu Quy, Namsu Islands, depth 2-20 m.

Distribution. South Vietnam, ? South-Eastern Asia.

Turbinaria radicalis Bernard, 1896

Fig. 68 - 3,4

Turbinaria radicalis Bernard, 1986: Veron and Pichon (1980) cum syn., Veron (1986)

Diagnosis. Septa are arranged radially and plumosely, directive septa are shorter than the other septa, and the axial ends of septa, next to the directive, fuse with higher cycle septa, located between them. Granulation is moderate with low spines throughout the entire septal surface, including the axial margin. The number of septa is 16-18, and their length is not less than two thirds of a corallite radius.

Description. Colonies are horizontally lamellar, foliose-encrusting or weakly funnel-shaped, with thin wavy margins, which can be tubularly twisted to the upper or lower colony side. The colony skeleton is thin and porous.

Corallites are fine, very rarely greater than 1.6 mm in diameter, immersed and circular, and slightly prominent. They are irregularly distributed throughout the colony surface in oriented, curved, subparallel lines. Along the colony margin corallites are located more closely together (up to 12-14 /cm²), and lines are closer together – 1-2 mm. Towards the colony center corallites are more widely spaced (6-8 /cm²), and the distance between corallite rows increases up to 3-6 mm. Calices are deep, with vertical walls.

Eighteen to twenty-four equal-sized septa of three cycles, almost not distinguishable by order, are present. Septa are long, up to 2/3 of a corallite radius, at the base of the calice they fuse with the columella. Internal septal margins are vertical, even, and weakly dentate. Lateral surfaces are moderately granulated with rather large denticles. First cycle septa are hardly noticeably more excert than the other septa. Septa, next to the directive septa, come together at their axial ends, and septa of the third cycle, which are between them, are noticeably shorter. The columella is not large, round, dense, and located deeply in the calice. The coenosteum is weakly porous, and densely covered with numerous lamimae with moderately dentate edges.

The color of living corals is shades of pale-yellow-brown.

The limits of variation are not established because of the limited amount of material, but it differs from the other *Turbinaria* by barely prominent corallites and, as a rule, by a flat-foliose colony.

Uncommon.

Location. Reefs of Khanh Hoa Province, and Namsu Island, depth 2-20 m.

Distribution. South Vietnam, and Eastern Australia.

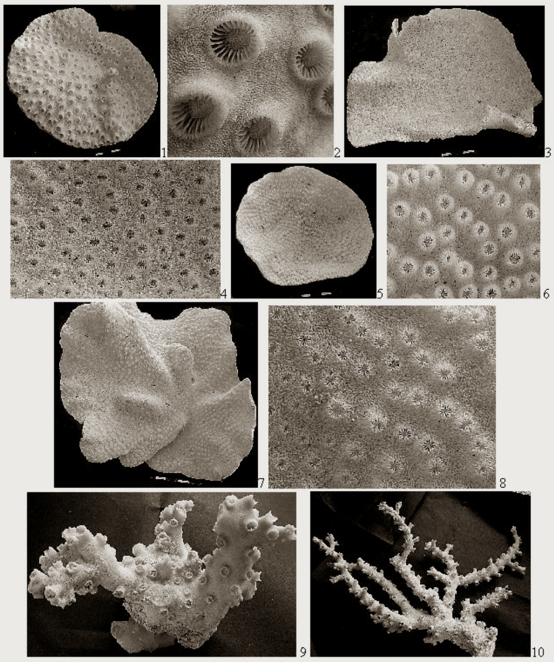


Fig. 68. Appearance colonies and its corallites. 1-2 – *Turbinaria peltata*, spec. 1/95215, Bai Tu Llong Archipelago; 3-4 – *T. radicalis*, spec. 1/95224, Namsu Islands; 5-6 – *T. reniformis*, spec. 1/95220, Thu Island; 7-8 – *T. stellulata*, spec. 1/95221, Namsu Islands; 9 – *Dendrophyllia japonica*, spec. 30/9501, Phu Quoc Archipelago; 10 – *Tubastrea micranta*, spec. 36/9501, Phu Quoc Archipelago

Turbinaria conspicua Bernard, 1896

Turbinaria conspicua Bernard, 1896: Veron and Pichon (1982)

Diagnosis. Septa are radial in the opposite sextants, the directive septum is detached from the other septa, and three neighboring long higher cycle septa fuse with each other's axial ends. Granulation is very weak with single fine spines, and axial margins are dentate with large wide spines. The number of septa is 16-18, and their length is not less than two thirds of a corallite radius.

Description. Colonies are oval, funnel-shaped-elliptical, with steep to subvertical sides, highly bent, especially at the upper margin, and wavy in the length of the lamina, with vertical digitate projections. A weak tendency to form bifacial laminae and projections with corallites on both sides is present. The coral skeleton is moderately thick, and dense.

Corallites are prominent, low-conical, with a 1.7-2.5 mm diameter. They cover the colony surface with a moderate density (6-12 /cm²), being distinctly arranged in curving rows on the upper colony margin. Calices are open, deep, and with an aperture of about 2 mm.

Twelve to eighteen equal-sized thin septa are present, almost indistinguishable by orders. They have a length of, as a rule, not less than one third of a calice radius. Internal septal margins are steeply inclined, intensively or moderately dentate with spines and denticles. The lateral surfaces of septa are smooth or covered by solitary spines. Septa, next to the directive septa, irregularly fuse on their axial ends only at the base of the calice. This takes place mainly in corallites which have more than 15 septa. The columella is of a medium size or small, not dense, and recessed deep in the calice. The coenosteum is porous, rather coarse, and covered by short laminae, which are arranged in linear curved rows and intensively dentate with saw-like teeth. The character of fusion of septa, next to the directive, is variable, as well as granulation of the axial margin of septa. The colony shape is also highly variable.

The color of living corals is pale yellow-brown.

Similar species *T. bifrons* is distinguished by a very weak tendency to form larger more conical bilateral corallites.

Very rare.

Location. Cham and Namsu Islands, depth 10 m.

Distribution. Known in the South Vietnam, Western and Southwestern Australia.

Turbinaria contorta Bernard, 1896

Fig. 67 - 3,4

Turbinaria contorta Bernard, 1896: Eguchi (1938, 1968), Yabe and Sugiyama (1941), Ma (1959), Utinomi (1965)

Diagnosis. Wedge-shaped reinforced septa are arranged radially and plumosely, directive septa are longer and larger than the other septa, and the axial ends of septa, next to the first cycle septa, fuse, exceeding in length the higher cycle septa, located between them. Granulation is abundant with big spines, and axial margins are dentate. The number of septa is 18-20, and their length reaches ¾ of a corallite diameter.

Description. Colonies are horizontal and lamellar with highly bent prominent margins, and some fold-shaped protrusions extend vertically upwards. Colony skeleton is thick and dense.

Corallites are low hills, projecting with a variable diameter of 1.8-3.25 mm. They rather densely (12-18 /cm²) cover the colony surface, being rarely arranged in subparallel rows. On the prominent parts of a colony corallites are the largest and are more sparse (6-8 /cm²). Calices are fine with an aperature diameter of 1-2 mm.

Eighteen to twenty, very rarely 24, equal-sized septa of three cycles, not distinguishable by orders, are present. Septa are long, up to three fourth of a corallite radius, they are highly tapered and reinforced towards the calice periphery. Internal septal margins are dentate, fuse with the columella, and their upper margins can be elevated like pali. Lateral surfaces are intensively granulated with large spines and denticles. Three septa, next to the directive septum, fuse on their axial ends. The columella is small, dense oval or styliforme and does't quite reach the upper calice margin. The coenosteum is highly porous, densely covered by thin highly dentate laminae, which are arranged in subparallel curved or concentric rows.

The color of living corals is shades of gray-green.

This species differs from the other *Turbinaria* by the very abundant granulation of the septal apparatus and coenosteum, which is densely covered by laminae, arranged in curved or concentric rows.

Rare.

Location. Reefs of Khanh Hoa Province, Namsu, and Thu Quy Islands, depth 3-15 m.

Distribution. South China Sea, Vietnam, Taiwan, and Japan.

Genus *Balanophyllia* Searles Wood, 1844

Type species*: Balanophyllia calyculus* Searles Wood, 1834.

Diagnosis. Solitary or pullutate corals with cylindrical, cylindrico-conic or trochoid corallites, sometimes attached to the substrate by a pedicel. Corallites are round or oval with a ribbed and porous wall. Septa are fused according to Pourtalés plan. The columella is spongy. Tabulae are single and interseptal.

Balanophyllia cummingii Edwards and Haime, 1848

Fig. 50 - 5

Balanophyllia cummingii Edwards and Haime,(1848: Van der Horst (1922), Gardiner and Waugh (1939), Yabe and Eguchi (1941), Scheer and Pillai (1983)

Phodopsammia ovalis: Semper (1872).

Solitary or clustering colonial corals with pairwise adjoining or solitary large corallites, connected by a common coenosteum. The corallites are oval-elliptical. They reach 10-18 mm diameter and 10-15 mm height. Their outer surface is covered with costae. Calices are cup-shaped with vertical porous walls, and their depth is 8-12 mm.

There are four to five cycles of septa. Fifth cycle septa are incomplete. First and second cycle septa differ distinctly from the other septa by their enlarged sizes, and expanding in a fan-like manner, they project above the calice by 1-2 mm. They fuse with the columella at the bottom of the calice. Third cycle septa fuse with second cycle septa by their axial ends. Fourth cycle septa adjoin the lateral surfaces of the third cycle septa. Short fifth cycle septa are formed mainly on a calice wall. All septa are highly perforated, and larger septa are mainly in marginal parts. Septal edges, except for the first and second cycles, are strongly notched. The upper edges of the large septa, especially in lateral corallite sectors, are notched, and towards the periphery they split into separate bars connected by cross connections. The total number of septa is 84-96. The columella is not large, spongy, and elliptically elongated. Costae are broad and flat with scattered fine spines, and intercostal intervals are perforated in a dotted way. Tabulae are single and interseptal. The axial ends of lamellae are elevated.

Similar species *B. stimpsoni* has thin costae covered with irregular-shaped spines, which often fuse with each other.

Uncommon

Colonies are shades of yellow-red.

Location. Bai Tu Long Archipelago, and Anthoi Islands.

Distribution. The Red Sea, Sri Lanka, Vietnam, Japan, and the Philippines, depth 11-223 m.

Balanophyllia stimpsoni Verrill, 1865

Fig. 50 - 4

Solitary or clustering corals with cylindrical corallites having 10-14 mm diameter and 12-18 mm height. Their outside surface has fine costae. Calices are cup-shaped and shallow (4-6 mm) with thin porous vertical walls.

Four complete cycles of septa are present. Complete sets of septa of the fifth cycle are not available in all sectors. Thin first and second cycle septa differ distinctly from the other septa by their greater length. They separate from the upper edge of the calice and fuse with the columella at its bottom. Third cycle septa also reach the columella. Fourth cycle septa adjoin the lateral surfaces of the third cycle septa. Fifth cycle septa, as a rule, are short, and their length does not reach half of the corallite radius. Sometimes they can adjoin the fourth cycle septa. Lateral septal surfaces are ornamented with fine spines, arranged as compact parallel rows at an angle of 40-60º to the corallite wall. The perforation of septa can be observed mainly in the peripheral zone. The distal margins of large septa are even, and that of the others are notched with rows of spines of various ornamentation. The total number of septa is 60-72. The columella is well developed. It can occupy up to 1/3 of a calice bottom, and has a round or elliptical shape. Costae are thin and covered with irregular-shaped spines, which often fuse with each other. Tabulae are single, interseptal and subhorizontal.

Similar species *B. cummingii* has a small spongy columella elliptically elongated.

Rare.

The color of living corals is orange-red.

Location. Bai Tu Long Archipelago.

Distribution. Vietnam, and the Great Barrier Reef of Australia.

Genus *Dendrophyllia* Blainville, 1830

Type species: *Madrepora ramea* Linnaeus, 1758.

Diagnosis. Colonies are ramose, clusters, dendroid or arborescent. Corallites are cup-shaped round or oval with a costate and porous wall. Septa are fused according to Pourtales plan, the columella is spongy, often cellular. Tabulae are sparse, are laid occasionally between septal septa, and sometimes they are vesicular.

Dendrophyllia arbuscula Van der Horst, 1922

Fig. 50 - 6, C18 - 4

Dendrophyllia arbuscula Van der Horst, 1922: Eguchi (1934, 1941, 1968), Scheer and Pillai (1974, 1983), Pillai, Sheer, Vine (1976)

Dendroid-subplocoidal colonies with rare lateral offshoots in different directions. Corallites are subcylindrical, calices are 6-8 mm diameter and 7-15 mm height, and costae on the outer surface are clear. Calices are not deep, 3-5 mm, cup-shaped with a wide bottom and vertical walls.

Four complete cycles of septa are developed, and fifth cycle septa are single (Fig. 50a). Thin first and second cycle septa are distinguished from the other septa by their enlarged sizes, and their lateral surfaces and distal ends are free. In the base of the calice large septa merge with the columella. Fourth cycle septa adjoin the lateral surfaces of the third cycle septa by their axial ends. Fifth cycle septa adjoin septa of the fourth cycle. All septa are perforated, and first cycle septa have perforation only in their distal part. Distal septal ends bear fine denticles, and lateral surfaces are evenly ornamented with small spines. The total number of septa is 48-54. The columella is thick, trabecular and elliptical. Costae are thin and densely covered with one row of spines. Tabulae are sparse, thin, interseptal, and their lamellae are slightly inclined towards the coral axis.

Similar species *D. horsti* has a smaller colomella and is distinguished by a different scheme of septal insertion.

Uncommon.

The color of living colonies is deep green.

Location. Bai Tu Long Archipelago, and Cham Island.

Distribution. Red Sea, Maldives, Nicobar Islands, Vietnam, and Japan, depth 9-311 m.

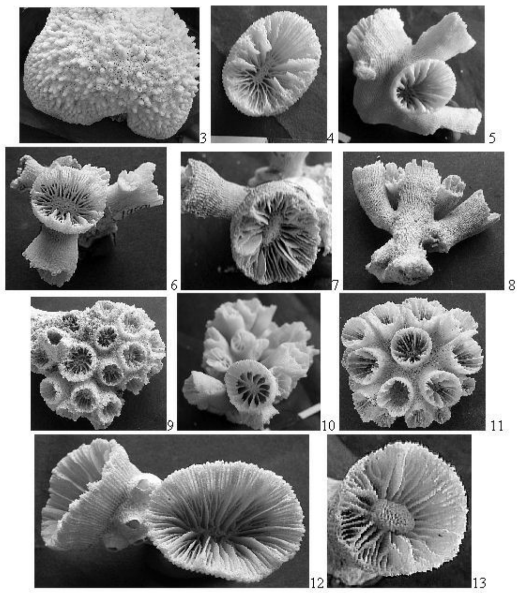


Fig. 50. Appearance of colonies. 1- *Lithophyllon undulatum*, spec. 1/95180, Bai Tu Long Archipelago; 2- *L. mokai*, spec. 1/95181, Bait u Long Archipelago; 3- *Astreopora cuculata*, spec. 1/9583, Con Dao Islands; 4 – *Balanophyllia stimpsoni*, spec. 40/9501, Khanh Hoa Province; 5 – *B. cummingii*, spec. 25/9501, Cham Island; 6 - *Dendrophyllia arbuscula*, spec. 31/9501, Cham Island; 7 – *D. sphaerica*, spec. 32/9501, Bai Tu Long Archipelago; 8- *D. cornigera*, spec. 26/9501, Bai Tu Long Archipelago; 9 – *Tubastrea aurea*, spec. 39/9501, Tho Chu Island; 10 - *T. diaphana*, spec. 38/9501, Con Dao Islands; 11- *T. coccinea,* spec. 37/9501, Con Dao Islands; 12- *D. robusta*, spec. 35/9501, Khanh Hoa Province; 13 – *D. aculeata*, holotype spec. 28/9501, Dangho Island, Bai Tu Long Archipelago

Dendrophyllia horsti Gardiner and Waugh, 1939

Fig. 50b

Dendrophyllia horsti Gardiner and Waugh 1939: Scheer and Pillai (1983).

Dendroid colonies with radially arranged conical corallites, slightly horn-shaped and bent. Their diameter is 6-8 mm and height 8-15 mm, with fine costae on the outer surface. Calices are round, cup-shaped, and rather deep (5-7 mm), their walls are thin, vertical and porous.

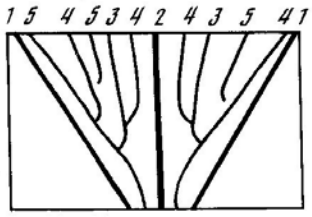


Fig. 50a

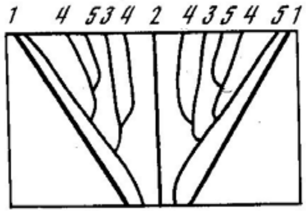


Fig. 50b

Fig. 50a. The scheme of septa insertion in *Dendrophyllia arbiscula*: four cycles form a complete set; septa of the fifth cycle make one third of a set.

Fig. 50b. The scheme of septa insertion in *Dendrophyllia horsti* and *D. sphaerica*: four cycles make a complete set; septa of the fifth form half of a set.

Septa of four complete cycles are developed, whereas fifth cycle septa contain a half of a set and are not developed in all sectors (Fig. 50b). First cycle septa are detached from the others by a barrier, and in the bottom of the calice they fuse with columella. Second and third cycle septa are fused in the axial zone, and also join the columella. Fourth cycle septa adjoin septa of the third cycle. Fifth cycle septa are short and free. All septa are thin, slightly ornamented with fine spines, and their lamellae are often perforated, except for the first cycle of septa. Distal septal edges are highly notched, and septa of the third through fifth cycles are notched to a greater extent than septa of the first and second cycles. The total number of septa is 54-66. The columella is thick, trabecular, and elliptical. Interseptal intervals are thinner than costae. Tabulae are single and interseptal, and their flat lamellae are slightly inclined towards the axis.

The color of living colonies is red or red-brown.

Similar species *D. cornigera* has a distinguishing scheme of septa insertion and a small spongy columella.

Relatively rare.

Location. Bai Tu Long Archipelago, Cham Island, and Con Dao Islands.

Distribution. Red Sea, Maldives, and Vietnam, depth 9-125 m.

Dendrophyllia cornigera (Lamarck, 1816)

Fig. 50 - 8, 50c

Caryophyllia cornigera: Lamarck (1816).

Dendrophyllia cornigera: Edwards and Haime (1860), Gravier (1920), Van der Horst (1922, 1926), Zibrowius (1980), Scheer and Pillai (1983)

?*Dendrophyllia subcornigera*: Eguchi (1968).

Dendroid colonies with cylindrical and subturbinate corallites with 8-10 mm diameter and 15-20 mm height, with fine costae on the outer surface. Calices are cup-shaped, 5-8 mm deep with vertical walls.

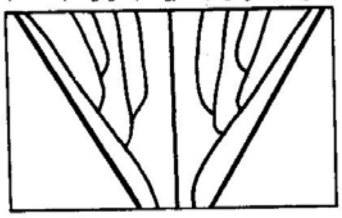


Fig. 50c. The scheme of septa insertion in *Dendrophyllia cornigera*: four cycles in a complete set; fifth cycle septa make one fourth of a set or less.

Four cycles of septa are formed, fifth cycle septa are rare and episodically have more than one fourth of a set (Fig. 50c). First cycle septa separate from the upper calice edge by 2-3 mm, gradually elongating towards the calice bottom, and fuse with the columella. Second cycle septa also separate from the calice edge, where they bulge in the form of short ribs, elongating towards the calice base. The axial ends of septa split into spines and pali forming the columella together with the rest of the septa; third cycle septa are short and develop mainly along the corallite wall. Fourth cycle septa are long, and fuse on their axial ends, which take the main part in columella formation, dividing into vertical spines and pali. Fifth cycle septa adjoin one of the fourth cycle septa. All septa, except for first cycle septa, are highly perforated, and their lateral surfaces are slightly ornamented with small spines. The distal edges of first cycle septa are smooth, and that of the others are highly notched up to dividing into separate spines. The total number of septa is 60-66. The columella is small and spongy, it is formed by long vertical spines and pali, bent to various degrees. Costae are low and dotted; they are ornamented by one to two rows of spines and connected by a few cross connections. The morphology of the base is not clarified because of a shortage of material.

Similar species. See *D. horsti*.

Rare.

The color of living corals is red, and the corallite skeleton is pink-violet.

Location. Con Dao Island.

Distribution. Mediterranean Sea, Red Sea, South Africa, Amiran and Providence Islands, Arafura Sea, and Vietnam.

Dendrophyllia japonica Rehberg, 1892

Fig. 68 - 9

Dendrophyllia japonica Rehberg, 1892: Van der Horst (1922, 1926), Gardiner (1939), Yabe and Eguchi (1932), Eguchi (1934, 1965, 1968)

Arborescent colonies with thick branches, branching in all directions. Branch thickness is 12-35 mm, and their ends can branch dichotomously. Branch surfaces are evenly covered by separate corallites or groups of 2-3 corallites with a diameter of 5-7 mm and a height of 4-6 mm.

Calices are round, cup-shaped and small (3-5 mm), and the bottom is flat with a noticeable elevation of the axis. Branch and corallite surfaces are covered with clear costae.

Four complete septal cycles are developed. Reinforced first cycle septa freely reach the columella. Second and third cycle septa fuse, and their axial ends are fused with the columella. The fourth cycle septa adjoin the third cycle septa. Short fifth cycle septa can be found in some sectors. All septa are slightly ornamented with fine spines. The distal septal ends are slightly notched. The total number of septa is 36-48. The columella is thick, trabecular, and occupies up to one third of the calice area. Costae are broad and low. Tabulae are rare, interseptal, slightly bulging, and their lamellae are axialy inclined.

The color of living colonies is deep green.

Similar species *Tubastrea micranthus* has arborescent colonies with long branches and a small columella.

Uncommon.

Location. Con Dao, and Phu Quoc Islands.

Distribution. Vietnam, Japan, Caroline Islands, and New Zealand.

Dendrophyllia sphaerica Nemenzo, 1981

Fig. 50 - 7, 50d

Dendroid colonies with individual long corallites, diverging in various directions at an angle of 45-60º. The corallites are subcylindrical and slightly conical, having a diameter of 8-14 mm and height of 12-20 mm. The upper part of the corallites (4-10 mm) is covered with thin costae, whereas the lower part is fouled by calcareous algae. Calices are round with thin vertical walls, and their depth is 3-5 mm.

Septa of four complete cycles are developed. Fifth cycle septa are available in half of the sectors (Fig. 50d). First cycle septa are reinforced in comparison with the other septa and bulge upwards with respect to them. First cycle septa merge with the neighboring septa near the upper calice edge. They are free as well as second cycle septa, and reach the columella in the bottom of the calice. Second cycle septa adjoin the third cycle septa, merging with the axial structure, on their axial ends. Short fifth cycle septa adjoin the fourth cycle septa. All septa, except for the first cycle, are perforated. The distal edges of the first cycle septa are smooth, whereas that of the rest of the septa are notched. The lateral surfaces of all septa are abundantly granulated with fine spines. The total number of septa is 60-72. The columella is large, thick, ellipsoidal, and trabecular. Costae are thin and densely covered with thick rows of spines. Tabulae are rare, interseptal; they bulge up to the point that they are vesicular. They are present primarily in the distal parts of a corallite.

The color of living colonies is red-brown.

Similar species *D. arbuscula* has more large and high corallites and has 1.5 times as many septa.

Uncommon.

Location. Bai Tu Long Archipelago, Namsu and Anthoi Islands.

Distribution. Vietnam, and the Philippines.

Dendrophyllia robusta (Bourne, 1905)

Fig. 50 - 12, 50e

Lobopsammia robusta Bourne, 1905.

Dendrophyllia robusta (Bourne): Gardiner and Waugh (1939), Scheer and Pillai (1983).

Clustered colonies with large corallites, radiating in pairs in different directions. Corallites are oval, their diameter is 12-18 mm and height 15-25 mm, and their outer surface is clearly costate. Calices are deep, up to 10-14 mm deep with vertical porous walls up to 0.5 mm thick.

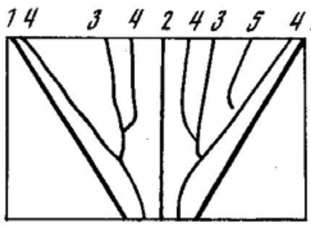


Fig. 50d

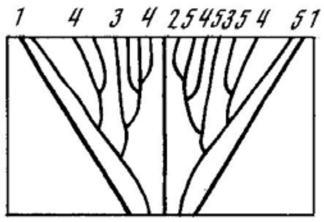


Fig. 50e

Fig. 50d. The scheme of insertion of septa in *Dendrophyllia japonica*; four cycles with complete (full) set, and the fifth cycle septa with 1/8 of a set

Fig. 50e. The scheme of insertion of five cycles of septa; a complete set in *Dendrophyllia robusta*, *D. laboreli* and others

A complete set of five cycles of septa is developed (Fig. 50e). First and second cycle septa are lanceolate, and they are longer than the other septa. Diverging from the upper calice edge, they fuse with the columella near its bottom. Third and fourth cycle septa are connected on their axial ends near the columella. Fifth cycle septa adjoin lateral surfaces of the fourth cycle septa in the upper part of the calice. All septa have a light ornamentation by low spines. The distal edges of first and second cycle septa are smooth, notched with very small denticles, and the other septa have highly notched edges. All septa are perforated, large septa are perforated mainly along the calice wall. The total number of septa is 80-96. The columella is small, trabecular, and rather dense. Costae are broad and bear two rows of very fine spines. They are separated by porous intervals. Tabulae are interseptal, rare, and developed mainly in periphery.

Similar species *D. laborelli* has a large, elliptical, trabecular columella which is sometimes rather porous.

The color of living colonies is red-brown.

Rare.

Location. Reefs of Khanh Hoa Province.

Distribution. Red Sea, Sri Lanka, and Vietnam.

Dendrophyllia laborelli Zibrowius and Brilo, 1984

Dendroid, subplocoid and fan-shaped colonies with individual pullutate corallites of subcylindrical and elliptical shape having 10-15 mm diameter and 12-30 mm height. The outer surface is clearly costate. Calices are cup-shaped and deep, up to 8-12 mm.

Septa form five complete cycles. First and second cycle septa are noticeably longer in comparison with the other septa, their lamellae are free and reach the columella near the bottom of the calice. Second and third cycle septa are also connected with columella. Fourth cycle septa adjoin lateral surfaces of the third cycle septa, and short fifth cycle septa adjoin the fourth cycle septa. All septa are perforated. Large septa have perforations mainly in the periphery along the corallite wall. The distal ends of the first and second cycle septa are covered by a row of very fine denticles. The edges of the other septa are highly notched up to disintegration into separate spines. Lateral surfaces of all septa are ornamented with very fine spines arranged in parallel vertical rows. The total number of septa is 84-96. The columella is large, elliptical, trabecular, and sometimes rather porous. Costae are thin and covered by fine spines. Tabulae are rare, interseptal, their flat lamellae are laid beginning from the corallite wall up to the columella.

The color of living colonies is yellow-red.

Similar species *D. robusta* has a small, trabecular, rather dense columella.

Relatively rare.

Location. Bai Tu Long Archipelago, Dang Kho, and Phong Vong Islands.

Distribution. Western Africa, Canaries, Mozambique, and Vietnam.

Dendrophyllia aculeata sp. nov.

Fig. 50 - 13

Holotype. Specimen 28/9501, Museum of Institute of Marin Biology, Vladivosok, Russia. Dang Kho, depth 11 m..

Solitary corals, connected by a common base (bottom) or coenosteum**,** with long subcylindrical corallites with a diameter of 7-13 mm and height 15-20 mm, and an outer surface covered with a clear spinulose costae. Calices are cup-shaped and deep (6-8 mm) with thin vertical walls and sparse pores.

Four to five cycles of septa are developed. The fifth cycle of septa have half of a set (Fig. 12). Lanceolate septa of the first cycle are distinguished by their size from the other septa. They separate from the upper calice edge, reaching up to one third of the corallite radius lengthwise, and merge with the columella at the base of the calice. Second cycle septa are slightly smaller and thinner than first cycle septa. Fourth cycle septa adjoin by their axial ends the lateral surfaces of the third cycle septa, and the axial ends of the third cycle septa merge with the columella near the second cycle septa. Fifth cycle septa adjoin the lateral ends of the fourth cycle septa in their middle. All septa are abundantly ornamented with fine spines, which on large septa are arranged in parallel rows at small angle to the corallite wall. The distal septal edges of the third and higher cycles are highly notched up to the formation of a row of spines. In the upper part of the calice septa are mainly perforated. First and second cycle septa are perforated to a lesser degree. The total number of septa is 54-72. The columella is small and trabecular. Costae are clear in the form of well-developed rows or spines of complicated shapes which fuse with each other. Tabulae are interseptal, single, and flat.

The color of living corals is deep green.

The new species is distinguished from the known species *Dendrophyllia* by the single growth form, well developed small dense columella, and five cycles of septa.

Etymology. Aculeus (Latin) - aculeate

Rare.

Location. Bai Tu Long Archipelago, and Con Dao Island.

Distribution. Vietnam, depth 11-21 m.

Genus *Tubastrea* Lesson, 1834

Type species: *Tubastrea coccinea* Lesson, 1834.

Diagnosis. Colonies are plocoid or dendroid with corallite sprouts in the marginal zone. Columnar corallites are connected by ribbed cenosteum. Septa are partially merged according to Pourtale's plan**,** columella is spongy, can be well developed and is presented by weak weave of Axis ends, ends of the first and second cycles septa. Tabulae are available permanently, and are laid evenly and periodically between septal intervals.

Tubastrea aurea (Quoy and Gaimard, 1833)

Fig. 50 - 9

Lobophyllia aurea Quoy and Gaimard, 1833

Tubastrea coccinea: Lesson (1834). :

Dendrophyllia aurantia: Dana (1846).

Dendrophyllia willeyi: Van der Horst (1922).

Dendrophyllia aurea: Van der Horst (1926).

Tubastrea aurea (Quoy and Gaimard): Boschma (1953), Eguchi (1968) cum syn., Scheer and Pillai (1983), Nakamori (1986)

Plocoid or subplocoid colonies with compact cylindrical corallites, projecting above the coenosteum by 6-10 mm and having a diameter of 8-10 mm. Calices are deep – 5-8 mm, and funnel-shaped.

Four cycles of septa are developed, and septa of the fourth cycle are not developed in all sectors. The first and second cycles of septa separate from the upper calice edge and reach the columella, and their axial ends do not fuse. Third and fourth cycle septa develop mainly on the calice walls in a form of short ridges, highly perforated up to disintegration into rows of individual spines. In the main sectors third cycle septa sometimes can reach the columella, fusing with the second cycle septa. The distal ends of the first and second cycle septa are smooth, and slightly notched in their upper parts. Their lateral surfaces are slightly ornamented with fine spines. The total number of septa is 30-40. The columella can be either very small or occupy up to one third of the calice; it can be porous or very dense in different corallites of the same colony. Costae are regular, and not always distinct on some corallites. Tabulae are interseptal and rare. They are often laid down on the entire area from the wall to columella in every 0.8-1.2 mm, their lamellae are inclined and raised near the axis.

The color of colonies is red.

Similar species *T. coccinea* has first cycle septa that differ noticeably by their reinforced width and length and rare interseptal tabulae.

Common.

Location. Bai Tu Long Archipelago, Cham, Con Dao, Thu, Thotu, Anthoi Islands, and reefs of Khanh Hoa Province.

Distribution. Red Sea, Indian and Pacific Oceans from Madagascar to Hawaii and ? Panama.

Tubastrea coccinea (Ehrenberg, 1834)

Fig. 50 - 11, C17 - 6,7

Oculina coccinea Ehrenberg, 1834

Dendrophyllia coccinea: Dana (1846).

Coenopsammia coccinea: Marenzeller (1907).

Dendrophyllia danae: Verrill (1877).

Dendrophyllia ehrenbergiana: Van der Horst (1922).

Dendrophyllia coccinea: Van der Horst (1922, 1926), Head (1980).

Tubastrea coccinea (Ehrenberg): Eguchi (1968), Scheer and Pillai (1983).

Plocoid subdendroid colonies with disconnected cylindrical corallites up to 8-14 mm diameter, projecting above the coenosteum by 8-17 mm. The surface is covered by clear costae. Calices are cup-shaped, and deep, 8-12 mm.

Three-four cycles of septa are developed, and fourth cycle septa rarely have more than a half of a set. First and second cycle septa separate from the upper calice edge and merge on their axial ends forming a trabecular columella. First cycle septa differ noticeably by their reinforced width and length. Third cycle septa are narrow ridges widening towards the calice base and adjoining the second cycle septa by their axial ends. Fourth cycle septa develop only on the calice wall in the form of individual spines, merging in rows. The distal ends of large septa are even. Their lateral surfaces are moderately ornamented with fine spines, arranged in vertical rows. The total number of septa is 36-42. The columella is, as a rule, porous and small. Costae are dense, and they are interconnected by numerous cross connections. Tabulae are interseptal, rare, laid in every 2-4 mm, their lamellae are flat, and lower near the axis and raised in the periphery.

The color of colonies is red and orange.

Similar species. See *T. aurea*.

Common.

Location. Bai Tu Long Archipelago, reefs of Khanh Hoa Province, Thotu, Con Dao, and Anthoi Islands.

Distribution. Red Sea, Maldives, ?Seychelles, Vietnam, Japan, and the Marshall Islands.

Tubastrea diaphana (Dana, 1846)

Fig. 50 - 10

Dendrophyllia diaphana Dana, 1846

Tubastrea diaphana (Dana): Scheer and Pillai (1983).

Plocoid and subplocoid colonies with adjoining conical corallites, capable of budding and radiating fan-like. Corallites are round, slightly conical, with a diameter of 8-10 mm and a height of 10-12 mm, and their outer surface is finely costate. Calices are funnel- and cup-shaped, very deep (8-15 mm) with thin vertical walls.

Three to four cycles of septa are developed, and fourth cycle septa more often do not have a complete set. First and second cycle septa are lanceolate and reach half of a corallite radius. They separate from the upper calice edge and merge with the columella near the axis. Third and fourth cycle septa develop only on the calice wall in a shape of thin ridges or spines fusing into rows. All septa are ornamented with fine spines, arranged in rows, parallel to the even distal margins. Perforation is typical for all septa, whereas large septa are perforated only near the calice wall. The total number of septa is 36-42. The columella is not large, spongy, and consists of axial septal ends. Costae are thin, and densely covered with fine spines. Tabulae are interseptal and rare, are laid down every 4-6 mm, and their lamellae are raised near the axis and inclined in the periphery.

The color of living colonies is red-brown.

Similar species *T. coccinea* and *T. aurea* are distinguished their cylindrical compact corallites.

Relatively common.

Location. Reefs of Khanh Hoa Province, Thu, Con Dao, and Thotu Islands.

Distribution. Red Sea, Cocos Islands, Singapore, Vietnam, Fiji, Samoa, and the Great Barrier Reef of Australia, from the lower littoral level up to 120 m.

Tubastrea micrantha (Ehrenberg, 1834)

Fig. 68 - 10, C18 - 3

Oculina micranthus Ehrenberg, 1834

Coenopsammia micranthus: Ortmann (1888).

Dendrophyllia nigrescens: Dana (1846), Vaughan (1918).

Coenopsammia nigrescens: Edwards and Haime (1860).

Dendrophyllia micranthus: Van der Horst (1922, 1926), Scheer and Pillai (1974)

Tubastrea micrantha (Ehrenberg): Loya and Slobodkin (1971), Mergner and Schuhmaher (1974) Scheer and Pillai (1983)

Dendroid and arborescent colonies with long branches, ramifying in various directions with frequent lateral offshoots and numerous individual corallites. Branches are 10-25 mm thick and sometimes more than 1 m long. Corallites are cylindrical, their diameter is 6-8 mm and height 8-15 mm with clear costae. Calices are deep – 5-8 mm with vertical walls and few pores.

Three complete cycles of septa are present. Fourth cycle septa are present chiefly in the main sectors of some corallites. They are clearest in axial corallites on the ends of the main branches. First and second cycle septa are lanceolate. Diverging the upper calice rim and increasing in length towards its base, they become claviform reinforced and diversely bent, forming or not forming a columella. Third and fourth cycle septa are present in the majority of corallites only in the shape of low thin ridges on calice walls. In axial corallites third cycle septa form lamellae, adjoining the middle of the lateral surface of the second cycle septa, and short septa of the fourth cycle adjoin the third cycle septa. Perforation of septa is weak, and mainly peripheral. Ornamentation of lateral surfaces is fine in the form of small spines, arranged in rows, corresponding to the distal septal margin. The total number of septa is 36-48. The columella is small and spongy. Costae are thin with wide spaces between them and clearly seen insertion of alternate metasepta. Tabulae are not found. Rod-shaped cross connections develop between septa.

From other species *Tubastrea* this species is distinguished by dendroid and arborescent colonies with long branches.

Common on reef slopes.

Location. Everywhere from the Gulf of Tonkin to the Gulf of Siam, dept 8-40 m.

Distribution. Red Sea, Aldabra Atoll, Sri Lanka Island, Seychelles Islands, Mascarene Islands, Maldives, Nicobar Islands, Cocos Islands; Singapore, Vietnam, Japan, the Philippines, Palau, Fiji, and the Great Barrier Reef of Australia.

Genus *Heteropsammia* Edwards and Haime, 1848

Type species: *Heteropsammia michelini* Edwards and Haime, 1848.

Diagnosis. Single unattached small corals with a flat basis. Corallites are round, septal configuration corresponds to Pourtalés plan.

Heteropsammia cochlea (Spengler, 1781)

Fig. 75-2

Corallites are round or somewhat compressed laterally, with a diameter of 6-12 mm. The corallite wall is spongy on the outside, formed of interlaced skeletal elements.

Thirty seix to forty-eight septa of four cycles are present. First and second cycle septa are the widest and highest, and are wedge-shaped. Their distal margin is rounded and in the same way as lateral surfaces is densely ornamented by fine tubercles. Their internal margin is almost vertically descends towards the columella. Second cycle septa are only slightly shorter than first cycle septa. Short, narrow third cycle septa are much lower, but are also ornamented along the distal margin. Fourth cycle septa are fused laterally, to the sides of the third cycle septa, but often higher than they and slightly thicker. Closer to the corallite center they fuse. The distal margin of all septa, except for first cycle septa, is flatly inclined to the columella, and dentate. The columella is broad, spongy, and oval.

The color of living corals is gray or hazel.

Location. Namsu, Ant Hoi, and Tho Chu Islands, depth 6-10 m.

Distribution. Widely distributed in the Indian Ocean from the coast of Africa and the Persian Gulf to the Coral Sea of the eastern coast of Australia.

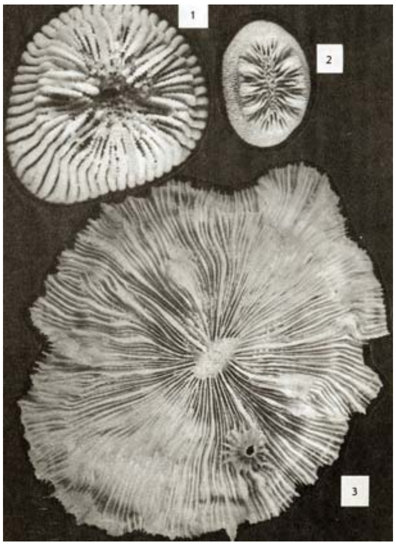


Fig. 75. 1 - *Heterocyathus aequicostatus*, spec. 1/95297, Namsu, depth 6 m; 2 - *Heteropsammia cochlea*, spec. 1/95296, Is. Namsu, depth 6 м; 3 - *Echinophyllia nichihirae*, spec. 1/95260, Is. Thu, depth 42 m.

Family Caryophylliidae Mather, 1994

Genus *Heterocyathus* Edwards and Haime, 1848

Type species: *Heterocyathis aequicostatus* Edwards and Haime, 1848.

Heterocyathis aequicostatus Edwards and Haime, 1848

Fig. 75-1

Solitary corals, unattached, with a flat base. Corallites are round, having a diameter of up to 12 mm. The corallite wall is costate on the outside. Costae are intensively ornamented with fine tubercles, and continue down to the lower corallite surface, where they converge to a point.

Thirty to forty septa of four to five cycles are formed. First and second cycle septa are wedge shaped, and the widest and highest have free internal margins. Second cycle septa are somewhat shorter. Third cycle septa are narrow, and uniform in width along the entire length. They are noticeably lower and shorter than septa of the first cycles. Septa of higher cycles (fifth and fourth) laterally adjoin septa of the lower cycles (fourth and third). Septa are abundantly ornamented by tubercles on the lateral surfaces and along the margin, which makes them look finely dentate. The columella is wide and spongy.

The color of living corals is hazel or green.

Location. Nam Zu, Ant Hoi, and Tho Chu Islands.

Distribution. Widely distributed in the Indian Ocean from the coast of Africa and the Persian Gulf to the Coral Sea in the Pacific Ocean.

3.8. Family Agariciidae Gray, 1847

Many of the structural features of the family Agariciidae are called "pavonoid", as they are similar to the structures of corals of the genus *Pavona*. Corals of the genus *Pavona* are among most variable and difficult corals to identify, therefore we shall consider the morphology of these corals more in detail. The capacity for formation of colonies with different degrees of polyp integration and different structures is typical for *Pavona*. They can be cerioid, in which corallites closely adjoin each other and have polygonal shapes in cross-section; or thamnasteroid, in which corallites are spaced, with an space filled with coenosteum, and have an oval shape; or hydnophoroid, on the surface of which septocostal ridges are seen, separating corallites series, or separate pointed projections, around which corallites are chaotically grouped.

The following colony forms are usually distinguished among *Pavona*: encrusting, foliose of various shapes, columnar, massive, lamellar and digitate with vertically diverging branch-like projections (Veron and Pichon, 1979). It is known that colony formation and its shape are closely connected with environmental conditions (Foster, 1979, 1980, 1985; Preobrazhensky, 1986). Various colony growth forms are derivatives of each other, and a small encrusting colony is always the initial form. As a rule, colonies of different forms can be found within a species, and combination of several forms within the same colony. However some species-specific limitations and regularities can be observed here. Thus, *P. cactus* and P. *decussata* have colonies with a foliose form, with thicker laminae in the latter species. However it is difficult to confuse similar sized colonies of these species, as the thin edge of laminae in *P. cactus* are always strongly undulating, whereas laminae margin in *P. decussata* are always even. Such features can be important for diagnostics, since characteristics of corallites of these species are somewhat similar. Certain

Pavona species, forming massive and columnar colonies, do not form foliose colonies, though the latter form is typical, as a rule, for the other species.

The growing margin of a colony at its base is always free, lamellar and at a distance of several centimeters off the substrate in large colonies, and at least at a distance of 2-3 mm in small colonies. The colony margin surface, facing the substrate, can be even or wavy. Waviness is observed in species which have colonies that bear septo-costal ridges on the surface. These ridges are usually arranged perpendicular to the growing margin. Corresponding to every ridge, on the lower surface of the growing margin these are grooves, which make the surface wavy. The lower surface of a growing margin can be also be covered with ridges that are fuzzy or rounded margin or rows of fine spines. The nature and disposition of these elements are fixed for every species and can be highly specific.

A common feature for all *Pavona* is also what Wells and after him Veron and Pichon as well call the “absence of the corallite wall” (Wells, 1956; Veron and Pichon, 1979). In fact, a normal wall, i. e. elevated over the external septal margins, is absent along the entire corallite circumference in such species as *P. cactus, P. explanulata*, and at some areas of such species as *P. venosa* and *P. varians*. These typical features indicate that all variants of *Pavona* colonies, formed initially from a planula, develop further by way of intra-tentacular budding. Indeed, even in *P. venosa*, which has colonies that are so similar to cerioid ones, only some of the corallites are detached and surrounded by an elevated wall. The other corallites of these colonies are situated in groups of three to six. Such a group is surrounded by a common elevated wall, and inside the group corallites are brought closely together but not separated by anything.

One can write much on the subject “what is a corallite wall for *Pavona*?”, but some ambiguities will still remain. A corallite wall is a skeletal formation, limiting its internal cavity along the external surface of a polyp. Morphologically this formation can have a wide variety of different structures, and various types of corallite walls are described in detail in special publications (Fundamental paleontology, 1962; Wells, 1956). It is important for us to stress that the presence of intra-tentacular budding and of a high level of integration in *Pavona* does not exclude their capacity for development of a wall between corallites or its fragments between corallite groups. A narrow wall, consisting of one row of trabeculae, can be clearly viewed around single corallites or corallite groups in such species as *P. venosa*. The presence of this wall does not prevent septa of one corallite from extending to the other corallite, and a colony, outwardly corresponding to a cerioid one, actually is a thamnasteroid one, developing by the way of intra-tentacular budding. Colonies of *P. cactus, P. clavus* and *P. explanulata* have a smooth surface. If we find swellings or projections on these colonies, it means that they are either consequences of epibiont colonies or rudiments of new laminae, if we mean foliate colonies. But septo-costal ridges are often formed on the surface of such species as *P. decussata, P. frondifera,* and *P. varians*.

Morphologically it is nothing but a single-rowed trabecular wall, highly elevated between corallites and rows (series) of corallites. Septa, many of which extend from one corallite to another, extend from the very top of this wall to the corallite center. Horizontal cross connections between the wall trabeculae can be well seen along the upper margin of such a ridge.

The presence or absence of septo-costal ridges together with areas, where a wall between corallites is formed, is a stable feature for the diagnosis of *Pavona* in combination with the other features, such as division of septa into orders and colony shape. The septa of *Pavona* consist of one row of trabeculae, which can be variously calcified and ornamented, and which noticeably affects their thickness. Since the calcification of scleractrinian skeleton is closely connected with environmental conditions, these features are highly variable even in the same colony, and cannot be used for species diagnostics. The septa of *Pavona* extend from one corallite to another, and they are called septo-costae. The distal septal margin can be horizontal or inclined to various degrees. If the septocostal distal margin is horizontal, then the calice is not pronounced. This is typical for such colony areas, where septocostal ridges are not developed. In other species septal distal margins are inclined towards the corallite center. This inclination permits the designatation of a calice, and this is always noticeable enough and that is why it is a stable diagnostic feature. If the inclination of the distal margin towards the calice bottom is great, then there is no noticeable twist between the distal and proximal margins. In such a case a cup indentation – fossa – is not pronounced. When a free internal septal margin is high enough and vertically descends towards the calice bottom, a deep axial fossa is formed, which is one of the typical features of not only *Pavona* but also of many other representatives of scleractinians of the described families. Near the internal septal margin of some *Pavona* species, projections form which are usually called “palimorphic”. These are triangular projections, where, as a rule, ornamentation is reinforced, which produces some thickening of the septum in this area. Only one such projection, located at uniform distances from corallite centers, can be often found on septo-costae between two neighboring corallites. Septa in *Pavona* corallites are distinguished by their sizes: they are arranged in orders (size classes). As a rule, two to three orders are observed. However, size orders and cycles of septa do not coincide. Thus, the first order which for *Pavona* includes six to fourteen septa, includes both first and second cycle septa. If a number of septa, constituting a size order, is not stable and changes even from one corallite to another, then size ratios between orders is one of the most important and stable diagnostic species features. The number of orders, in which septa are grouped, may not be stable even within the same colony. Nevertheless, if a species is capable of developing septa of more than two orders, this feature will surely be displayed at least in a small number of corallites.

The columella in *Pavona* corallites is an axial formation in the shape of a single trabecula or a group of twisted trabeculae. A free columella, located at the bottom of the fossa, can be represented by a short ornamented rod, lamina (in a corallite with an oval cross section), granular, or an irregular lump-like form. As a rule, these columella shapes can be found within the same colony and are not species-specific. At the same time the absence of a columella in the overwhelming majority of corallites is a stable enough species-specific feature.

Genus *Pavona* Lamarck, 1801

Type species: *Madrepora cristata* Ellis and Solander, 1786.

Diagnosis. Submassive, encrusting and/or foliose colonies with two-sided laminae. The corallite wall is poorly developed or absent.

Pavona cactus (Forskål, 1775)

Fig. C23-6

Madrepora cactus Forskål, 1775

Pavona cactus (Forskål): Klunzinger (1879), Veron and Pichon (1980) cum syn., Sheppard and Sheppard (1991)

Colonies are foliose, and consist of thin, variously bent, anastomosing laminae with a wavy margin, joined by a common basis. Lamina thickness at the margin is 1 mm, at the base, 3-5 mm. The height of laminae is several centimeters. Surfaces of laminae are smooth, without ridges or lumps. Corallites are 2-4 mm in diameter, and are superficial. They are arranged in regular rows, which are located parallel to the plate margin at a distance of 2-4 mm from each other. A row can include 2-30 corallites, and the distance between their centers may be 1-2 mm. Corallite walls are not developed, and calices are not pronounced. At the colony base the growing margin adjoins the substrate and is separated from it only in some small areas. The lower surface of a colony is smooth with weakly developed ridges, located perpendicular to the growing margin.

Septocostae are formed, arranged in two orders, differing in length and shape. Six to eight first order septocostae almost reach the columella, and they are abundantly ornamented with spines on their lateral surfaces. Their internal margin descends vertically to the bottom of the fossa. The upper septocostal margin is evenly shape, and not dentate. Reinforcements and palimorphic projections are not developed. Second order septocostae (eight to twelve in number) are slightly lower and shorter. Their internal margin gently descends to the bottom of the calicular depression. The ornamentation of the second order septocostae is very minor. Otherwise they are similar to first order septocostae. Internal septal margins are not fused. The fossa is round, less than 1 mm wide, and not deep. The columella is in the shape of a short ornamented rod with fine spines.

The color of living colonies is brown.

Similar species *P. frondifera* has larger corallites and less branched fronds.

Common.

Location. Phu Quy, An Thoi, Tho Chu Islands, depth 1-25 m.

Distribution. Widely distributed in the tropical zone of the Indo-Pacific from the Red Sea to the Marshall Islands.

Pavona decussata (Dana, 1846)

Fig. C20 - 8

Agaricia decussata Dana, 1846

Pavona decussata (Dana): Veron and Pichon (1980) cum syn., Veron and Kelley (1988), Sheppard and Sheppard (1991)

Colonies are foliose, and consist of several vertical laminae, attached to the substrate by a common base. Laminae are 2-4 mm thick at the margin and more than 8 mm at the base. Lateral surfaces of laminae are smooth, laminae margins are slightly wavy. Small projections on the lateral surfaces appear only as the result of settlement of barnacles and polychaete worms. Corallites are surperficial, 3-4 mm in diameter, and some of them are grouped in rows, consisting of 3-8 corallites, subparallel to the lamina margin. The rest are disorderly arranged. The corallite wall is poorly developed or absent. The growing margin of a colony is even at the base of laminae, closely adjoins the substrate, and is sometimes spaced 1-6 mm from it.

Septocostae are ranged in three-four orders. First order septa (up to 12) are straight, thin, and weakly ornamented with pointed spines on lateral surfaces. Their distal margin is horizontal, sharp, dentate, and proximal margins almost reach the columella and vertically descend to the bottom of the fossa. Second order septa (up to 11) are distinguished by their shorter length, and their internal margins are at a greater distance from the corallite axis and gently descend to the bottom of the calicular depression. Their thickness, height and degree of ornamentation are the same as in septa of the first order. Third order septa are significantly lower and shorter than first order septa. They are thin, laminae-like, without ornamentation, and with a thin sharp margin. Fourth order septa are very short, rudimentary, with rarely more than two to three in large corallites. Internal septal margins are not fused. The fossa is deep, round or oval, and 0.5-1 mm wide. The columella is in the form of a granule or a short spine, and a platform is formed of merged radial elements at its base.

The color of living colonies is green.

Similar species *Pavona anai* and *P. frondifera* have more branched fronds.

Common in various reef zones.

Location. Bai Tu Long Archipelago, reefs of Khanh Hoa Province, Phu Quy, An Thoi, Tho Chu, Con Dao, and the Spratly Islands, depth 1-30 m.

Distribution. Distributed everywhere in the tropical zone of the Indo-Pacific.

Pavona explanulata (Lamarck, 1816)

Fig. 69-3

Agaricia explanata Lamarck, 1816

Pavona explanata (Lamarck): Pillai and Scheer (1976), Veron and Pichon (1980) cum syn., Sheppard and Sheppard (1991)

Colonies are massive, rarely with hilly projections on the smooth, even, surface, and peripheral margins are free and lamellar. Corallites are superficial, 2-7 mm in diameter, and located irregularly, with only with a slight tendency to formation of curved rows. Corallite walls are not developed.

Septocostae are formed, arranged in two orders. First order septocostae (nine to twelve in number) curve between corallites, and have a sharp horizontal margin. They almost reach the columella with their internal margin, which forms small palimorphic projections (reinforced and elevated) in many corallites, and after this the septocostae descend vertically to the bottom of the calicular depression. Sometimes projections are located at a distance from the internal septal margin, as they are displaced towards the external corallite margin. Second order septocostae (nine to twelve in number) are significantly shorter, their internal margins are at a greater distance from the columella, and very gently descend to the bottom of the fossa. Lateral septal surfaces are moderately granulated with fine lumps. Second order septa are significantly thinner and lower than first order septa in depressions on colony surface where corallites are brought closely together. The fossa is deep, round and oval. The columella is in the form of a granule of an irregular shape.

The color of living corals is gray, brown, pink, orange, or purple.

Similar species *P. minuta* has columnar colonies with else corallites.

Usually common .

Location. Known on the majority of reefs from the Gulf of Tonkin to the Gulf of Siam and the Spratly Islands, depth 1-25 m.

Distribution. The Red and Arabian Seas, Persian Gulf, Madagascar, Cocos-Keeling and Amirante Islands in the Indian Ocean, Vietnam, the Great Barrier Reef and Lord Howe Island in the Pacific Ocean.

Pavona clavus (Dana, 1846)

Fig. 69-4

Agaricia clavus Dana, 1846

Pavona clavus (Dana): Marenzeller (1901), Veron and Pichon (1980), Veron and Kelley (1988)

Colonies are massive, columnar, with smooth surfaces, with a free laminar margin at the base. Calices are pronounced, since the distal septal margin is inclined towards the corallite center. The corallite wall is poorly developed. A single-rowed circular synapticular bridge (cross connection) can be viewed at the base of septocostal ridges of lightly calcified colonies. The corallites are round, arranged in curved rows, or single, and septocostae between them are elevated the a form of triangular ridges. At the colony base almost all corallites are arranged in series, separated from each other by septocostal ridges, parallel to the growing margin, the lower surface of which is streaked by grooves, between which single rows of fine spines can be seen.

Two orders of 14-26 septocostae are formed. First order septa have a high, even, sharp margin. Their lateral surfaces are abundantly ornamented with irregular granules. First order septa almost reach the columella, second order septa are significantly shorter, uniform in height and also abundantly ornamented. The internal margin of the first order septa vertically descents to the calice base, and the internal margins of the second order septa, which are inclined towards the corallite center to a greater degree, are almost not expressed , and very low. All septa are straight and even. Their internal margins are free. The fossa is round, not deep. The columella is the form of a short round granule.

The color of living colonies is gray and brown.

Similar species *P. minuta* has less columnar colonies.

Common.

Location. Reefs of Khanh Hoa Province, Il-Buase, Con Dao, Phu Quy, Tho Chu, Namsu, An Thoi, and the Spratly Islands, depth 1-30 m.

Distribution. Widely distributed in the Indo-Pacific from the Red Sea to the Marshall Islands and Hawaii.

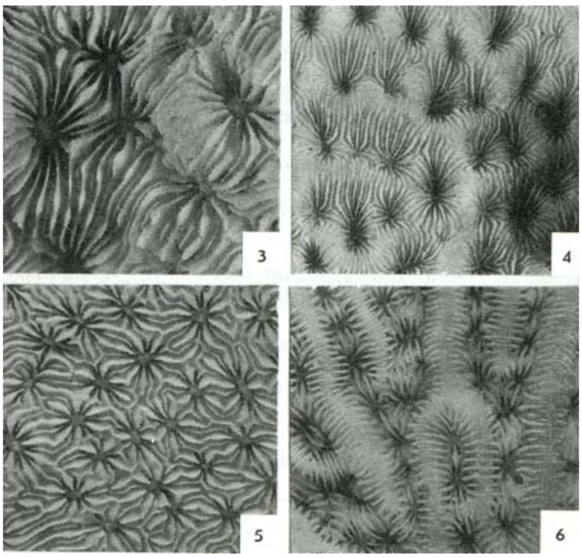


Fig. 69. 3 -P. explanulata, spec. 1/95229, Is. Thochu, depth 6 m; 4 - P. clavus, spec. 1/95230, Is. Tyaklon, depth 3 m; 5 -P. minuta, spec. 1/95231, Is. Tyaklon, depth 2 m; 6-P.varians, spec. 1/95232, Is. Cham, depth 6 m.

Pavona minuta Wells, 1954

Fig. 69-5

Pavona minuta Wells, 1954: Veron and Pichon (1980) cum syn., Veron and Kelley (1988), Sheppard and Sheppard (1991)

Colonies are columnar, with a smooth surface, and corallites are single, adjoining each other, and superficial. The inclination of the distal septal margin towards the corallite center is slightly pronounced only at the top. The wall is poorly developed, and a massive multi-row circular cross connection can be viewed between septocostae. The growing margin at the colony base is hardly at a distance of 1-2 mm from the substrate, and its lower surface is covered by interrupted ridges, which are perpendicular to the margin.

Septocostae are arranged in two rows. First order septa (six to eight in number) are even with almost horizontal, weakly dentate margins. They almost reach the columella. Second order septa (six to seven in number) are noticeably shorter and lower. All septa are equally granulated with a few tubercles on the lateral surfaces, and have a vertical proximal margin. In weakly calcified parts of colonies (tips) all septa are lamellar, twisted, and without ornamentation. First order septocostae can be reinforced and elevated between corallites. Both orders of septocostae are curved between corallites. Internal septal margins are free. The fossa is round, deep, and radial and synapticular elements around the columella are absent. The columella is in the form of an irregular granule or lamina, without ornamentation.

The color of living corals is gray.

Similar species. See *P. explanulata* and *P. clavus*.

Relatively common.

Location. An Thoi, Roy, Phu Quy, Culao Cham, Tho Chu, Nam Zu, and the Spratly Islands, depth 5-25 m.

Distribution. Bikini Atoll, the Marshall Islands and Hawaii, Arabian Sea, Vietnam, Papua and New Guinea.

Pavona varians Verrill, 1864

Fig. 69-6

Pavona varians Verrill, 1864: Veron and Pichon (1980) cum syn., Veron and Kelley (1988), Sheppard and Sheppard (1991)

Colonies are encrusting with a free lamellar margin. The colony surface is covered by high septocostal ridges with sharp margins, perpendicular to the growing margin, and chaotically located solitary septocostal pointed elevations and short ridges. Single rows of corallites are located between long ridges called collines. Corallites are situated chaotically between short collines. The height of collines is 2-5 mm. A single row of slightly twisted cross connections, resembling a single-rowed synapticular corallite wall, can be seen along the upper margins of ridges. On colony areas free of septocostal elevations, corallites are very shallow, since the distal septal margins are only slightly inclined towards corallite centers. The growing colony margin is at a distance not less than 3 mm from the substrate (usually several centimeters). If a colony bears long septocostal ridges, then the lower surface of the growing margin is supplied with grooves, diverging in a fan-shaped fashion, each of which corresponds to a septocostal ridge. In all cases the lower surface of the growing margin is streaked with rows of spines, perpendicular to the margin.

Two to three orders of septocostae are formed. First order septocostae (seven to nine in number) are even, densely ornamented by spines, including their distal margin. They reach the corallite center, but do not adjoin, leaving a small round fossa. Second order septa are at a greater distance from the corallite center, and they are slightly lower and often less ornamented. Third order septa (four to six in number) are shorter by one third and significantly lower than second order septa. They are ornamented on septacostal ridges and very thin, and lamellar between corallites on even areas of a colony. The columella is not developed, but on the bottom of the calicular depression several twisted short trabeculae or a small irregular granule are formed.

The color of living colonies is green, orange, or brown.

Similar species *Pavona venosa* has similar corallites but walls between valleys (collines) are acute, and it has less developed columellae.

Relatively common.

Location. Reefs of Khanh Hoa Province, Culao Cham, Ant Hoi, and the Spratly Islands, depth 2-20 m.

Distribution. Widely distributed in the Indo-Pacific from the Red Sea to Hawaii and Tahiti.

Pavona venosa (Ehrenberg, 1834)

Fig. 70-1

Podobacia venosa Ehrenberg, 1834

Pavona venosa (Ehrenberg): Veron and Pichon (1980) cum syn., Veron and Kelley (1988), Sheppard and Sheppard (1991)

Colonies are massive and round with a smooth surface. Corallites are single, as well as grouped in short irregular series, and separated from each other by high septocostal ridges with a sharp margin. A single-rowed straight cross connection (bridge) can be viewed along the margin of the ridges.

Septocostae are formed, arranged in three orders. First order septa (seven to nine in number) are longer than the other septa, and their distal margin is inclined towards the corallite center at a noticeably greater angle. Second order septa (six to nine in number) are somewhat lower and significantly shorter. Third order septa are very short. All septa are ornamented with a few spines and have a very high vertical internal margin. Septa do not form any reinforcements or elevations at the corallite center. Their axial ends are not fused. The columella is not developed, only several twisted trabeculae project at the bottom of a deep calicular depression.

The color of living colonies is hazel.

Similar species *P. varians* is distinguished by less well developed ridges (collines) and usually two orders of septa.

Uncommon.

Location. Phu Quy, Con Dao, and An Thoi Islands, depth 5-15 m.

Distribution. Widely known in Indo-Pacific from the Red Sea to the Marshall Islands.

Pavona maldivensis (Gardiner, 1905)

Fig. 70-2

Siderastrea maldivensis Gardiner

Pavona maldivensis (Gardiner): Matthai (1948), Veron and Pichon (1980) cum syn., Veron and Kelley (1988), Sheppard and Sheppard (1991)

Colonies are massive and encrusting, with a free lamellar margins. Corallites are shallow, chaotically located on the colony surface and slightly elevated. The colony growing margin is at a distance of several millimeters from the substrate. Its lower surface is covered by rows of very fine tubercles, which are located perpendicular to the margin and diverge fan-shaped in various directions.

Two orders of massive, tapered septocostae are formed. Their internal margin is steeply inclined towards the center and descends to the calicular base. First order septa (nine to eleven in number) are straight, even with a narrow ridge along the internal margin, which is weakly dentate and sharp. Lateral surfaces are abundantly granulated and densely dentate. Second order septa (nine to eleven in number) are distinguished by the fact that their axial margin is at a greater distance from the corallite center. A columella is not present. A platform of merged radial elements is formed at the bottom of a round axial fossa.

The color of living colonies is dark, brown or green.

From all species *Pavona maldivensis* is distinguished by circular plocoid corallites .

Sometimes common.

Location. Khanh Hoa Province, Phu Quy, Tho Chu, Nam Zu, and An Thoi Islands, depth 5-20 m.

Distribution. Widely distributed in Indo-Pacific from Madagascar to the Marshall Islands.

Pavona frondifera (Lamarck, 1801)

Fig. 70-3, C20 - 7

Agaricia frondifera Lamarck, 1801

Pavona frondifera (Lamarck): Hoffmeister (1925), Umbgrove (1940), Wells (1956), Veron (1986)

Colonies are foliose, consist of thin twisted laminae with numerous ridges, which are rudiments of new laminae. Lamina margins are even, their thickness at the base is 3-5 mm, height – up to 4 cm. Corallites are superficial, integrated in short curved rows, subparallel to the lamina margin. Some corallites are located chaotically. The colony base is encrusting with a free lamellar margin. Its lower surface is streaked by rows of fine spines, perpendicular to the growing margin.

Two orders of septa, are present. First order septa (nine to eleven in number) reach the corallite center. They are even with a high sharp axial margin, which is somewhat dentate and scalloped. Lateral septal surfaces are ornamented with denticles. At the corallite center these septa are clavately reinforced and elevated, with more abundant ornamentation, and their low internal margin vertically descends to the calicular base. Second order septa (six to nine in number) are lower and shorter, more weakly ornamented, and their internal margin is at a greater distance from the corallite center. The distal margin of the second order septa is horizontal between corallites, and their proximal part very smoothly descends to the bottom of the fossa without a noticeable twist. The calicular depression is oval and deep. A columella is not present, instead a platform of merged skeletal elements is formed at the bottom of the axial fossa.

The color of living colonies is unknown.

Similar species. See *P. cactus*.

Relatively common.

Location. Reefs of Khanh Hoa Province, Ant Hoi, Tho Chu, and Phu Quy Islands, depth 1-30 m.
Distribution. Known in Vietnam, Indonesia and Hawaii.

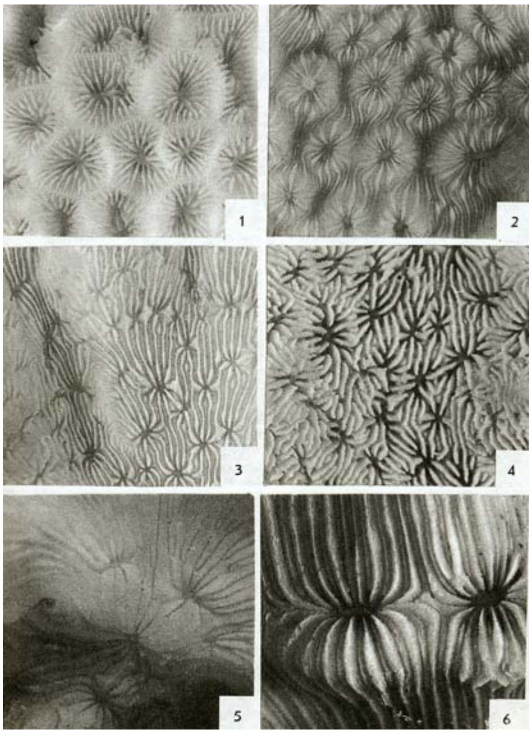


Fig. 70. 1 -*Pavona venosa*, spec. 1/95233, Is. Thu, depth 6 m; 2 -*P. maldivensis*, spec. 1/95234, Is. Zyan, depth 11 m; 3 -*P.frondifera*, spec. 1/95235, Is. Thu, depth 12 m; 4 -*Pavona distinta* sp.nov., spec. 1/95236, Is. Thu, depth 12,5 m; 5 -*Leptoseris gardineri*, spec. 1/95237, Is. Thu, depth 42 m; 6 - *L. explanata*, spec. 1/95238, Is. Phu Cuok, depth 5 m.

Pavona distincta sp. nov.

Fig. 70-4

Pavona sp. 1: Latypov and Dautova (1998)

Holotype. Specimen 1/95236, Museum of Institute of Marine Biology, Vladivostok, Russia, Thu Island, South Vietnam, depth 12,5 m

Colony is massive, cerioid with a free lamellar margin. The colony surface is smooth, with insignificant projections. Corallites are situated chaotically and closely adjoin each other, and septocostae are not developed. Peripheral part of corallites are very low in comparison with septa, that is why the colony surface has an appearance of being completely covered by the short vertical laminae of septa.

Septa are arranged in two to three orders only by their length. First order septa are longer, and second order septa are at a greater distance from the corallite center at their internal margins. Third order septa can be found in some corallites as thin rudimentary laminae. All septa are of an equal height and thickness, massive, even, straight, and weakly ornamented with a few tubercles. There are 23-25 stpta. The distal margins of all septa are horizontal and sharp. Internal margins descend vertically to the bottom of the fossa. The columella is absent, instead a platform of merged radial elements or several radii is formed.

Remark. In comparison with the other *Pavona* species from the South China Sea this species has a number of distinctions. It differs from *P. cactus* and *P. frondifera* by having corallites closely brought together. From the similar species *P. venosa, P. varians, P. minuta* and *P. clavus* – by a horizontal proximal septal margin, absence of a columella, and weakly ornamented septa. *P. distincta* is similar to *P. decussata* by the nature of its septal apparatus and outward septal appearance, but substantially differs from the latter by the absence of a columella and series (rows) of corallites, and the massive colony form.

The color of living colonies is unknown.

Location. Thu Island, in the South China Sea, depth 12.5 m.

Distribution. South Vietnam.

Genus *Leptoseris* Edwards and Haime, 1849

Type species: *Leptoseris fragilis* Edwards and Haime, 1849.

Diagnosis. Encrusting, foveolate unifacial colonies. Corallites with a prominent low theca, can be arranged in concentric rows. Septocostae of two orders are thick, tapered, radially oriented, and merging between corallites. The columella is clearly pronounced.

Leptoseris gardineri Van der Horst, 1921

Fig. 70-5

Leptoseris gardineri Van der Horst, 1921: Veron and Pichon (1980) cum syn., Scheer and Pillai (1983), Veron (1986)

Branched colonies, consisting of flat, thin branches, which are wavy and zigzag curved. Their thickness is not more than 2 mm, width – 1-1.5 cm. Corallites are slightly prominent, sometimes merging with each other. The thecal rim is mainly distinct, low, and wide. The diameter of corallites is not more than 4 mm. The calice is shallow. The lower colony surface bears distinct fine ribbing, covered by fine numerous denticles. Two orders of 14-18 thick tapered radially oriented septa are formed. First order septa are 1.5-2 times thicker (especially at the periphery) than second order septa, and more prominent and more carinated. All septa reach the columella. The columella is small, distinct, consists of several trabeculae and is located in a calicular depression. The wall is not pronounced.

The color of living corals is shades of yellow- or pale-yellow-brown.

Similar species *L. papyracea* has smaller, coarser fronds containing few corallites.

Uncommon, usually occurs on reef slopes.

Location. Phu Quy, and Con Dao Islands, depth 15-42 m.

Distribution. Known on the reefs of the Seychelles and Maldives in the Indian Ocean to Samoa and Fiji Islands in the central Pacific.

Leptoseris explanata Yabe and Sugiyama, 1941

Fig. 70-6

Leptoseris explanata Yabe and Sugiyama, 1941: Veron and Pichon (1980) cum syn., Sheer and Pillai (1983), Veron (1986), Sheppard and Sheppard (1991)

Thin lamellar colonies, with a funnel-like concave shape with a wavy surface and variously bent thin margin, which can have horizontal prominent projections. Corallites are prominent, always stronger on the peripheral side, and distinctly porous (spongy, and nostril-shaped). They have a diameter up to 8 mm, and are mainly arranged in concentric rows. The calice is deep. The lower surface is covered by holotheca with a fine ribbing.

Two orders of 34-56 thick septocostae are formed. First order septa are more tapered, are more excert, and in the corallite center they are 1.5-2 times thicker than second order septa. On the central side of corallites second order septa can be thin, untapered, and 2-4 mm shorter than first order septa. The majority of septa reach the columella. All septa are intensively granulated with long spines. The columella is well pronounced, ovally elongated, and consists of numerous merging trabeculae, imbedded in a deep calicular depression. The wall is synapticular, pronounced rather clearly, especially on the peripheral side of the corallite.

The color of living corals is shades of pale-brown.

Similar species *L. scabra* has encrusted colonies with surface curved in a complicated fashion, with projecting vertical thick projections and thin horizontal projections, and wavy twisted protuberances with uneven margins.

Relatively common.

Location. Culao Cham, Tho Chu, Con Dao, Nam Zu, and Phu Quoc Islands, depth 7-25 m.

Distribution. Known on the reefs of Palau, the Red Sea, Vietnam, and the Great Barrier Reef of Australia.

Leptoseris scaba Vaughan, 1907

Fig. 71-1

Leptoseris scabra Vaughan, 1907: Veron and Pichon (1980) cum syn., Nakamori (1986), Veron (1986), Sheppard and Sheppard (1991) cum syn

Encrusting colony with a surface twisted in a complicated fasion, with thick vertical projections and thin horizontal projections, and wavy twisted projections with uneven margins. The corallites are irregular, mostly merging with each other, moderately prominent, with wide oval walls. They are 6-10 mm in diameter. Calices are fine with a distinct central depression. The lower colony surface is finely ribbed, and distinctly spiny.

Two, more rarely three orders of long thick septocostae (34-46 in number) are formed. First order septa, often tapered, are twice as thick as the other septa. They project upwards over all other septa and are always longer at the axis at least by fractions of a millimeter. Their upper and axial margins are distinctly carinated. Irregular pinnacles (or lobes) are often formed at the periphery of the first order septa. Second order septa are more regular, thin, slightly tapered, and reach the columella. Third order septa, rarely more than six in number, are uniform in thickness or slightly thinner than second order septa and one third shorter than the second order septa. All septa are intensively granulated with long carina-like spines. The columella is distinct, small, pinnacle-like, and situated in the deep calicular depression. The wall is thick and distinct.

The color of living corals is shades of green-brown.

Similar species *Leptoseris hawaiiensis* is distinguished by having deep, rounded corallites and a smooth coenosteum.

Uncommon.

Location. Hon Mung and Tho Chu Islands, depth 21-40 m.

Distribution. Known from the Red Sea to the eastern part of Hawaii.

Leptoseris hawaiiensis Vaughan, 1907

Fig. 71-2

Leptoseris hawaiiensis Vaughan, 1907: Veron and Pichon (1980) cum syn., Sheer and Pillai (1983), Nakamori (1986), Veron (1986), Sheppard and Sheppard (1991) cum syn.

Thin, lamellar, weakly twisted small semicircular colonies. The corallites are small, usually rarely more than 3 mm diameter, and just slightly projecting over the colony surface. They are grouped in distinct concentric circles, spaced 2-5 mm from each other. Calices are fine with a deep axial depression. The lower colony surface is finely ribbed with fine, regularly spaced spines.

Two, rarely three orders of septocostae (24-36 in number), are formed. First order septa are thick, tapered, and 1.5-2 times thicker than the other septa. They project greatly upwards especially at the corallite periphery, forming pinnacle-like projections. Lateral surfaces and axial margins of septa are distinctly carinated. Second order septa are slightly tapered with an even axial margin and lateral surface. They are fractions of a millimeter shorter than first order septa and reach the columella only at the calice base. Third order septa are not developed in all corallites, mainly on their outer surface. They are 2-3 mm shorter than all other septa. Second and third order septa are moderately granulated with fine spines. The columella is distinct, compact, pinnacle-like or lamellar. The wall is weakly pronounced.

The color of living corals is green or brown.

Similar species. See *L. scabra*.

Rare.

Location. Bai Tu Long Archipelago, and Phu Quy Island, depth 6-14 m.

Distribution. Known on the reefs of the tropical Indo-Pacific from the Red Sea to Hawaii.

Leptoseris mycetoseroides Wells, 1954

Fig. 71-3

Leptoseris mycetoseriodes Wells, 1954: Veron and Pichon (1980) cum syn., Sheer and Pillai (1983), Nakamori (1986), Veron (1986), Sheppard and Sheppard (1991)

Encrusted lamellar colonies, often funnel-shaped with uneven, wavy-hilly surfaces with a thin peripheral margin. Corallites are numerous, grouped in series of up to seven to eleven, as well as in short and long irregular rows, separated by high ridges. Calices are deep with a distinct axial fossa. The lower surface is covered by very fine ridges with numerous fine spines.

Two to three orders of long, densely packed septocostae, 48-64 in number, are formed. First order septa are highly excert, slightly more so than the other septa. Their lateral surface is intensively covered by long carina-like spines. Second order septa are slightly shorter, slightly project upwards and have a slight carination only at the calice periphery. Third order septa are one third shorter than second order septa, and they are inserted in pairs on both sides of the second order septa. The columella is weak, deeply imbedded in the calicular depression, and consists of one or several simple pinnacles. The wall is not distinct.

The color of living corals is yellow-brown.

Similar species. See *L. yabei*.

Location. Bai Tu Long Archipelago, Re, Phu Quy, Tho Chu Islands, and reefs of Khanh Hoa Province, depth 7-35 m.

Distribution. Widely known in the tropical zone of the Indo-Pacific from the Red Sea and La Reunion Island to Japan and the Marshall Islands.

Leptoseris var. *mycetoseroides* Wells, 1954

Fig. 71-4

Lamellar-encrusting funnel-shaped colony with a hilly surface and a fine curved margin. Corallites are numerous, merging with each other, highly prominent, especially by their external sides, similar to a swallow's nest. They can be arranged in rows, parallel to the colony margin. Calices are deep with a small axial depression. The lower surface is covered by very fine ridges, evenly dentate with obtuse denticles.

Three orders of long thin septa, 54-78 in number (in some corallites up to 90) are formed. First and second order septa do not quite reach the columella, and the second order septa are shorter by 0.1-1 mm. Both orders of septa are slightly but distinctly projected upwards over the other septa. Their lateral surface is ornamented with long numerous spines, carina-like at the upper calice margin. Third order septa are almost 2-3 mm shorter than septa of the earlier orders, and as a rule they are situated in pairs with second order septa. Their surface is slightly granulated with fine spines. The columella is rather large, moel-like, distinctly detached from septa in a deep axial calicular depression. The wall is thick and synapticulothecal.

Remark. The described variant differs from *L. mycetoseroides* by a considerably greater number of septa in three distinct orders; and from all other *Leptoseris* species by a large well-formed columella, distinctly detached in the axial fossa, by the absence of vertical and irregular ridges separating corallite series; and from *L. yabei* by detached porous (nostril-like) corallites, irregularly arranged or arranged in dense concentric rows.

Uncommon.

Location. Nha Trang Bay, Cha La Island (Khanh Hoa Province), depth 10 m.

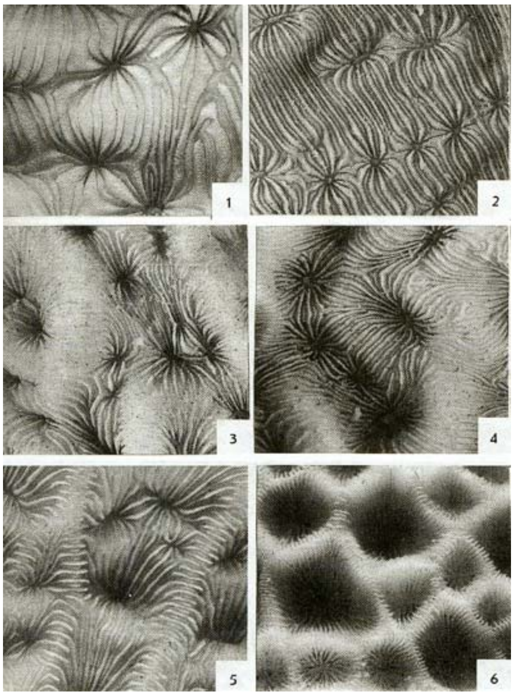


Fig. 71. 1 - *Leptoseris scabra,* spec. 1/95239, Is. Thochu, depth 21 m; 2 - *L. hawaiiensis*, spec. 1/95240, Is. Re, depth 12 m; 3 - *L. mycetoseroides*, spec. 1/95241, Is. Moon, depth 18 m; 4 - *L. var. mycetoseroides*, spec. 1/95242, Is. Cha La, depth 15 m; 5 - *L. yabei*, spec. 1/95243, Is. Thu, depth 42 m; 6 – *Gardineroseris planulata*, spec. 1/95244, Bay Bai Kanh, depth 15 m.

Leptoseris yabei (Pillai andt Scheer, 1976)

Fig. 71-5

Pavona yabei Pillai and Scheer, 1976

Leptoseri yabei (Pillai and Scheer): Veron and Pichon (1980) cum syn., Veron (1986), Sheppard and Sheppard (1991)

Funnel-shaped or vase-like flat colonies with variously protruding multideck projections from subhorizontal to vertical. The corallites merge with each other, arranged in distinct series, which are concentric and radial, separated by high radiating ridges, which often have a subsquare shape. Calices are deep with a shapeless or oval axial fossa. The lower colony surface is covered by radiating dichotomously branching tubercles, covered by dense fine ridges with numerous fine spines.

Three to four orders of long thin septa, 54-90 in number, are formed. First order septa reach or almost reach the columella. They are significantly (up to 1 mm) projected upwards over the other septa and ornamented to a greater extent with long spines. Second order septa are shorter only by fractions of millimeters and project less upwards. Third order septa are one third shorter, and weakly ornamented with fine spines. Fourth order septa are rarely longer than 2 mm. They are formed mainly in the upper part of the calice on the adjoining walls. The columella is weak, lamellar or in the form of simple pinnacles. The wall is not distinct.

The color of living corals is pale-yellow with shades of yellow-brown.

Similar species *Leptoseris yabei* is closest to *L. mycetoseroides* but is readily distinguished from all other species by having corallites in rectangular pockets.

Common, usually on reef slopes.

Location. Culao Cham, Re, Phu Quy, Con Dao Islands, and reefs of Khanh Hoa Province, depth 20-42 m.

Distribution. Known on the reefs of the Red Sea, the Maldives, Vietnam and the Great Barrier Reef of Australia.

Genus *Gardineroseris* Scheer and PillaI, 1974

Type species: *Agaricia (Undaria) planulata* Dana, 1846.

Diagnosis. Encrusted, massive cerioid corals with polygonal corallites. Calices are deep, mono- and tristomatous with numerous thin septa in two to three orders, five to six cycles of septa. Septa of the higher and lower cycles are formed in groups, subordinate by length. The columella is pinnacle-like, and situated in a small axial fossa.

Gardineroseris planulata (Dana, 1846)

Fig. 71-6, C6 - 5

Agaricia planulata Dana, 1846

Gardineroseris planulata (Dana): Veron and Pichon (1980) cum syn., Scheer and Pillai (1983) cum syn., Veron (1986), Sheppard and Sheppard (1991)

Small encrusting or massive colonies with polygonal, sometimes highly prominent corallites, having a diameter of 3-9 mm. Calices are deep, up to 4 mm deep with a small axial fossa, and thin steeply inclined walls. The colony margins are thin and covered by a granulated epitheca.

Thin septa of five to six cycles, differentiated by length into two to three orders, are formed. First order septa, including septa of the first and second cycles and an incomplete set of the third cycle, are vertically located along the calice wall, being elongated in their lower part where they reach the columella. Septa of the second order (including septa of the third and fourth cycles) are one fourth shorter than the first order septa. The length of the other septa varies depending on the formation of complete or incomplete septal sets of the fifth and sixth cycle septa. They can reach from one third to two thirds of a corallite radius. The total number of septa can be more than 100. Lateral surfaces of all septa are abundantly covered by long spines, with a slight tendency to be arranged in parallel rows. Internal septal margins are vertical and even. The columella is small, and consists of several flat trabeculae. Dissepiments are frequent, prominent and subhorizontal, inclined towards the axis, and often with additional laminae. The wall is thick and dense.

The color of living corals is straw or gray-pink.

Similar species. From the most similar colonies of *Pavona* it is distinguished by clearly polygonal corallites.

Realatively common.

Location. Reefs of Khanh Hoa Province, Re, Phu Quy, Con Dao, Namsu, and Ant Hoi Islands, depth 10-25 m.

Distribution. Known everywhere in the tropical zone of the Indo-Pacific.

Gardineroseris pavonoides sp. nov.

Fig. 72-1

Holotype: spec. 1/95245, Museum of Institute of Marine Biology, Vladivostok, Russia, Bay Kan Bay, Khanh Hoa Province, depth 10 m, reef slope.

Colonies have the shape of bilateral vertical laminae with uneven wavy margins, weakly undulating. Their surface is covered by septocostal ridges parallel to the lamina margin. Ridges are high, sharp, slightly inclined by their upper margin towards the growing margin of the lamina. The length of ridges is from several mm to 7 mm, and its height from 3 to 5 mm. Corallite series, closely adjoining each other by their lateral sides, are located between ridges. In these areas peripheral parts of the corallite are lower than the distal septal margin, that is why the corallite wall here is not seen. The corallite profile is polygonal. Septocostae are of an uniform height and thickness, narrow, and even. Their distal margin is steeply inclined towards the corallite center, and the proximal margin is vertical and low.

Septa, arranged in several orders, are formed. First order septa (eight to eleven in number) extend to the columella, but do not fuse with it. Second order septa (eight to eleven in number) are shorter, and their internal margins are more distant from the columella. Third order septa (two to three in number) fuse with septa of the second order by their proximal margin, and their length is not greater than half of the length of the second order septa. Single septa of the fourth and fifth orders also fuse with septa of the previous orders by their internal margins, being respectively shorter. The columella is a short granulated rod.

Remark. This species differs from *G. planulata* by the lamellar bilateral growth form and by corallites, arranged in rows, which are separated by septocostal ridges, parallel to the lamina margin.

The color of living colonies is unknown.

Distribution. Hon Mung Island, depth 15 m.

Genus *Coeloseris* Vaughan, 1918

Type species: *Coeloseris mayeri* Vaughan, 1918.

Diagnosis. Cerioid massive corals with small polygonal corallites. Calices are monostomatal, deep, and with three cycles and orders of septa, projecting over the wall. A columella is absent.

Coeloseris mayeri Vaughan, 1918

Fig. 72-2, C6 - 4

Coeloseris mayeri Vaughan, 1918: Veron and Pichon (1980) cum syn., Veron (1986)

Small massive colonies with uneven surfaces and tubercular projections. Corallites are polygonal, elongated on the border, with unevennesses and projections on the colony surface, and with a diameter of 3-6 mm. Calices are deep with vertical walls and a free axial zone.

Four cycles of septa are formed, arranged by thickness and length in two to three orders. First cycle septa are clearly distinguished by their length and thickness from the other septa. They reach or almost reach the axis at the base of the calice. Second cycle septa are thinner and slightly shorter, rarely by more than 1/3 of the length of the first cycle of septa. Third cycle septa can be a half as long as septa of lower cycles. Fourth cycle septa rarely reach more than 1/3 – ½ of the corallite radius. All septa are excert and have a uniform length, rarely exceeding 0.5-0.6 mm. The total number of septa is equal to 30-44. Lateral surfaces of all septa are finely granumated, and proximal margins are even and vertical or steeply inclined, and finely dentate. A columella is absent. There are one to two rows of widely spaced dissepiments, large and fine, which are steeply inclined up to vertical. The wall is thick, but thin along the calice margin.

The color of living corals is shades of yellow-brown and green.

Similar species. Underwater it is looks like a faviid, especially *Leptastrea*.

Uncommon.

Location. Re, Phu Quy, and Tho Chu Islands, depth 5-25 m.

Distribution. Known from the Nicobar Islands in the Indian Ocean to New Caledonia in the Pacific Ocean.

Genus *Pachyseris* Edwards et Haime, 1849

Type species: *Agaricia rugosa* Lamarck, 1801.

Diagnosis. Lamellar, lamellar-encrusting or subbranched corals with thick irregular branches. Corallites without distinct centers are arranged in concentric narrow rows, divided by well pronounced high ridges. Septocostae of two orders are highly carinated and adjoining. The columella is dense, narrow, and lamellar.

Pachyseris rugosa (Lamarck, 1801)

Fig. 72-3, C6 - 6

Agaricia rugosa Lamarck, 1801

Pachyseris rugosa (Lamarck): Edwards, Haime (1815), Veron and Pichon (1980) cum syn., Scheer and Pillai (1983) cum syn., Nakamori (1986), Veron (1986)

Small colonies have encrusting, mainly round laminae of a complicated concave-convex shape. In colonies larger than 20 cm vertical projections of various shape are formed: columnar, conical, and/or thick-branched dichotomizing, and reaching 15-20 cm height. Corallites merge in long concentric or variously curved rows, separated by distinct symmetrical ridges of 2-4 mm width. On horizontal surfaces rows are straight, and 4-6 cm long. On vertical projections, rows are shorter and have a complicated form, often forming monticules resembling those of *Hydnophora*. Monticules are formed especially often on branch tips, which become similar to branched colonies of *H. exesa.* Calices are of a moderate depth. Two orders of long, medium- thick septocostae are formed, reaching the columella. First order septa project upwards more than other septa, and their axial margin is thinner. Septa are fused, mainly plumosely arranged, which is why they look like rows of herring-bones. All septa are highly carinated up to zigzag convolution. There are up to 28 septa per cm of corallite wall. The columella is dense, and consists of vertical interrupted dotted laminae and flat horizontal laminae of smaller size, connecting with the axial ends of septa. The wall is thin, and poorly distinguishable.

The color of living corals is shades of gray-blue and yellow-brown.

Similar species *P. speciosa* has unifacial laminae, usually horizontal, which may develop upright ridges.

Common.

Location. Known everywhere from the intertidal zone to the reef slope base.

Distribution. Widely distributed throughout the entire tropical zone of the Indo-Pacific.

Pachyseris speciosa (Dana, 1846)

Fig. 72-4, C6 - 7

Agaricia speciosa Dana, 1846

Pachyseris speciosa (Dana): Edwards and Haime (1851), Veron and Pichon (1980) cum syn., Scheer and Pillai (1983) cum syn., Nakamori (1986), Veron (1986), Sheppard and Sheppard (1991)

Thin lamellar-encrusting round colonies, prominent or funnel-shaped concave, with well pronounced attachment projections. Separate corallites are not distinguishable. They are arranged in concentric rows around the primary corallite and separated by narrow and medium-width (1.5-2 mm) asymmetrical ridges of 2-4 mm height. Secondary rows with distinctly seen separate corallites (from one to five in number) are formed on some vertical ridge surfaces. More rarely secondary corallites are formed in the upper part of a ridge, as if separating the ridges in halves, but in such cases corallites are barely separated.

Long septocostae of two orders, reaching the columella, are formed. First order septa project upwards more than other septa. All septa are highly carinated, and look wavy-curved up to zigzag. Up to 24 septa occur in 1 cm of a corallite. Sometimes a pair of first order septa, which are more prominent, fuse at their axial ends and are connected with a shortened third septum that is second order. The columella is interrupted or continuous, and consists of fused horizontal dissepiment-like laminae, connected with the axial ends of septa.

The color of living corals is shades of pale-yellow-gray and brown.

Similar species *P.speciosa* is closest to *P. rugosa* but has a thin more distinct corallite wall.

Common in various reef zones.

Location. Distributed everywhere from the northern Gulf of Tonkin to the Gulf of Siam and reefs of the Spratly Islands in all areas of the reef.

Distribution. Widely known in the Indo-Pacific from the Red Sea and Madagascar to Japan, the Marshall Islands and South Australia.

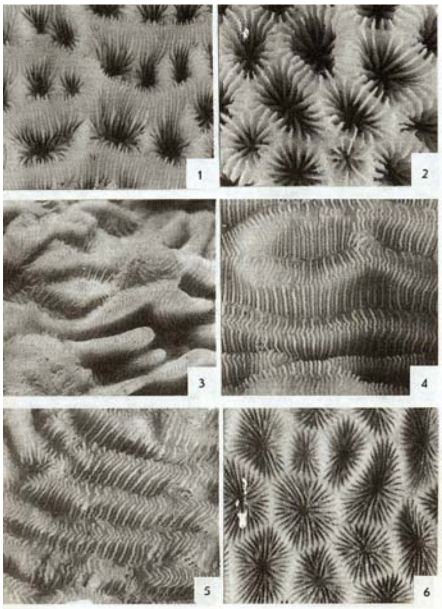


Fig. 72. 1 - *Gardineroseris pavonoides* sp. nov., spec. 1/95245, Is. Moon, depth 10 m; 2 - *Coeloseris mayeri*, spec. 1/95246, Is. Re, depth 6 m; 3 - *Pachyseris rugosa*, spec. 1/95247, Is. Moon, depth 15 m; 4 - *P. speciosa*, spec. 1/95248, Is. Moon, depth 15 m; 5 - *P. monticulosa* sp. nov., spec. 1/95249, Is. Tyaklon, depth 16 m, on the right are visible monocentric corallites; 6 - *Pseudosiderastrea tayamai*, spec. 1/95250, Is. Roi, depth 10 m.

Pachyseris monticulosa sp. nov.

Fig. 72-5

Holotype: Specimen 1/95249, Museum of Institute of Marine Biology, Vladivostok, Russia, Tyak Lon Island, Con Dao Islands, base of a reef slope, organogenic detritus, depth 16 m.

Lamellar, funnel-shaped concave or faveolate round colonies with a diameter of up to 20-30 cm, with thin wavy margins. Corallites are monocentric or arranged in short and long series. They are separated by very high (up to 5 mm) and narrow (less than 2 mm) ridges of a complicated form. They can be even and wavy, or in the shape of merging cones. Numerous simple and complicated monticules, similar to those of *Hydnophora*, with one to five monocentric large corallites, having a diameter up to 2.5 mm, are formed throughout the entire colony surface between ridges (on the upper surface). Two orders of long, thin septa are formed. First order septa are twice as long as second order septa and project highly upwards. All septa are moderately carinated, with an intensification of the carination towards the axial margin. The columella is distinct, and consists of several layers of merging or disconnected horizontal laminae, connected with axial septal margins. The wall is thin and distinct.

Remark. This species differs from *P. rugosa* by the foveolate funnel-shaped colony form, and the very long corallite series and columella structure; from *P. speciosa* it differs by very high narrow ridges, and their variable height and width; from the both by the capacity to form numerous monocentric corallites between ridges and in the complicated monticules.

The color of living corals is shades of yellow-gray.

Etimology:

Location. Reefs of Khanh Hoa Province, Con Dao Islands, depth 10-16 m.

3.9. Family Siderastreidae Vaughan and Wells, 1943

Genus *Pseudosiderastrea* Yabe and Sugiyama, 1935

Type species: *Pseudosiderastrea tayamai* Yabe and Sugiyama, 1935.

Diagnosis. Small encrusting and massive colonies with cerioid corallites, tapered reinforced septa of which fuse in fan-like formations with each other. The columella is distinct, and consists of one to four pinnules.

Pseudosiderastrea tayamai Yabe and Sugiyama, 1935

Fig. 72-6, C16 - 4

Pseudosiderastrea tayamai Yabe and Sugiyama, 1935: Veron and Pichon (1980) cum syn., Veron (1986), Sheppard and Sheppard (1991)

Small encrusting or massive colonies, rarely more than 4 cm high. Corallites are polygonal, have a diameter of 3-5 mm, and sometimes can be elongated. The calice is shallow with a small central depression.

Three to four cycles of septa are formed. First cycle septa are in the form of even laminae which reach the columella, not merging with other septa by their lateral surfaces and axial ends. All the other septa fuse at the axis in groups, typical for all Syderasteriidae. Higher cycle septa fuse symmetrically to the lateral surfaces of lower cycle septa. All higher cycle septa have a slightly tapered shape. The lateral surfaces of all septa are covered by granules, arranged in coupled parallel rows. Towards the proximal septal margin they merge in laminar denticles, arranged perpendicular to the margin. Their number varies from six to fourteen in an inverse relation to the septal cycle. All septa are very compactly arranged in a calice, and their total number usually ranges within 32-42. The columella is compact, very dense, and situated in a small depression. The wall is synapticulothecal, thin, dense, and distinct. Interseptal dissepiments are narrow, thin and medium thick. Their laminae have various shapes from convex subhorizontal to variously concave.

The color of living corals is pale-yellow-yellow with white corallite walls.

Similar species. This species also resembles *Coscinaraea* and superficially resembles the agariciid *Coeloseris* and the faviid *Leptastrea*. *Coscinaraea* has true affinities with *Pseudosiderastrea* but corallites are not cerioid and septa are coarser and have their own distinctive patterns . *Coeloseris* has no columella and has smooth sided septa which seldom fuse. *Leptastrea* has corallites separated by a groove, septa seldom fuse and only rarely do they have saw-like teeth (Veron, 1986).

Common but cryptic.

Location. Found everywhere from the Gulf of Tonkin to the Gulf of Siam, depth 5-40 m.
Distribution. Known from the Gulf of Oman in the Arabian Sea and Madagascar to Japan and the Great Barrier Reef in Australia.

Genus *Coscinaraea* Edwards and Haime, 1848

Type species: *Coscinaraea monile* (Forskål, 1775) = *Coscinaraea bottae* Edwards and Haime, 1848.

Diagnosis. Massive, submassive or encrusting corals. Corallites are intra-tentacular mono- and poly-stomadeal, and cerioid to meandroid. Septa are petaloid and perforated, weakly distinguished by cycles and orders. The wall is synapticular (Veron and Pichon, 1979, p. 89).

Coscinaraea exesa (Dana, 1846)

Fig. 73-1

Psammocora exesa Dana, 1846

Coscinaraea exesa (Dana): Veron and Pichon (1980) cum syn., Veron (1986)

Columnar, clavate or weakly digitate colonies with uneven tubercular surfaces. Corallites almost do not project over the colony surface, and have a diameter of 3-6 mm. Calices are shallow.

Eighteen to twenty-eight petaloid septa, weakly distinguished by cycles and orders, are formed. All septa are porous, highly reinforced, more intensively reinforced towards the periphery; and eight to ten septa reach a small axial fossula. Axial and lateral surfaces of two to four first cycle septa are free and petal-shaped. The other septa are tapered or petaloid, connected by their axial ends in groups of three to five septa, and dividing dichotomously towards the periphery.

Lateral surfaces, especially the upper and axial parts of septa, are intensively granulated with very spiny papillae. Especially large papillae, resembling tubercules of *Montipora*, are formed at the periphery of first cycle septa and one to two large septa of the second cycle. The columella is small, formed by one or several projecting upwards papillaes. The wall is porous, synapticular, wide, and covered by three to five rows of prominent papillae-like spikes.

The color of living corals is shades of yellow-brown.

Similar species *C. columna* has massive, encrusting-massive colonies with a thin peripheral margin.

Common.

Location. Da Nang Cape, Nha Trang Bay, Jiang Bo Reefs, Phu Quy, Tho Chu, and Ant Hoi Islands, depth 10-20 m.

Distribution. Known on the reefs of Vietnam, ?Japan, Fiji and the Great Barrier Reef of Australia.

Coscinaraea columna (Dana, 1846)

Fig. 73-2

Psammocora columna Dana, 1846: Matthai (1923)

Coscinaraea columna (Dana): Hoffmeister (1925), Veron and Pichon (1980) cum syn., Veron (1986), Sheppard and Sheppard (1991)

Massive, encrusting-massive colonies with a thin peripheral margin. Corallites are meandroid, arranged in series, rarely separate, and round-polygonal. They can be wide or narrow (from 4 to 15 mm), straight or curved, up to 4 mm high. Walls, separating corallites, clearly project, and have variable sizes and configurations. The calice is deep or of a moderate depth. The lower surface is covered by holotheca with distinct fine high ridges.

Twenty to forty-two porous septa are developed, equally narrow, and weakly distinguished by cycles and orders. Eight septa almost reach the axis, and three to five of them are free. The other septa fuse on their axial ends with second cycle septa in groups of three to nine, forming clusters, irregularly branching dichotomously towards the periphery. Internal septal margins are vertical or steeply inclined and dentate. Lateral septal surfaces are uneven, and slightly granulated. Internal margins of all septa are covered by pali-like lamellar projections (10-15 in number) with highly divided spiny tips. The columella is small and loose, consists of one or several pinnacles, and is located in a small deep axial fossa. The wall is synapticulothecal, wide, and well pronounced.

The color of living corals is shades of red-yellow-brown.

Similar species *C. exesa* has columnar, clavate or weakly digitate colonies with uneven tubercular surfaces and larger corallites.

Common.

Location. Known everywhere in all reef zones.

Distribution. Distributed throughout the entire tropical zone of the Indo-Pacific from the Red Sea and Madagascar to Japan, the Samoan Archipelago and the Great Barrier Reef of Australia.

Coscinaraea mcneilli Wells, 1962

Fig. 73-3

Coscinaraea mcneilli Wells, 1962: Veron and Pichon (1980) cum syn., Veron (1986)

Colonies are lamellar and round with a thin margin. Corallites do not protrude or slightly protrude over the colony surface. They are grouped in series or rows, subparallel to the colony margin, having a diameter of 4-5 mm. Calices are not deep at the axial fossa. The lower surface is weakly ridged, smooth here and there, and irregularly spiny.

Two orders of 12-20 thick septa, distinguished by sizes, are developed. First order septa are more reinforced by tapering, noticeably project upwards over the other septa, and have highly prominent lobes at the periphery. Their axial ends, as a rule, are free. The other septa are thinner and less tapered. They can be free or fuse by their axial ends in pairs or in triplets, forming petaloid mergers. Lateral and axial septal surfaces are intensively covered by lamellar spines with very spiny tips. Septocostae are long, prominent, their sizes are comparable with sizes of first and second order septa, and they are similarly intensively granulated. The columella is distinct, dense, and consists of fusing papillae trabeculae, situated in a depression. The wall is synapticular, weakly pronounced, and perforated.

The color of living corals is shades of yellow-brown.

Similary species. Superficially resembles the agariciid *Pavona*.

Rare.

Location. Middle Vietnam, Culao Cham Island, depth 11 m.

Distribution. Southwestern Australia, central Vietnam.

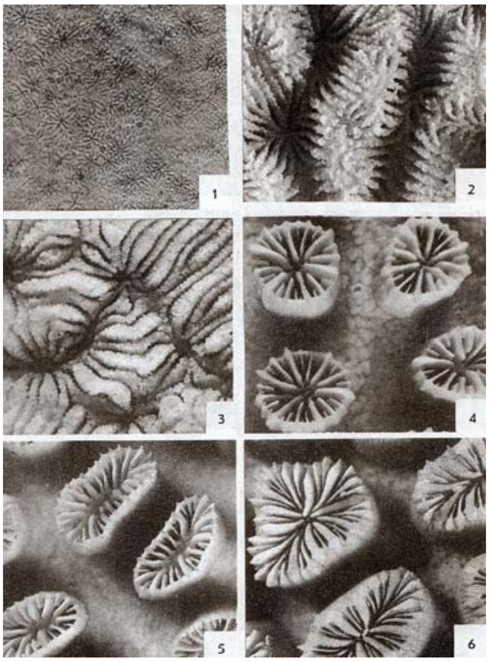


Fig. 73. 1 - Coscinaraea exesa, spec. 1/95251, Bai Thanh Bay, depth 5 m, septa as petals of

inflorescences are distinctly visible; 2 - C. columna, spec. 1/95252, Is. Mok, depth 4 m; 3 - C. mcneilli, spec. 1/95253, Is. Cham, depth 6 m; 4 - Galaxea astreata, spec. 1/95254, Bay Bai Kanh, depth 4,5 m; 5 - G. fascicularis, spec. 1/95255, Is. Moon, depth 12 m; 6 - G. crassiseptata sp. nov., spec. 1/95256, reef Jiang Bo, depth 12 m.

3.10. Family Oculinidae Gray, 1847

Genus *Galaxea* Oken, 1815

Type species: *Madrepora fascicularis* Linnaeus, 1767.

Diagnosis. Plocoid, massive, columnar and encrusting colonies with cylindrical and oval corallites, highly protruding over the finely vesicular coenosteum. Uniformly developed third to fifth cycle septa highly project over the thin wall and are distinctly differentiated by sizes. The calice is deep, and columella is small. Budding is basal, and mainly peripheral.

Galaxea astreata (Lamarck, 1816)

Fig. 73-4

Caryophyllia astreata Lamarck, 1816

Galaxea astreata (Lamarck): Chevalier (1971), Veron and Pichon (1980) cum syn., Scheer and Pillai (1983) cum syn., Veron (1986), Sheppard and Sheppard (1991)

Massive, lamellar encrusting plocoid colonies with evenly situated cylindrical and oval corallites having a diameter of 3-5 mm. Corallites project over the coenosteum by up to 6-8 mm and are spaced at a distance of 2-3.5 mm. Calices are deep with a well-pronounced endotheca. The lower colony surface is covered by fine-rugose holotheca.

Three to four cycles of septa are developed, which are distinguished well by width and length, and reach the axis or columella. First cycle septa project well over the other septa, and are always 1.5-2 times thicker than higher cycle septa. The directive septa are somewhat longer than all other septa. Second cycle septa are noticeably thinner and shorter than first cycle septa. Third cycle septa are thin with variable lengths, which are from ½ to ¾ of a corallite radius. Their axial ends do not fuse with neighboring septa and the columella. Fourth cycle septa very rarely have a complete set. More often they are represented by thin and very short laminae along the calice wall. Total number of septa is 30-38, and only in a few corallites is a complete set is observed – 48 septa in four cycles. The lateral surfaces first and second cycle septa are evenly covered by fine spines, which increase in number and size towards the axial septal margin, especially in first cycle septa, sometimes passing into dentation of the proximal septal part. The columella is weak, very small, and consists of separate disconnected or weakly fusing trabeculae, located deeply in the calice. Dissepiments are widely spaced, thin, and prominent or weakly prominent. The coenosteum consists of fine, numerous highly swollen vesicles differentiated by sizes from 0.3 to 0.8 mm, intensively covered by fine granules. Costae are weakly prominent, and more pronounced in the upper part of a corallite.

The color of living corals is shades of green and yellow-brown.

Similar species *G. fascicularis* has corallites projecting over the coenosteum up to 15 mm at a distance of 2 to 6 mm from each other, with a diameter of 3-9 mm.

Common in a wide range of habitats and may form monospecific stands.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam and the Spratly Islands, depth 0-30 m.

Distribution. Widely known from the Red Sea to Japan and Fiji.

Galaxea fascicularis (Linnaeus, 1767)

Fig. 73-5, C14 -3

Madrepora fascicularis Linnaeus, 1767

Galaxea fascicularis (Linnaeus): Edwards and Haime (1857), Veron and Pichon (1980) cum syn., Scheer and Pillai (1983) cum syn., Veron (1986), Sheppard and Sheppard (1991)

Massive, columnar, thick encrusting colonies up to 2 m high and 5 m in diameter. Corallites are cylindrical, elliptical, or irregularly polygonal. They project over the coenosteum up to 15 mm at a distance of 2 to 6 mm from each other, with a diameter of 3-9 mm. Calices are deep with vertical walls.

Four to five cycles of septa are formed. First cycle septa and second cycle septa, and sometimes some third cycle septa, are equal-sized or almost equal. They are noticeably reinforced by tapering in comparison with the other septa and project well over the calice wall, fusing with the columella by their axial ends deep in the calice. Third cycle septa, as a rule, are thin, a half or ¼ shorter than septa of the first two cycles, and axial ends of some of them reach the columella. Fourth cycle septa are thin, short, and rarely more than 1/2 of the corallite radius. Fifth cycle septa (an incomplete set) are thin and very short, rarely being longer than 0.5 mm. The total number of septa is 40-60. Lateral septal surfaces are slightly or moderately covered by fine spines. The axial septal margins of the first three cycles of septa are saw-like dentate with fine denticles, and in combination with the columella they can produce a form of pali. The columella is dense, small, rarely more than ¼ of a calice diameter, and is formed of densely merging pali-like laminae of first to third cycle septa. Dissepiments are widely spaced, thick, and subhorizontal. The coenosteum is formed of fine, prominent, large, elongated vesicles, intensively covered by fine granules and in a narrow range of sizes (0.5-0.8 mm). Costae are of different lengths in accordance with the sizes of septa of different cycles of septa, and distinctly pronounced in the upper part of the corallite.

This species differs from *G. astreata* by a greater size and number of corallites, which more often have an irregular form; by projecting septa in one to three cycles; and by the presence of a well developed columella and vesicular coenosteum, consisting of larger laminae.

Common in various reef zones and may be a dominant species.

The color of living corals is shades of green and brown.

Location. Known everywhere from the northern Gulf of Tonkin to the Gulf of Siam and the Spratly Islands, depth 0-25 m.

Distribution. Widely distributed throughout the entire tropical zone of the Indo-Pacific from the Red Sea and Madagascar to Japan and the Great Barrier Reef of Australia.

Galaxea crassiseptata Latypov, 1998

Fig. 73-6

Galaxea crassiseptata: Latypov and Dautova (1998)

Holotype. Specimen 1/95256, Museum of Institute of Marine Biology, Vladivostok, Russia, Gjang Bo Reef, Khanh Hoa Province, reef slope, coralogenic substrate, depth 12 m.

Massive colony with large (up to 15 mm), compact corallites, regularly projecting over the coenosteum surface. They corallites have an ovally elongated, subtriangular, irregularly polygonal or rarely cylindrical form. The thick corallite wall sharply narrows at the upper border of the deep calice with vertical walls.

Four to five cycles of septa are formed, and the insertion of the fourth cycle septa is observed even at early developmental stages with a corallite diameter of 2-3 mm. Tapered, thick (0.5-0.9 mm) septa of the first and second cycles reach or almost reach the axis, merging with the columella in the depth of the calice. Third cycle septa are thin, long (rarely less than ¾ of a corallite radius), and do not quite reach the columella and and are slightly lanceolately reinforced at the periphery. Fourth cycle septa are thin. In the main sectors they are ¼ or 1/3 of the corallite radius, and in opposite sectors sometimes half as long as third cycle septa. When they are incomplete, they can have the form of thin vertical laminae at the calice wall. Fifth cycle septa (always incomplete) are represented by thin, short laminae not longer than 1 mm along the calice wall. The total number of septa is 48-64. The lateral surfaces of first to fourth cycle septa are covered by rows of spines, which decrease in size and increase in thickness of coverage in higher cycles of septa. Internal septal margins are thin and smooth except for protoseptum. All septa, except for that of the fifth cycle, are noticeably excert. The columella is small, and consists of separate pali-like lobes or of fusing axial ends of the first and second cycle septa. Dissepiments are sporadic, narrow, slightly prominent, and interseptal. The coenosteum consists of prominent vesicles in a range of sizes (from 0.3 to 2 mm). Numerous deep indentations are located along their perimeter, which causes many vesicles to acquire an irregular shape. The surface of vesicles is moderately covered by fine granules. Costae are smoothed out, with sizes in proportion to the sizes of septa of various cycles, and at the upper margin of the corallites they are more pronounced.

Remark. This species differs from the previously known species of *Galaxea* by very thick first and second cycle septa, by the irregular shape of large corallites and the complicated morphology of coenostium vesicles. The *G. fascicularis* specimen, presented by Veron and Pichon (1979, p. 206, Figs. 338, 340), closely resembles this species in the size and shape of the corallites, septal thickness, and presence and structure of the fourth and fifth cycle septa.

The color of living corals is emerald green.

Location. Khanh Hoa Province, Jang Bo Reefs, depth 12 m.

Galaxea vesiculosa sp nov.

Fig. 83-4

Galaxea sp. 1, Latypov and Dautova (1998)

Holotype. Specimen 1/95294, Museum of Institute of Marine Biology, Vladivostok, Russia, Chuong Island, Namsu Islands, reef slope, coralogenic substrate, depth 10m.

Columnar colony with small hump-like projections, covered by numerous diverging corallites. The corallites, mostly oval-elongated, have a diameter of 2-3 mm and are unevenly spaced at a distance of 2-7 mm. Calices are deep, and the wall is thin.

Three to four cycles of septa are formed. First and second cycle septa are equal in size. They are slightly lanceolately reinforced at the corallite wall, reaching ¾-2/3 of a corallite radius. Their vertical axial margins fuse with the columella in the depth of a calice. First cycle septa project over the calice wall up to 1.5-2 mm. Third cycle septa are thin, short, and their length makes from a half to ¼ of a corallite radius, and axial ends are free. Fourth cycle septa (mainly incomplete) are represented by thin and very short laminae, rarely longer than 2 mm, mainly in the upper part of the calice. The total number of septa is 32-38. The lateral surfaces of the first three cycles of septa are moderately, more rarely intensively, covered by granules and spines, which can be arranged in vertical rows on first cycle septa. The proximal margins of first cycle septa can be finely dentate. A columella is rarely seen, but when present is small. It is formed by a merger of single pali-like projections of first and second cycle septa. Dissepiments are widely spaced, narrow, slightly prominent, and interseptal. Costae are distinct, and highly project on the first cycle septa. The coenosteum is formed by various-sized (0.75-2 mm) dissepiments, highly prominent with pointed tips resembling pyramids or hillside mountains. The surface of the vesicles is covered by numerous fine granules, which can be arranged in parallel rows.

Remark. This coral differs from the other *Galaxea* representatives by highly prominent, almost pyramidal exothecal dissepiments. It differs from the very similar *Acrhelia horrescens* by the colony shape, though has a slight tendency to form clustered columnar projections. In *G. astreata* only first cycle septa are highly excert, whereas in *G. fascicularis* corallites are always bigger and the number of septa is 1.5 times greater.

Etimology:

Location. Gulf of Siam, Chuong Island, depth 10 m.

3.11. Family Pectiniidae Vaughan and Wells, 1943

Genus *Echinophyllia* Klunzinger, 1879

Type species: *Madrepora aspera* Ellis and Solander, 1786.

Diagnosis. Colonies are encrusting with a reinforced central area and free lamellar margin, which is slightly wavy. Corallites are situated chaotically. In the central reinforced area corallites are raised several millimeters over its surface. The other corallites have no pronounced calice. The coenosteum between corallites is slightly ornamented with widely spaced tubercles. On the lower surface of a colony growing margin, even, sharp ridges are situated perpendicular to the margin.

Echinophyllia aspera (Ellis and Solander, 1786)

Fig. C24-1

Madrepora aspera Ellis and Solander, 1786

Echinopora aspera (Ellis and Solander, 1786): Veron and Pichon (1980) cum syn., Veron (1986), Veron, Kelley (1988), Sheppard and Sheppard (1991)

Colonies encrusting with a flattened central area and free lamellar edge, which is slightly wavy. Corallites are located chaotically. In the central area corallites are raised several millimeters. Other corallites do not have calices. The coenosteum between corallites has little ornamentation and rarely is hillocky. Equal sharp ridges are located perpendicular to the edge on the bottom surface of growing edges of a colony.

Fourteen to eighteen septa are formed, which are not distinctly distinguished by orders or cycles. The most pronounced four to eight septa are reinforced in the peripheral part of a corallite and bear the tallest teeth. The other septa are thin, with small teeth. Septocostae are arranged in various directions according to the location of the corallites. At the colony periphery the septocostae are perpendicular to the growing margin. Septocostae are dentate with tall pointed triangular teeth. Teeth are taller and more pointed on septa than on the coenosteum. Septal teeth extend above the colony surface for 3-6 mm. Each septum bears two to four teeth. Internal septal teeth, located around the circle of a corallite, form the likeness of a palar crown. The columella is spongy, formed by interlacing of septal sprouts. Alveoli are arranged in a disorderly fashion and not numerous, and are found when a new septocosta is inserted.

The color of living corals is brown, green and/or red.

Similar species *E. echinata* has a large primary corallite, which has a diameter of 12-15 mm with radiating septocostae.

Common.

Location. Bai Tu Long Archipelago, reefs of Khanh Hoa Province, Culao Cham, Re, Phu Quy, and Ant Hoi Islands, depth 1-30 m.

Distribution. Distributed in the Indo-Pacific from the Red Sea to the Marshall Islands and Tahiti.

Echinophyllia orpheensis Veron and Pichon, 1979

Fig. 74-1, C14 - 6

Encrusting colonies with a reinforced central area and a free lamellar margin. Corallites are located chaotically, often raised above the colony surface for 1 cm or more. Ornamentation of the coenosteum is weak, with a few scattered tubercles. Septocostae are supplied with massive pointed teeth.

Septa of a wide range of lengths are formed, without distinct grouping in cycles or orders. The most developed septa (from seven to thirteen in number) are reinforced in comparison with the other septa, and bear one to three massive teeth. Less developed septa (three to five in number) are thin, without widenings or reinforcements, their internal margins are usually farther from the columella than the margins of reinforced septa. The internal teeth of the larger septa form a certain likeness to a palar crown (1-2 mm height), and the tallest teeth rise over the columella for 4-6 mm and have the shape of laterally compressed laminae. Costae are massive, not ornamented, and bear numerous teeth with thin pointed tips. Costae on flat parts of a colony are directed towards the colony margin, whereas in its central part they have no particular orientation. Teeth on costae decrease as far farther away from the corallite. The columella is spongy, constituted of trabeculae with pointed denticles on the tips.

The color of living corals is yellow, hazel, or brown.

Similar species *Echinophyllia aspera* has smaller corallites without thick beaded costae.

Relatively common.

Location. Found on the majority of reefs, except for Nam Zu Island, depth 1-30 m.

Distribution. Known on the reefs of Japan, Vietnam, the Philippines, Indonesia and the Great Barrier Reef of Australia.

Echinophyllia echinata (Saville-Kent, 1871)

Fig. C14 - 8

Echinophyllia echinata (Saville-Kent): Chevalier (1975), Veron and Pichon (1980) cum syn., Veron (1986)

Thin lamellar round colonies having a diameter of 7-12 cm. A large primary corallite is formed with a diameter of 12-15 mm, from which septocostae radiate. Secondary corallites are smaller (6-9 mm), arranged in a disorderly fashion, or in concentric rows. Secondary corallites are outwardly inclined towards the colony surface.

Three orders of septa are present . First order septa (six to nine in number) are larger, and bear two to three tall (2-5 mm) teeth. These teeth often have the shape of massive vertical laminae, and on the tip they have fine denticles. The lateral sides of septa and teeth are ornamented by fine tubercles, and in the axial area three to five pali are present. All first order septa have a vertical internal margin, and connect to the columella and are separated by spacious interseptal loculi.

Second order septa (three to nine in number) are thin, have no reinforcements or massive teeth, but only one to three fine needle-shaped teeth, which are not so tall and almost without ornamentation. They sometimes descend evenly to the columella, and some of them do not reach it. Third order septa are rudimentary, in the form of short sharp ridges on the internal surface of the wall of some corallites. Septocostae bear tall thin pointed teeth, arranged in two to three in sharp laminae. Several fine denticles are on the tip of costal teeth. Lateral septocostal surfaces are ornamented with a few fine spines. Alveoli are present in places of insertion of new septocostae. The columella have a flat tip.

The color of living colonies is brown, green, red.

Similar species this species resembles *Oxypora crassispinosa* more than other *Echinophyllia* species.

Uncommon.

Location. Phu Quy, Con Dao, Culao Cham, and Dang Kho Islands, depth 10-30 m.

Distribution. Known in Vietnam, the Solomon Islands and the Maldives, New Caledonia, and the Great Barrier Reef of Australia.

Echinophyllia echinoporoides Veron and Pichon, 1980

Fig. C14 - 5

Colonies of the present series are explanate or encrusting plates with thin edges. Corallites are irregularly distributed. They are usually more widely separated in the direction of the costae, with those of the same age sometimes forming irregular, concentric rows. Most mature corallites are plocoid or sub-plocoid; none protrude more than 2.5 mm.

Septa are in two alternating orders. Second order septa are frequently absent but are usually reduced to a few spines on the theca. Second order costae, if present, are very reduced. First order septa, eight to sixteen in number, extend inwards horizontally almost to the columella. They have one to four tall paliform dentations, the innermost of which slant towards the columella. The latter are compact, although their formation from dentations of the vertical, inner septal margins, can usually be seen. The sides of the septa are finely granulated. The costae are finely dentate, the dentations varying in appearance from spines to beads. Small alveoli are present at the insertion of the costae but are seldom abundant. On their undersurface, all coralla are finely costate, the costae being glabrous or minutely dentate. The walls are primarily septothecal. Exothecal dissepiments are conspicuous towards the centre of most coralla.

Colonies have a wide range of colours, from cream to dark brown-green.

Similar species: Unlike other *Echinophyllia*, but superficially resembles the faviid *Echinopora lamellosa*.. It is readily distinguished by its exsert costae.

Relatively common.

Location. Phu Quy Island, Jang Bo Reef, Cham, Thu, Con Dao and An Thoi Islands, 6-14 m.

Distribution. South-West Pacific.

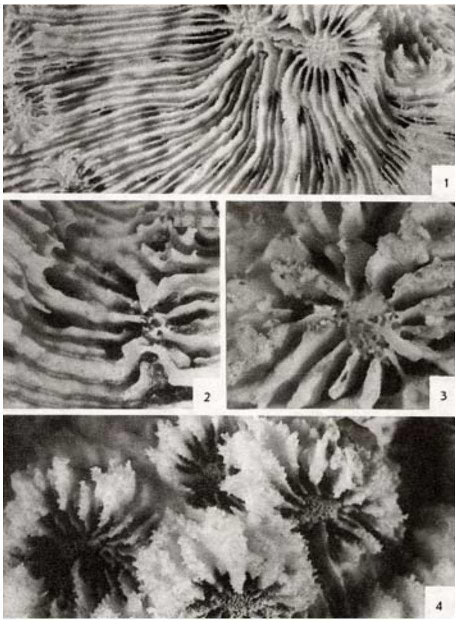


Fig. 74. 1 - *Echinophyllia orphensis*, spec. 1/95259, Is. Il Buaze, depth 3 m; 2 - *Oxypora lacera*, spec. 1/95261, Is. Tyac Lon, depth 6 m; 3 - *Oxypoгa glabra*, spec. 1/95262, Is. Namsu, depth 12 m; 4 - *Mycedium elephantotus*, spec. 1/95263, reef Jiang Bo, depth 9 m.

Echinophyllia nichihirai Veron and Pichon, 1990

Fig. 75-3

Thin lamellar round colonies having a diameter of 7-8 cm. A large primary corallite is present. Secondary corallites are absent. The lower surface of the colony margin bears sharp dentate ridges, which correspond to septocostae in arrangement.

Septa are in the form of thin dentate laminae with pointed, laterally compressed teeth. First order septa (12-20 in number) are taller and thicker than the other septa and have taller and more massive teeth. The internal margins of these septa are free. Shorter low and thin septa of the second order fuse with the lateral sides of the first order septa. Septa of the other higher orders fuse in the same way with neighboring septa of lower orders. Up to six orders of septa can be counted in total. Almost all septa have a flat elevation at a distance of approximately 3 cm from the corallite center. On thinner septa denticles are numerous and finer. The columella is spongy, round, and approximately 13 mm wide. Alveoli are not developed.

Remark. Our specimens slightly differ from the holotype, described by Veron (1990) in that their septa belonging to different orders are clearly distinguished by thickness and height.

The color of living corals is unknown.

Location. Phu Quy Island, Jang Bo Reef, depth 6-10 m.

Distribution. South China Sea.

Echinophyllia patula (Hodgson and Ross, 1981)

Fig. C14 - 7

Physophyllia patula Hodgson and Ross, 1981

Colonies are thin laminae with widely spaced, irregular corallites. Corallites are immersed and have broad columellae. A large central corallite may be distinguishable. Costae are well developed and have exsert triangular teeth; there are deep pits where costae commence. Color: Usually grey-green, grey or brown

Similar species *E. aspera*, which has smaller, more exsert and more crowded corallites. *E. echinata* has more irregular costae and a more prominent central corallite (Veron, 2000).

Rare.

Location. Khanh Hoa province, depth 12 m.

Distribution. South-West Pacific.

Genus *Oxypora* Saville-Kent, 1871

Type species: *Trachypora lacera* Verrill, 1864.

Diagnosis. Colonies are lamellar. Calices are round or oval, fine, and slightly inclined to the colony surface. Septa are not numerous, and the columella is weakly developed. Open-ended alveoli are developed in places of new septocostae insertion.

Oxypora lacera (Verrill, 1864)

Fig. 74-2

Trachypora lacera Verrill, 1864

Oxypora lacera (Verrill): Yabe and Eguchi (1935), Veron and Pichon (1980) cum syn., Veron (1986), Veron, Kelley (1988), Sheppard and Sheppard (1991)

Colonies are encrusting, with a free lamellar margin. Corallites are superficial, having a diameter of 6-12 mm, and located chaotically. Only some of them are slightly elevated over the colony surface, but they have no pronounced theca.

Nine to sixteen septocostae are formed, which are weakly distinguishable by orders. First order septa are well developed, reach columella and connect with it. They bear two to four teeth, often merging in a lamina. External teeth are thicker and taller that the internal ones. External septal margins are often reinforced and they fuse here, imitating a corallite wall. Two to four thin, low second order septa, which do not reach the columella and extend as thin low costae or end in alveoli, can be developed in a corallite. First order septa extend as more massive costae, having frequent and very tall teeth (up to 5 per cm). These teeth often merge in laminae and branch on the tip. The top parts of teeth are ornamented with tubercles and spines. Interseptal loculi are deep and open. Intercostal intervals are filled with vesicular coenosteum, which is especially well seen at the colony periphery. The columella is spongy, oval, and 2-6 mm long, with a flat top.

The color of living corals is brown, green and red.

Similar species: *O. glabra* has septa slightly distinguished by thickness, without distinct arrangement in rows or cycles.

Common.

Location. Phu Quy, Con Dao Islands, Bai Tu Long Archipelago, and the reefs of Khanh Hoa Province, depth 10-25 m.

Distribution. Widely distributed in the Indo-Pacific from the Eastern part Africa and the Red Sea to the Marshall Islands, New Caledonia and Loyalty Islands.

Oxypora glabra Nemenzo, 1959

Fig. 74-3

Oxypora glabra Nemenzo, 1959: Veron and Pichon (1980), Veron (1986)

Colonies are encrusting with a free lamellar margin. Corallites are situated chaotically, some of them form short rows, parallel to the colony margin. Corallites have a weakly pronounced calice, not having an elevated wall. The lower surface of the growing colony margin bears ridges with a rounded margin, ornamented with fine tubercles and dentate with tall pointed teeth. Some of them branch.

Seven to fourteen septa are formed, which come together towards the corallite center, slightly twisting in the right-hand direction. Every septum is ornamented with one to two tall pointed teeth. Internal teeth are always taller and thicker than the external teeth. Septa are slightly distinguished by thickness, without distinct arrangement in orders or cycles. Costae are of different thickness, dentate with a few pointed teeth. Two to four thinner and lower costae, less dentate, are situated between every two thicker costae with tall pointed teeth. The majority of septa are connected with the columella. Endothecal alveoli are formed near free internal septal ends not reaching the columella. Exothecal alveoli are open-ended and situated in rows at the periphery. Interseptal loculi are absent. The columella is weakly developed and consists of several twisted thin septal outrowths.

The color of living corals is brown and green.

Similar species: *O. lacera* is distinguished by its first order septa with more massive costae, having frequent and very tall teeth.

Rare.

Location. Reefs of Khanh Hoa Province.

Distribution. Vietnam, the Philippines, New Caledonia, and the northern part of the Great Barrier Reef of Australia.

Genus *Mycedium* Oken, 1815

Type species: *Mycedium elephantotus* Pallas, 1766.

Diagnosis. Foliose colonies with large porous corallites, arranged in rows, subparallel to the colony margin. Septa are thick, short, and the columella is well developed. Septocostae are radial, are not inserted again on the coenosteum.

Mycedium elephantotus (Pallas, 1766)

Fig. 74-4, C14 - 2

Madrepora elephantotus Pallas, 1766

Mycedium elephantotus (Pallas): Yabe and Eguchi (1935), Veron and Pichon (1980) cum syn., Veron (1986), Veron and Kelley (1988), Sheppard and Sheppard (1991)

Colonies are encrusting, with a free lamellar margin. Corallites are porous, situated chaotically or form short rows parallel to the colony margin. All corallites are inclined towards the colony surface in the direction of the growing margin, and an elevated septothecal corallite wall is developed on the central side of the corallite, projecting above the colony surface, whereas on the opposite side the wall is absent.

Six to twelve septa of various sizes are formed. First order septa (four to seven in number) are taller and more massive, dentate with high pointed teeth. At the corallite periphery they extend as massive costae, ornamented with denticles. The other septa are noticeably thinner and shorter. They are supplied with fine, laterally compressed denticles. The distal margin of all septa is inclined to the corallite center. Almost all of them reach the columella and connect with it. The columella is spongy, with a flat top. Alveoli are not form in places of the insertion of new septocostae.

The color of living colonies is brown, gray, red, green.

Similar species. Underwater externally like some species of *Echinophyllia*.

Common.

Location. Known on most reefs, except for the eastern and top parts of the Gulf of Siam, depth 5-25 m.

Distribution. Widely distributed in the tropical Indo-Pacific from the Red Sea to Tahiti.

Genus *Pectinia* Oken, 1815

Type species: *Madrepora lactuca* Pallas, 1766.

Diagnosis. Lamellar or subarborescent corals with a fine skeletal structure. Corallites are very large with a very high insufficiently definite wall. Septa are irregularly dentate and formed by a monofan system of complicated trabeculae. Large convex dissepiments are formed. The columella is poorly developed, and the coenosteum is weakly ornamented.

Pectinia lactuca (Pallas, 1766)

Fig. 76-1, C23 – 4

Pectinia lactuca (Pallas): Veron and Pichon (1980) cum syn.

Colonies are lamellar, rounded, and 25-40 cm wide. Corallites are chaotically situated at the colony periphery, they are mainly arranged in rows (series), radiating from the colony center to its margins. From two to seven corallites can constitute a row. Rows are separated by high continuous septocostal ridges. The margins of septocostal ridges are dentate, as septal teeth project over them.

All septa bear frequent short triangular teeth which are laterally compossed. Septa in a corallite are of a uniform size and shape, without a distinct arrangement in orders or cycles. The columella is in the form of several twisted trabeculae. One to three rows of large swollen dissepiments are developed.

The color of living corals is gray, brown, green.

Similar species *P. paeonia* has corallites which do not form rows, but are separated by continuous septocostal ridges.

Common.

Location. Known on the majority of reefs, except for the eastern and northern parts of the Gulf of Siam, depth 1-20 m.

Distribution. Widely distributed in the Indo-Pacific from Madagascar to Japan and Fiji.

Pectinia paeonia (Dana, 1846)

Fig. 76-3, C14 – 4, C20-5

Pectinia paeonia (Dana): Veron and Pichon (1980) cum syn

Colonies are lamellar and round. Colony width is 15-35 cm. Corallites do not form rows, but are separated by continuous septocostal ridges. They are arranged chaotically or in irregular short groups of two to three. Between corallites and groups of corallites, septocostal elevations are developed only in the form of high sharp and narrow walls. The colony surface is covered by groups (clusters) of three to four such elevations, which merge laterally approximately at 1/3-2/3 of their height.

Septa are weakly ornamented and supplied with small triangular teeth. Septocostae are arranged in two orders. First order septocostae are more massive than those of higher orders, and they, projecting beyond the growing colony margin, impart a dentate shape to it. The columella is weak, and is composed of several twisted trabeculae. Dissepiments are large, slightly prominent, steeply inclined, and three to four rows are formed.

The color of living colonies is blue and green-brown.

Similar species *Pectinia alcicornis* has less solid skeletal structures, tall spires, and less developed columellae.

Common, usually on reef slopes..

Location. Reefs of Khanh Hoa Province, Phu Quy, Con Dao, and Tho Chu Islands, Bai Tu Long Archipelgo, depth 1-25 m.

Distribution. Known on the reefs of Sri Lanka, the Nicobar Islands, Vietnam, Indonesia, the Philippines, the Great Barrier Reef of Australia, New Caledonia and Fiji.

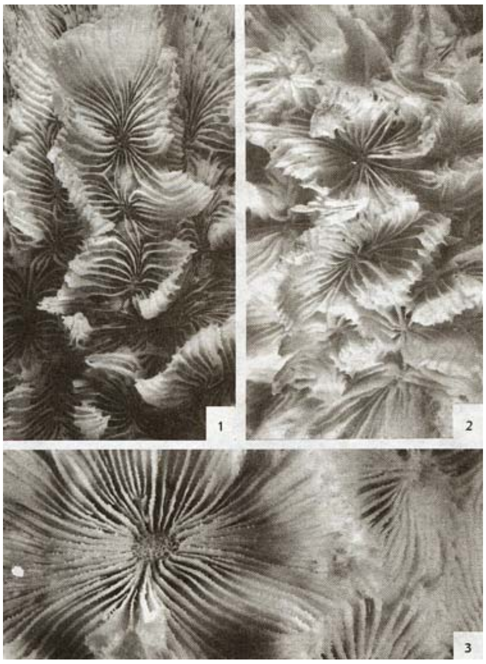


Fig. 76. 1 - *Pectinia lactuca*, spec. 1/95264, Bay Bai Kanh, depth 12 m; 2 - *P. alcicornis*, spec. 1/95265, Is. Moon, depth 18 м; 3 - *P. paeonia*, spec. 1/95266, о-в Намзу, depth 12 m.

Pectinia alcicornis (Saville-Kent, 1871)

Fig. 76-2, C24 - 4

Pectinia alcicornis (Saville-Kent): Veron and Pichon (1980) cum syn.

Colonies are lamellar, round, and have a diameter of 25-30 cm. Corallites are located chaotically or in groups of three to four. Septocostae between them are fragmentary, in the form of high, sharp, narrow elevations. The colony surface is covered by single projections and groups of projections, which merge laterally at about 1/3-2/3 of their height. In one colony up to nine clusters can be found, consisting of four to eleven elevations, connected laterally almost to the very tips. Such groups form irregular dentate laminae, twisted and curled. As a rule, these laminae have a fan-like shape.

Septa are weakly ornamented and supplied with small triangular teeth. Septocostae are arranged in two orders. Septocostae of the first order are more massive, and they, projecting beyond the growing colony margin, impart a dentate shape to it. The growing margin of a colony is undulating. The columella is weak, and is composed of several twisted trabeculae. Three to four rows of large disorderly and spine-shaped dissepiments are formed.

The color of living corals is pink-orange or green-brown.

Similar species. See *P. paeonia*.

Relatively common.

Location. Bai Tu Long Archipelago, and the reefs of Khanh Hoa Province, depth 5-20 m.

Distribution. Known in Vietnam, Indonesia, New Caledonia, Palau, the Solomon Islands, the Great Barrier Reef of Australia and Addu Atoll.

3.12. Family Merulinidae Verrill, 1866

Genus *Merulina* Ehrenberg, 1834

Type species: *Madrepora ampliata* Ellis et Solander, 1786

Diagnosis. Lamellar-encrusted, laminate colonies with vertical projections of various shapes. Corallites are grouped in long series, diverging fan-like from the center of the colony. Two orders of septa are highly carinated. The columella is formed from the merger of axial septal ends.

Merulina ampliata (Ellis and Solander, 1786)

Fig. 77-1, C13 - 1

Madrepora ampliata Ellis and Solander, 1786

Merulina ampliata (Ellis and Solander): Veron and Pichon (1980) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986)

Lamellar, or lamellar-encrusting multitier colonies with tubercular or thick-branched 50-100 mm high projections in the central part of the colony. Corallites are grouped in long and short valleys, separated by high, mainly wide ridges. Series of three to five monocentric corallites of irregular shape are frequent on tubercular-branching parts of colonies. On horizontal parts of colonies, corallite valleys are long (with four to ten corallites), radial and diverging. Calices are moderately deep to deep. The lower colony surface is covered by radially diverging tubercles with coarse ribbing, ornamented by fine spines and papillae divided in complicated ways.

Twenty to thirty septa in two orders are present. First order septa are thick, and merge with columella. They project well above the calice and over the corallite wall, and are abundantly carinated along the axial and distal margins. Their axial ends have thick, digitate pali with pointed tips, which can form a circle. Second order septa are very short and project as short spines. The columella is dense and spongy, depending on the thickness of axial septal ends and the degree of their merger with each other. Corallite walls fuse with each other and are thick.

The color of living colonies is cream-brown, or pale-yellow.

Similar species *M. scabricula* is delicate with less coarse skeletal structures.

Common.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam and the Spratly Islands, depth from the littoral down to 42 m.

Distribution. Widely distributed on the reefs of the tropical zone of the Indo-Pacific.

Genus *Hydnophora* Fischer de Waldheim, 1807

Type species: *Madrepora exesa* Pallas, 1766.

Diagnosis. Branched, more rarely submassive colonies with numerous vertical projections. Two orders of septa project far upwards on conical and ovally conical monticules. The columella is variable, from a dense columella of thick merging axial septal ends to a weak columella of single bars and small laminae.

Hydnophora rigida (Dana, 1846)

Fig. 77-2, C16 - 5

Merulina laxa Dana, 1846

Merulina rigida Dana, 1846

Hydnophora rigida (Dana): Edwards and Haime (1857), Veron, Pichon and Wijsman-Best (1977) cum syn.

Branched colonies, sometimes with submassive or encrusting bases. Branches are thin (5-9 mm), roundly flattened, having a length of 5-12 cm. Their upper ends chaotically diverge into three to six tips or can grow fan-like. Monticules are not high, but are pointed-conical or rounded. Towards the branch tips they always merge in triangular rows with a plumose arrangement of the septa.

Fourteen to thirty septa in two orders are present. First order septa are long, and more protruding than higher order septa. They are highly reinforced in the axial space of the corallite and reach the tips of the monticules. Second order septa are developed in the form of short laminae only on monticules. They are situated mainly in pairs near the first order septa, fused to them on their axial ends. All septa are moderately ornamented by fine granules. The columella is massive, and consists of fusing thick septa. It is rounded or elongated in rows between the monticules. Single prominent interseptal dissepiments are developed. The wall cannot be seen.

The color of living corals is shades of green-brown.

Similar species *H. grandis* is distinguish by its more thick branches and little fusion of monticules.

Common.

Location. Reefs of Khanh Hoa Province, Culao Cham, Re, Phu Quy, Con Dao, Nam Zu, and the Spratly Islands, depth 10-20 m.

Distribution. The Seychelles and Nicobars, Singapore, Vietnam, the Philippines, Taiwan, Palau, Japan, New Caledonia, Fiji, and the Great Barrier Reef of Australia.

Hydnophora exesa (Pallas, 1766)

Fig. 77-3

Madrepora exesa Pallas, 1766

Monticularia exesa Schweigger, 1820

Hydnophora exesa (Pallas): Verril (1864), Veron, Pichon and Wijsman-Best (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986), Sheppard and Sheppard (1991)

Thick-branched colonies with encrusted-massive bases. Branches can be long (up to 15 cm) and thick (20-30 mm) with dichotomizing tips, and short (2-3 cm) with multipointed, radially diverging tips. Monticules are well developed, high, conical and pointed-conical, and mainly distinctly detached. They are arranged in rows at the periphery of the lower part of the colony and in the upper parts of branches.

Twelve to twenty-four septa in two orders are present. First order septa are long and thick, and when they reach the columella they become more strongly reinforced. Second order septa are short in the form of low laminae or separate spines, developed only on the dissepiments on monticules. Lateral septal surfaces are weakly or moderately ornamented with fine spines and granules. The columella is weak, formed of separate, mainly disconnected, pali-like long bars, which are variously inclined. Dissepiments are frequent, thin, and prominent up to the point that they are vesicular. The wall is not viewed.

The color of living corals is shades of yellow-green.

Similar species *H. microconos* is massive and rounded, with smaller monticules.

Common.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam and the Spratly Islands, depth 1-30 m.

Distribution. Widely distributed throughout the entire tropical zone of the Indo-Pacific.

Hydnophora microconos (Lamarck, 1816)

Fig. C12 - 8

Monticularia microconos Lamarck, 1816

Hydnophora microconos (Lamarck): Edwards and Haime (1849), Veron, Pichon and Wijsman-Best (1977) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986), Sheppard and Sheppard (1991)

Massive or massive-encrusting colonies, sometimes with thick (3-7 cm) vertical branches, evenly covered by conical star-shaped monticules, which are weakly arranged in rows throughout the entire colony surface. Branch ends weakly dichotomize or have multiple peaks of elongated monticules.

Fourteen to twenty septa of two orders are present. First order septa are thick, highly clavately reinforced at the axis, and towards the upper part of monticules they become thinner. Second order septa are developed in the form of short low laminae or separate spines only in the middle part of monticules. Septal dentation is weak, developed mainly in the lower part of septa. The columella consists of separated or merging pinnacle-like spines, fusing into short laminae, and surrounding monticules in a dotted manner. Dissepiments are frequent, obliquely inclined, prominent, and form one to two rows. The wall is not visible.

The color of living corals is yellow-green.

Similar species *H. exesa* has thick-branched colonies with an encrusting-massive base.

Common in various reef zones.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam and the Spratly Islands, depth 1-25 m.

Distribution. Widely distributed in the Indo-Pacific from the Red Sea to Islands Cook.

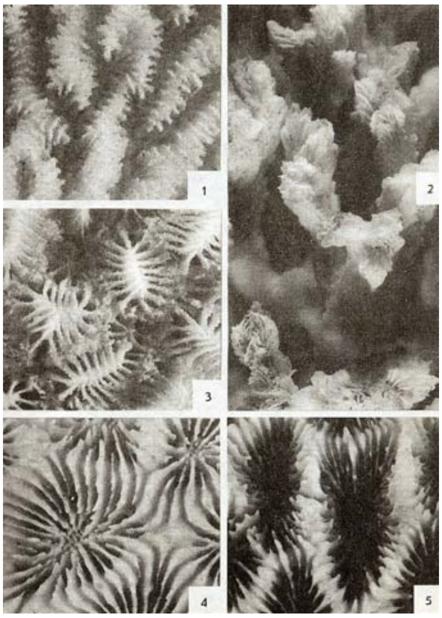


Fig. 77. 1 - *Merulina ampliata*, spec. 1/95267, Is. Hon Mju, depth 3 m; 2 - *Hydnophora rigida*, spec. 1/95268, Is. Moon, depth 10 m; 3- *H. exesa*, spec. 1/95269, Is. Il Buaze, depth 4 m; 4 - *Acantastrea echinata*, spec. 1/95274, Is. Thu, depth 18 m; 5 - *A. hillae*, spec. 1/95275, Bai Thanh Bay, depth 8 m.

3.13. Family Mussidae Ortmann, 1890

Genus *Cynarina* Brügelman, 1877

Type species: *Synarina savignyi* Brüggelmann, 1877 (=*Caryophyllia carduus* Audouin, 1826).

Diagnosis. Monocentric subcylindrical corals with big thick septa of four orders, septa of the first two cycles with very big lobate spikes. Palimorphic lobes are well developed. Columella is dense.

Cynarina lacrymalis (Edwards and Haime, 1848)

Fig. 78

Cynarina lacrymalis (Edwards and Haime): Wells (1964), Veron and Pichon (1980) cum syn.

Monocentric (solitary) or diverging budding corals with a wide attached base, with a high, distinct longitudinal ridging on the holotheca.

Up to 50 septa in four orders are present. First cycle septa are highly reinforced and project upwards with five to six large, thick, lobate spines. Second order septa are 1.5-2 times thinner, less protruding upwards and have no more than three large spines, only at the periphery. Third order septa are thin, tapered and reinforced towards the distal margin. Their axial margin is highly dentate with five to six thin vertical spines and two to four larger saw-like teeth at the periphery.

Fourth order septa are short and present sporadically. Septal dentition is the same as in third order septa. The lateral surfaces of all septa are densely covered by fine distinct granules. The columella is distinct, spongy, and situated in a small axial depression. Dissepiments are not numerous but are subhorizontal and weakly prominent.

The color of living corals is shades of yellow and brown.

Location. Bai Tu Long Archipelago, reefs of Khanh Hoa Province, Re, and the Phu Quy Islands, depth 10-25 m.

Distribution. Known throughout the entire tropical zone of the Indo-Pacific from the Red Sea and the Gulf of Aden to Japan.

Fig. 78. 1 - *Synarina lacrimalis*, spec. 1/95271, Is. Cha La, depth 18 m.

Genus *Scolymia* Haime, 1852

Type species: *Madrepora lacera* Pallas, 1766.

Diagnosis. Monocentric flat corals with a wide attached base. Septa are in five cycles, with lower cycle septa being thick and highly denticulated. The columella is dense and well developed.

Scolymia australis (Edwards and Haime, 1849)

Fig. 79-1, C23 - 5

Caryophyllia australis Edwards and Haime, 1849

Scolymia australis (Edwards and Haime): Veron and Pichon (1980) cum syn.

A solitary coral of irregular rounded shaped with a wide attached base, having a diameter of 2-4 cm. Calicies are shallow with a thick wall.

Sixty septa in five complete cycles are present. First and second cycle septa are the most reinforced with a wedge shape and are almost unform. They are more excert than the other septa, especially at the periphery. Reaching the columella, they have three to five thick wedge-shaped vertical spines. First cycle septa have less spines. Third cycle septa are 1.5-2 times thinner and have five to seven spines each. Fourth cycle septa are thin throughout their entire length, with an uneven axial edge and seven to nine thin twisted spines. Their axial ends are free and fuse with septa of the lower cycles, and their length reaches 2/3 of a corallite radius. Fifth cycle septa are thin, their length reaches ½ of a corallite radius, and their axial ends are free. The lateral surfaces of all septa are moderately covered by pointed granules. Costae are distinct, distinguished well enough by cycles, and coarsely dentate. The columella is small and dense.

The color of living corals is shades of yellow-green and brown, differing in the axial and peripheral areas.

Similar species *Scolymia vitiensis* is mostly larger and not cup-shaped.

Uncommon.

Location. Phu Quy Island, depth 42 m.

Distribution. South Vietnam, and eastern and southern Australia.

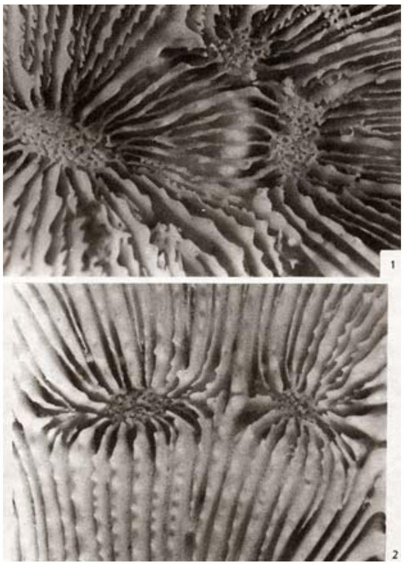


Fig. 79. 1 - *Scolymia australis*, spec. 1/95272, Is. Moon, depth 10 m; 2 - *S. aff. vitiensis*, spec. 1/95273, Is. Cha La, depth 20 m.

Scolymia aff. *vitiensis* Brüggemann, 1877

Fig. 79-2

Polycentric, cake-like, prominent or weakly funnel-shaped corals with large corallites (up to 50-60 mm diameter). Calices are wide and shallow or deep with a subhorizontal bottom and steep walls, especially in young individuals.

Up to 80 septa of five to six cycles are present. The first two cycles of septa are thick (up to 1.5 mm) with long (up to 2.5 mm) spines and highly projecting upwards. They can be uniformly thick along their entire length, smoothly become thicker or sharply become thinner towards the axis, and fusing with columella. Third and fourth cycle septa are thin, slightly reinforced by a wege shape towards the periphery, and their axial edges fuse. Axial parts of the septa are heavily dentate with high, tall blade-like spines. Fifth and sixth cycle septa are thin, low, and reach ½ to 2/3 of a corallite radius. Their axial edges are mainly free. Internal margins are very heavily dentate with frequent twisted blade-like teeth. The lateral surfaces of all septa are granulated with pointed spines. The columella is large, dense, and sometimes fused. The endotheca is vesicular, and consists of fine prominent dissepiments.

Remark. There is only one specimen available, which differs greatly from the described *Scolymia*. It differs from *S. australis* by its large size, polycentric colony and distinctly differentiated lower and higher cycle septa. It is distinguished from *S. vitiensis* by a larger columella, and less thick lower cycle septa. The most similar species to our specimen is *S. lacera* from the Gulf of Mexico, but it is less polycentric, the calice is deeper and septa are taller. The described specimen differs from all *Scolymia* by distinct, numerous, prominent to vesicular dissepiments. This coral has six cycles of septa. First and second cycle septa are moderately thick, slightly reinforced with tapering towards the columella. Third and fourth cycle septa are thin, and their axial ends fuse near the columella. Fourth and fifth cycle septa branch dichotomously in pairs. Sixth cycle septa are short and not always complete. All septa are highly dentate with 15-20 large and small teeth.

The color of living corals is shades of green-brown.

Location. Reefs of Khanh Hoa Province, Re, Phu Quy, and Con Dao Islands, depth 10-30 m.

Distribution. Known in Vietnam, the Marshall Islands, Fiji, and Australia.

Genus *Acantastrea* Edwards et Haime, 1848

Type species: *Acantastrea spinosa* Edwards et Haime, 1848.

Diagnosis. Massive, massive-encrusting corals with cerioid corallites. Septocosta are thick, of two to three orders, noticeably prominent, and highly dentate. The columella is compact. The wall is thick.

Acantastrea echinata (Dana, 1846)

Fig. 77-4

Astrea echinata Dana, 1846

Acantasrea echinata (Dana): Ewdards and Haime (1857), Veron and Pichon (1980) cum syn., Scheer and Pillai (1983), Veron (1986), Sheppard and Sheppard (1991)

Thin massive or massive-encrusting colonies. Corallites are cerioid, round or round-polygonal, with a diameter of 10-17 mm. Calices are shallow or moderately deep with thick walls.

There are 34-48 septa in two orders. First order septa are reinforced with tapering (up to 0.5 mm), are noticeably excert, and reach the columella. Their internal margins are highly dentate with long rod-shaped spines, with tips that are spiny, and slightly reinforced. Second cycle septa are two to three times thinner and ½ or 1/3 shorter. Their axial margins are dentate with blade-like thin spines. The lateral surfaces of all septa are covered by a few large spiny granules, the thickness of which noticeably increases towards the proximal septal margin. The columella is small, reasonably dense, and consists of twisted and fusing axial septal ends. There are two rows of fine to medium dissepiments, which are prominent and inclined towards the axis.

The color of living corals is shades of red-brown with a green-blue central area of corallites.

Similar species *A. hillae* has deep calices with vertical walls.

Uncommon.

Location. Reefs of Khanh Hoa Province, Re, Phu Quy, and Con Dao Islands, depth 3-20 m.
Distribution. Widely known in the tropical zone of the Indo-Pacific from the Red Sea to the Marshall Islands and the Tuamotu Archipelago.

Acantastrea hillae Wells, 1955

Fig. 77-5

Acantastrea hillae Wells, 1955: Chevalier (1971), Veron and Pichon (1980) cum syn., Veron (1986), Sheppard and Sheppard (1991)

Massive and submassive cerioid colonies. Corallites are polygonal, round-polygonal to elongated, their diameter varies from 10 to 30 mm, and they can be tricentric. Calices are deep and walls are vertical.

There are 48-60 long septa of two to three orders, which are highly dentate, and not always distinct. More than a half of the septa are noticeably reinforced and have five to seven long spines each. These septa and their spines project well over the theca and all reach the columella. The other septa are thinner and have seven to nine shorter and more often blade-like spines. Second order septa can also reach the columella, but more often their axial ends fuse with longer first order septa, not quite reaching the columella. Third order septa are thin, short, rarely longer than ½ of a corallite radius, and have four to six blade-like spines. The lateral surfaces of all septa are weakly to moderately granulated with spines, with the number and sizes increasing towards the wall and with depth in the calice. The columella is compact, imbedded in a depression, and consists of highly twisted axial septal ends, which fuse with each other. There are three to four rows of fine and medium dissepiments, which are prominent and slightly inclined towards the axis.
The color of living corals is shades of cream-red and brown with green corallite centers.
Similar species *A. maxima* has have relatively fleshy polyps.
Relatively common.
Location. Reefs of Khanh Hoa Province, Re, Culao Cham, and Phu Quy Islands, depth 5-20 m.
Distribution. Known on the reefs of Vietnam, New Caledonia, Australia.

Acantastrea hemprichii (Erhenberg, 1834)

Fig. C22 – 5

Colonies are encrusting to massive and frequently over one metre across. Corallites are cerioid. Septa have exsert teeth. Colonies have fleshy tissue over the skeleton, but this is not thick enough to mask underlying skeletal structures.

Colour: Mottled browns and greens, commonly with brown walls and green oral discs.

Similar species: *Acanthastrea echinata*, which has more widely spaced, fleshy, less cerioid corallites. See also *A. bowerbanki*, which usually has a central corallite and more angular peripheral corallites and *A. hillae*, which has larger and more fleshy corallites.

Genus *Lobophyllia* De Blainville, 1830

Type species: *Madrepora corymbosa* Forskål, 1775.

Diagnosis. Phaceloid, flabello-meandroid colonies with large detached corallites and meanders. There are two to four orders of septa, with three to four cycles having long numerous spines along the internal margin. The columella is large, dense and spongy.

Lobophyllia hemprichii (Ehrenberg, 1834)

Fig.. C13 - 4

Manicina hemprichii Ehrenberg, 1834

Lobophyllia hemprichii (Ehrenberg): Matthai (1928), Chevalier (1975) cum syn., Veron and Pichon (1980) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986), Sheppard and Sheppard (1991)

Flat, hilly and hemispherical colonies, reaching 40-50 cm in height and up to 6 m in diameter. The corallites are large and monocentric (up to 40 mm diameter) and united in meanders (up to 20 cm length) of three to ten corallite centers. Calices are deep, wide with well-developed vesicular endotheca. The external surfaces of corallites have fine to medium-sized costae with longitudinal rows of medium to large spines.

There are 48-92 long, thin or slightly taperedly reinforced septa in three to four orders. First order septa are highly excert, thicker than the other septa, and connect with the columella. Second order septa are thin, reinforced by thickening only at the corallite wall, and they almost reach columella. Third order septa are half the length of the lower order septa. Fourth order septa are developed variably in the form of low, thin laminae or separate spines in the upper part of the calice. Internal margins of all septa are dentate with long (up to 3-4 mm), pointed, tapered and blade-like spines, which vary in number from six to ten. In higher order septa they are thinner, more often lobate, and are numerous. The lateral septal surfaces are smooth. The columella is well developed, and consists of variously curved interlacing laminae. Four to six rows of prominent medium to large dissepiments are inclined towards the axis.

The living corals is uniform in colour or with two or more colours concentric to mouths or valley walls.

Similar species *L. corymbosa*, is monocentric and *L. robusta* has larger, more fleshy polyps.

Common.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam and the Spratly Islands, depth 1-40 m.

Distribution. One of the most common and widely distributed species of the tropical Indo-Pacific.

Lobophyllia corymbosa (Forskål, 1775)

Fig. 80-11, C13 - 5

Madrepora corymbosa Forskål, 1775

Lobophyllia corymbosa (Forskål): Matthai (1928), Veron and Pichon (1980) cum syn., Scheer and Pillai (1983) cum syn., Nakamori (1986), Veron (1986), Sheppard and Sheppard (1991)

Hemispheric colonies with mono- and tricentric corallites, distinctly separated from each other for a distance of 6-9 mm, with a 20-30 mm diameter. Calices are of a moderate depth with a wide vesicular endotheca. The external surface of corallites has fine costae with a few long spines, loosely arranged in vertical rows.

There are 42-75 long septa reinforced with tapering, in three to four orders. First order septa reach the columella, are highly excert, are strongly reinforced towards the periphery, where they are dentate with three to seven long, fan-like diverging spines. Second order septa are of the same length as the first order septa, but they are thin and weakly reinforced at the periphery, and have only one to two spikes. Third order septa are 1/3 shorter and lower than the lower order septa. Their axial ends can fuse with the second order septa. Fourth order septa are rudimentary, formed only in the upper part of the calice. The axial margins of all septa are dentate with tapered and blade-like long spines, which vary in number from eight to fourteen. The lateral surfaces of all septa are moderately granulated with very fine spines. The columella is large, well developed, consists of bent fused lobes, the tips of which are granulated with very fine spines. Four to six rows of prominent, usually large dissepiments are present, inclined towards the axis.

The color of living corals is shades of green with blue-pale-yellow color in corallite centers.

Similar species *Lobophyllia pachysepta* has thickened primary septa with large lobed dentitions.

Common.

Location. Bai Tu Long Archipelago, Danang Cape, Culao Cham, Re, Phu Quy, Nam Zu Islands, and the reefs of Khanh Hoa Province, depth 1-30 m.

Distribution. Widely known in the tropical zone of the Indo-Pacific from the Red Sea to the Tuamotu Archipelago.

Lobophyllia pachysepta Chevalier, 1975

Fig. 80-2

Lobophyllia pachysepta Chevalier, 1975: Veron and Pichon (1980) cum syn., Nakamori (1986), Veron (1986)

Small phaceloid colonies with large (20-40 mm) mono- and tricentric corallites, separated from each other by a distance of 9-15 mm. Sometimes where corallites are dividing, slightly meandroid areas can be formed. Calices are deep, widely funnel-shaped with a vast vesicular endotheca. The external surface of corallites has distinct costae, covered by a few large spikes, arranged in vertical and horizontal rows.

There are 40-46 long tapered septa in three to four orders. First order septa reach the columella, are very highly reinforced with tapering (up to 2 mm at the periphery), are excert, and have four to five long, large, pointed triangular spines. Second order septa are 0.4- 0.5 times as long, thin, and their axial margin is dentate with six to eleven blade-like spines. Third order septa are very thin, low, and 1/3 shorter than the lower order septa. Fourth order septa are solitary, and formed only in the upper part of the calice. Fourth order septa are moderately granulated with fine spines, the number and sizes of which increase towards the upper septal margin and especially on the tips of spines of septal dentition. The columella can be loose or very dense, small or large, and consists of axial septal ends. Four to six rows of prominent, flat, sometimes spine-shaped dissepiments of fine to medium sizes are present.

The color of living corals is deep-green with a light cream color of the areas of septal dentition.

Similar species. See *L. corymbosa*.

Relatively common.

Location. Culao Cham, Phu Quy, Phu Quoc Islands, and reefs of the Khanh Hoa Province, depth 6-12 m.

Distribution. Maldives, Vietnam, New Caledonia, and the Great Barrier Reef of Australia.

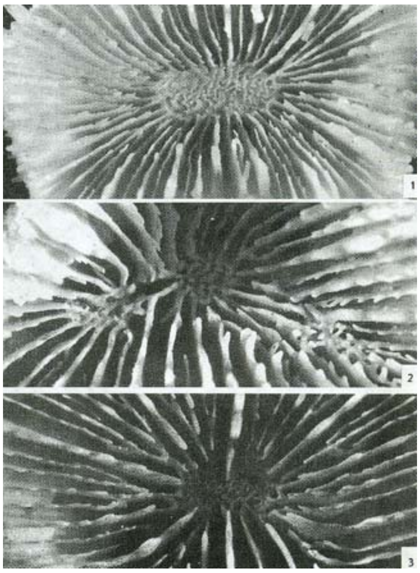


Fig. 80. 1 - *Lobophyllia corymbosa*, spec. 1/95277, Is. Thu, depth 6 m; 2 - *L. pachysepta*, spec. 1/95278, Is. Cham, depth 12 m; 3 - *L. grandis* sp. nov., spec. 1/95279, Bai Thanh Bay, depth 2,5 m.

Lobophyllia hattai Yabe, Sugiyama and Eguchi, 1936

Lobophyllia hattai Yabe, Sugiyama and Eguchi, 1936: Veron and Pichon (1980) cum syn., Veron (1986), Sheppard and Sheppard (1991)

Flabellate, weakly meandering, flatly hemispheric colonies. The corallites are polycentric, large, and grouped in short, wide, twisted series, often in two rows. Calices are wide and open. The external surface of corallites is costate, coarsely costate on the upper surfaces, with large spines.

There are 48-64 wedge-shaped septa in three to four orders. First order septa merge with the columella. They are 1.5-2 times thicker than the other septa and are highly excert, having six to eight large acute or blade-like spines. Second order septa are shorter, sometimes a quarter as long, and thinner, and their axial ends fuse with the first order septa. Third order septa are also one triens shorter than septa of the lower orders, with a fine blade-like dentition of up to 10-12 spines. Fourth order septa are present only in the upper part of the calice in the form of thin, low laminae, rarely longer than 5-7 mm. The lateral septal surfaces are smooth, and weak granulation is found only on the tips of spines of septal dentition. The columella consists of variously curved blade-like axial septal ends. It can be dense or loose and have two rows. Dissepiments are widely spaced, prominent, and vertical.

The color is usually brown or green. The valley floors and walls are usually of contrasting colors.

Similar species. Underwater it looks like *Symphyllia valenciennesi*.

Common.

Location. Distributed everywhere from the Gulf of Tonkin to the Gulf of Siam and the Spratly Islands, depth 1-25 m.

Distribution. Maldives, Vietnam, New Caledonia, and the Great Barrier Reef of Australia.

Lobophyllia robusta Yabe and Sugyama, 1936

Fig. C13 - 3

Massive hemispheric colonies, reaching 20-40 cm height and up to 1.5 m in diameter. The corallites are large phaceloid, poly- and monocentric (up to 60 mm diameter). Calices are deep and wide with well-developed vesicular endotheca. The external surface of corallites has fine to medium costae with longitudinal rows of medium to large spikes.

There are 42-52 septa which are long, thin or slightly reinforced with tapering, in four to five orders. First order septa are highly excert, are thicker than the other septa, and fuse with the columella. Second order septa are thin, reinforced by thickening only at the corallite wall, and they almost reach the columella. Third order septa are thin, their axial ends fuse to the second order septa close to the columella. Fourth order septa are developed variably in the form of low, thin laminae or separate spines in the upper part of the calice. The internal margins of all septa are dentate with long (up to 3-4 mm), pointed, tapered and blade-like spines, which vary in number from 10 to 16. In higher order septa they are thicker, more often lobate, and are present in smaller numbers. The lateral septal surfaces are smooth. The columella is well developed, and consists of variously curved interlacing laminae. Four to six rows of prominent medium to large dissepiments are present, and are inclined towards the axis.

The color of living corals is green-blue, pale-yellow, or red-brown.

Similar species *L. hemprichii* has smaller, less fleshy polyps and flabello-meandroid corallites.

Uncommon.

Location. Bai Tu Long Archipelago, and Nha Trang Bay, depth 6-15 m.

Distribution. South-west Pacific.

Lobophyllia flabellioformis Veron, 2000

Fig. 23 – 2

Colonies are large, usually dome-shaped. They are flabello-meandroid with closely compacted elongate valleys. Despite a robust appearance, large colonies readily break apart. Polyps have a thick fleshy mantle which obscures the underlying skeletal structure and thus this species appears to be a *Symphyllia* underwater. If the mantle is touched it retracts revealing the underlying growth-form, where valleys have no walls in common. The mantle is covered with elongate papillae that may resemble tentacles.

Living colonies uniform dark grey-brown.

Similar species *Lobophyllia robusta* does not have such a completely flabello-meandroid growth-form.

Usually uncommon.

Location. Reef of Khanh Hoa Province, dept 12m.

Distribution. South-Wesr Pacific.

Lobophyllia grandis sp. nov.

Fig. 80-3

Holotype. Specimen 1/95279, Museum of Institute of Marine Biology, Vladivostok, Russia, Bai Thanh Bay, Khanh Hoa Province, depth 2.5 m.

Lobophyllia sp. 1: Latypov and Dautova (1998)

Meandroid hemispheric colony with very large (50-60 mm) corallites and wide (40-80 mm) polycentric and double rowed corallite centers, spaced 0.9-2.5 cm from each other. Calices are subhorizontal or widely funnel-shaped with a vast vesicular endotheca. The external corallite surface is coarsely costate with big spines in the upper part.

There are 52-72 septa in five to six distinctly pronounced cycles and three orders. First order septa include detached reinforced first cycle septa, which are the thickest septa, not wedge-shaped, and highly excert. Their internal margin is dentate with five to seven large triangular and blade-like spines with rounded tips. The axial ends of first cycle septa are always free and noticeably detached in small widenings of the fossa. Second order (second cycle) septa are slightly wedge shaped, thinner and less excert. Their axial ends reach the columella in the same way as the first cycle septa, but fuse with septa of higher orders. Septal dentition of the second cycle septa consists of irregular thin blade-like spines. Four to five cycles of third order septa are thin, reinforced with a wedge-shape only towards the periphery, and their axial ends fuse with septa of the lower cycles. Septal margins are dentate with 10-12 thin blade-like spikes. Five to six cycles of fourth order septa are developed only in the upper part of the calice in the form of thin laminae 6-10 mm long. The lateral surfaces of all septa are smooth. The columella is well developed, spongy, and consists of fused laminae of axial septal ends, complicated by fine blades with spiny tips. Dissepiments are large, long, prominent, and inclined to subhorizontal.

Remark. Differs from all described and published *Lobophyllia*, as well as from all Vietnamese *Lobophyllia* (more than 200 specimens), by two to three times larger corallites and meanders, It differs from the very similar *L. hattai* by well pronounced, evenly thick, detached first cycle septa and the distinct cyclicity of septa of the second to fifth cycles

The color of living corals is green with blue corallite centers.

Location. Bai Tu Long Archipelago, Nha Trang Bay, and Than Bay, depth 2-9 m.

Genus *Symphyllia* Edwards and Haime, 1848

Type species: *Meandrina sinuosa* Quoy and Gaimard, 1833.

Diagnosis. Meandroid corals with a common corallite wall. There are two orders of septa with reinforced upper septocostal parts and large spines along the distal margin. The columella is trabecular and well developed.

Symphyllia recta (Dana, 1846)

Fig. C13 - 7

Mussa recta Dana, 1846

Symphyllia recta (Dana): Matthai (1928), Veron and Pichon (1980) cum syn., Nakamori (1986), Veron (1986)

Hemispheric and bun-shaped flat colonies with variously twisted valleys, sometimes wider than 15-20 mm. The corallites are rarely monocentric. Calices are wide with a moderate depth. The lower colony surface is plano-concave, radially wavy, distinctly ridged, with a few medium size spines.

Up to 40 septa in two orders are formed. First order septa are thick, noticeably wedge-shaped, and reach the columella. They are dentate with four to six long acute and blade-like spines, which increase in size towards the upper septal margin. Second order septa are thin, weakly reinforced, and mainly do not reach the columella. Their internal margins are dentate with 10-12 thin blade-like spines. The lateral surfaces of all septa are slightly granulated with fine spines, becoming denser towards the tips of dentition on the edge of the septa. The columella is small, spongy, consists of curved laminae of axial septal ends, and is sometimes curled clockwise. One to two rows of large to medium prominent dissepiments, inclined towards the axis, are present.

The color of living corals is brown or green, and sometimes red.

Similar species *S. radians* has larger and less sinuous valleys.

Common.

Location. Known everywhere from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Distributed in the tropical Indo-Pacific from the Seychelles to the Marshall Islands.

Symphyllia radians Edwards and Haime, 1849

Fig. C13 - 8

Symphyllia radians Edwards and Haime, 1849: Veron and Pichon (1980) cum syn., Veron (1986)

Hemispheric and flat bun-shaped colonies, becoming thinner along the perimeter. Valleys are slightly or moderately sinuous, and radially diverging. Calices are deep, mainly with vertical walls. The lower colony surface is radially and concentrically wavy with a moderate ridging and a few small spines.

Up to 30 septa in two well-distinguished orders are present. First order septa are thick, reach the columella and have three to five large peripheral spikes. Second order septa are thin, usually do not reach the columella, and their axial ends fuse with neighboring septa or are free. Septal margins are dentate with eight to ten thin blade-like spines. Third order septa are not distinct. They are 1/3-1/4, sometimes ½ shorter than first order septa. The lateral surfaces of all septa are very weakly granulated with fine spines, which increase in number towards the upper septal margin. The columella is well developed, dense, and consists of parallel horizontal laminae of axial septal ends. Two to three rows of prominent dissepiments of various sizes are present with additional laminae which are slightly inclined.

The color of living corals is shades of green-brown with gray-blue polyp centers.

Similar species *S. recta* has more meandering valleys.

Location. Distributed on the majority of reefs from the Gulf of Tonkin to the Gulf of Siam.

Distribution. Known in the tropical zone of the Indo-Pacific from the Seychelles to New Caledonia.

Symphyllia agaricia Edwards and Haime, 1849

Fig. C14 - 1

Symphyllia agaricia Edwards and Haime, 1849: Veron and Pichon (1980) cum syn., Veron (1986)

Hemisheric and flat bun-shaped colonies with wide (up to 30 mm) meandering valleys, sometimes radial at the periphery. Corallite centers are numerous, and often in more than one row. Calices are wide and deep. The lower colony surface grows to the substrate except for the narrow ridged peripheral margin.

Up to 48 septa of one order and four cycles are present. First order septa are the thickest and somewhat more excert than other septa. They fuse with the columella. Internal margins are saw-like (dentate) with large rounded spines, which increase in size towards the upper septal margin. Second and sometimes third cycle septa are arranged in the same way, but they are noticeably thinner, and fourth cycle septa are not the same size, they are 2-2.5 mm shorter than the other septa. Their axial ends are free. The lateral surfaces of all septa are smooth. The columella is small, dense and spongy, and can be in two rows which are connected by two to four vertical laminae. Dissepiments are of different sizes, slightly prominent, slightly to steeply inclined towards the axis, with additional laminae. Two peripheral rows of dissepiments consist of fine laminae, which are prominent to vesicular.

The color of living corals varies from green-brown to red tints, often with two colors.

Similar species: *S. radians*, which has smaller, straighter valleys. *Lobophyllia flabelliformis* can look similar underwater.

Location. Bai Tu Long Archipelago, Tho Chu, Con Dao, and the Ant Hoi Islands, depth 3-21 m.

Distribution. Known in the tropical zone of the Indo-Pacific from the eastern coast of the Indian Ocean to the Samoan Archipelago in the Pacific Ocean.

Symphyllia valenciennesii Edwards and Haime, 1849

Fig. C22 - 7

Symphyllia valenciennesi Edwards and Haime, 1849: Veron and Pichon (1980) cum syn., Veron (1986)

Flat rosette-shaped colonies with wide radially meandroid valleys of corallites, which can be arranged in rows or form clusters of three to five corallite centers Calices are wide and deep, with vertical walls. The lower colony surface is radially wavy, finely ridged with very few spines.

Up to 42 septa of two, more rarely three distinguishable orders are present. First order septa (protosepta) are reinforced with tapering, and merge with the columella. Their axial ends are free. The axial septal margins are dentate with six to eight large saw-shaped teeth. Second order septa (more rarely third cycle) are thin or slightly reinforced with a wedge shape, their axial margin is intensively dentate with 12-18 thin saw-shaped and blade-like teeth. Third cycle septa are thin to very thin, 1/3 to ½ shorter than the first two cycles of septa. Their axial ends fuse with second cycle septa. Fourth cycle septa are very thin, rare, and present only in the upper part of the calice. The lateral surfaces of all septa are smooth. The columella is well developed and usually dense. Clusters of three to five columellae, connected by three to seven thin vertical laminae, can be present. Two to three rows of fine to medium prominent dissepiments are present, which are horizontal to horseshoe-shaped.

The color of living corals is shades of green-gray with bluish irregular spots in the central parts of meanders.

Similar species *S. agaricia* has larger valleys that are not flat.

Common.

Location. Distributed at the majority of reefs from the Gulf of Tonkin to the Gulf of Siam, depth 1-25 m.

Distribution. Known in the tropical zone of the Indo-Pacific from the Seychelles to New Caledonia.

Symphyllia hassi Pillai and Scheer, 1976

Fig. C22 - 8

Flat cake-shaped colonies, thinning towards the periphery. Valleys are subhorizontal or slightly funnel-shaped, radial or weakly meandering. Corallite centers are in a single row or in clusters of three to five. Calices are shallow. The lower colony surface is concentrically rugose with distinct radial ridges.

There are 30-40 short thick septa of slightly distinguishable orders. First order septa with a thickness of up to 1.5 mm fuse with the columella. Their internal margin is dentate with five to six thick triangular spines. Second order septa are thin, sometimes reinforced, but not thicker than 0.5 mm, and can reach or not reach the columella. Their axial ends are free or fuse with first order septa. They are dentate in the same way as first order septa. The lateral surfaces of all septa are smooth. Neighboring septa are fused. The columella is well developed, and usually dense. At the branch points of meanders and at the colony periphery columellae can form two rows or form clusters of two to four. Two to three rows of different sized, prominent, variously inclined dissepiments are developed, from peripheral to U-shape.

The color of living corals is deep-green with gray-blue spots.

Similar species *S. agaricia* has large colonies with wide (up to 30 mm) sinuous valleys, sometimes radial at the periphery.

Rare.

Location. Bai Tu Long Archipelago, and Nam Zu Island, depth 6-9 m.

Distribution. The Maldives and Vietnam.

Symphyllia erythraea (Klunzinger, 1879)

Fig. C13 - 6

Isophyllia erythrea Klunzinger, 1879

Symphyllia erythrea (Klunzinger): Head (1980), Scheer and Pillai (1983), Sheppard and Sheppard (1991)

Massive colonies, expanding as they grow from a narrower base. Corallites are mono- to tristomodaeal. The wall (peritheca), excluding the septa, is 3 to 5 mm' thick, and broader below than at the top. Larger and smaller septa alternate, with seven to ten septa per cm length of valley. Larger septa are 0.75 mm thick, 1 to 1.5 mm exsert, and those on opposite sides of a wall usually fuse over the wall and look continuous. On a large septum there are six to eight teeth, 1 to 2 mm high, the uppermost vertical, and the tips of teeth are pointed. On thin septa there are six to ten serrations. The sides of septa are smooth. The columella is composed of closely twisted trabeculae, which most of the major septa unite with. Subsidiary septa turn towards and fuse to the sides of the major ones. Adjacent columella centers in polycentric calices are linked by thin lacerated lamellae. Septa are broader at the top than below, and a little swollen at the wall. The wall and the inside of calices have endothecal vesicles. At the periphery of the corallum costae corresponding to septa are visible.

The color of living coral is uniform brown, red, green or cream.

Similar species *Lobophyllia robusta* has large phaceloid corallites which are mostly monocentric and hemispherical colonies.

Rare.

Location. Reef Khanh Hoa Province, dept 11 m.

Distribution. The Red Sea and Vietnam.

3.14. Family Euphyllidae Mather, 1994

Genus *Euphyllia* Dana, 1846

Type species: *Caryophyllia glabrescens* Chamisso et Eysenhardt, 1821.

Diagnosis. Phaceloid mono- and polycentric corals with big corallites. Septa of five-six cycles, protruding. Columella is absent. A wide zone of several rows of exothecal prominent dissepiments is formed.

Euphyllia glabrescens (Chamisso and Eysenhardt, 1821)

Fig. 82-2, C7 – 6, C23 - 7

Caryophyllia glabrescens Chamisso and Eysenhardt, 1821

Euphylli glabrescens (Chamisso and Eysenhard): Dana (1846), Veron and Pichon (1980) cum syn., Scheer and Pillai (1983), Nakamori (1986), Veron (1986), Sheppard and Sheppard (1991)

Phaceloid and phacelo-flabellate corals with thick, long dichotomizing branches, spaced 15-25 mm from each other. Branch length is from 3 to 10 cm. The diameter of corallites is 15-25 mm. The calice is deep with thin vertical walls. Polycentric flabellate corallites usually form small colonies.

Up to 80 septa of five cycles are formed. First and second cycle septa are excert, almost reach the axis, and fall vertically in the center. Third cycle septa are usually not longer than ½ of a corallite radius, their axial part is subparallel to the calice wall. Fourth and fifth cycle septa are short in the upper parts of the calice, and elongate towards its base. All septa are finely granulated. The exotheca in the upper part of the calice is represented by single vesicles, which increase in number towards the calice basis until they form several rows of disspiments.

The large tubular tentacles of corals are expanded by day and night, and have a light gray-blue or gray-green color. Polyps have large tubular tentacles with knob-like tips.

Similar species the fungiid *Heliofungia actiniformis* has larger tentacles of similar appearance underwather.

Relatively common.

Location. Known on the majority of reefs of Vietnam, except for the northern part of the Gulf of Siam and the northern part of the Gulf of Tonkin, depth 15-40 m.

Distribution. Widely distributed in the tropical zone of the Indo-Pacific from the Red Sea to the Marshall Islands.

Euphyllia cristata Chevalier, 1971

Euphyllia cristata Chevalier, 1971: Veron and Pichon (1980) cum syn.,

Flabello-phaceloid compact colonies with polycentric flabelloid corallites and a tendency to formation of meanders 15-25 mm wide. Colonies are mainly low. Calices are deep and funnel-shaped with a well-developed exotheca. Corallites become sharply narrower towards the upper part of the calice, being covered by fine costae.

Up to 76 septa of five cycles are formed. First and second cycle septa protrude over the theca and descend smoothly and steeply towards the center and calice base, where their axial ends can twist sharply. Third cycle septa are arranged in the same way, but are not excert and are half as tall. Higher cycle septa are short, subparallel to the calice wall, slightly elongate towards the center and calice base. The lateral surfaces of all septa are densely granulated with fine granules. The exotheca is formed by numerous fine prominent dissepiments.

The large tentacles of corals, extended by day and night, have a green color with striped yellow-orange tips. Polyps have large tubular tentacles with knob-like tips.

Similar species. See *E. glabrescens*.

Rare.

Location. Reefs of Khanh Hoa Province and Con Dao Island, depth 15-30 m.

Distribution. South Vietnam, New Caledonia, and Australia.

Fig. 82. 1 - *Euphyllia grandiseptata* sp. nov., spec. 1/95287, Is. Cha La, depth 15 m; 2- *E. glabrescens*, spec. 1/95288, Is. Moon, depth 15 m; 3 - *E. aff. paraancora*, spec. 1/95289, Is. Moon, depth 15 m.

Euphyllia ancora Veron and Pichon, 1980

Fig. C7 - 5

Flabello-phaceloid corals with complicated corallites with a tendency toward polycentric and meandering corallites, having a diameter up to 40 mm. Branches dichotomize, reaching 50-70 mm height, and are more or less evenly spaced at a distance of 20-25 mm. Calices are deep subfunnel-shaped with a sharp narrowing at the very top. The upper external surfaces of corallites are highly costate with a distinct cyclicity.

Up to 96 septa of six cycles are present. First and second cycle septa are not highly excert over the bulk of the calice. Their axial ends vertically descend to the calice base, where they can variously curve. Third cycle septa are arranged in a similar way, but ¼ shorter, and their axial ends are less vertical and twist sharply. Higher cycle septa are not more excert than lower cycle septa. They are subparallel to the calice wall, slightly elongating to its center and base. All septa are moderately granulated with fine, thin granules. The upper part of the calice has medium to large swollen dissepiments in up to six to seven rows. Polyps have tentacles with anchor-shaped ends similar to those of *E. ancora*. Tentacle tips form concentric circles.

Similar species. *Euphyllia divisa* has an identical skeleton but distinctive tentacles. *Euphyllia paraancora* has similar tentacles but is phaceloid.

Rare.

Location. Hon Mieu Island, and reef of Khanh Hoa Province, depth 12 m.

Distribution. Known in South Vietnam, Indonesia, and New Guinea.

Euphyllia yaeyamaensis (Shirai, 1980)

Fig. 23 – 8

Colonies are phaceloid with corallites circular or flabello-meandroid with short valleys. Valleys are up to 40 millimetres wide. Corallite walls are sharp edged. Septa are closely compacted. There are no columellae. Tentacles are short and fleshy and covered with short uniform branchlets, each with a terminal knob. They are aligned radially to polyp centres and can retract, but only slowly.

Living colonies are usually a distinctive purple-grey, sometimes greenish-grey, occasionally translucent. Branchlets sometimes have pale tips.

Similar species *Euphyllia divisa* does not have such fleshy radiating tentacles or short uniform branchlets.

Uncommon.

Location. Re and Spratly Island, reef of Khanh Hoa Provonce.

Distribution. South-West Pacific.

Euphyllia grandiseptata sp. nov.

Fig. 82-1

Holotype. Specimen 1/95287, Museum of Institute of Marine Biology, Vladivostok, Russia, Tay La Island, Nha Trang Bay, depth 15 m.

Euphyllia sp. 1: Latypov and Dautova (1998)

Phacelloid corals with rounded or irregular elongated corallites with a diameter of 15-25 cm. Branches weakly dichotomize, being 20-25 mm in height. Calices are very deep (up to 20 mm), funnel-shaped with a large fossa, with a thin upper margin.

More than 100 septa of six cycles are present. First cycle septa are excert over the theca and the majority of the calice surface. Their vertical proximal margin almost reaches the axis. Second cycle septa are a half to a third the length. Third cycle septa have 3-4 mm length at the upper calice margin, and gradually become shorter towards its base. Their axial margin is dentate with large saw-like teeth. Higher cycle septa are short, rarely longer than 2 mm, and subparallel to the calice wall. They can elongate towards the calice base, almost reaching the axis. The axial margin is dentate with saw-like teeth. The lateral surfaces of all septa are weakly granulated with very fine spines. Dissepiments are medium to large, steeply inclined, prominent, and the number of rows of them grows towards the calix basis up to five to six. Tentacle tips form concentric vesicles.

The color of the large tentacles is shades of blue-gray.

Location. Tia Lia Island, Khanh Hoa Province, depth 15 m.

Remark. This species differs from the known *Euphyllia* species by the greatly increased sizes of only the first cycle of septa, while other septa are shortened and there is a deep funnel-shaped calice.

Euphyllia divisa Veron and Pichon, 1980

Fig. C 23 - 1

Flabellate corals with high and wide rows of large (up to 35 mm) corallites. Calices are deep with a narrow axial space, with thick walls and a large vesicular exotheca. External surfaces are coarsely ridged, and here and there are vesicular.

Three distinct cycles of septa are formed, and fourth cycle septa are rudimentary (incomplete). First and second cycle septa are noticeably excert over theca and the bulk of the calice. They are thick with round-vertical axial edges, and in the calice base are bent knee-shaped. Third cycle septa are 1.5-2 times thinner and 1/3-1/4 shorter. Their proximal ends are flat or slightly bent in an arc. The lateral surfaces of all septa are densely covered by very fine granules. A wide exothecal zone of very large prominent dissepiments extends from the upper calice margin. Polyps have large tubular tentacles with smaller tubular branches. All branches have knob-like tips. Large long tentacles of living corals have gray-blue or pale-yellow-orange colors.

Similar species: *E. ancora* has an identical skeleton but distinctive tentacles with T-shaped tips.

Rare.

Location. Hon Mung Island, Nha Trang Bay, depth 25 m.

Distribution. South Vietnam, the Great Barrier Reef of Australia.

Genus *Plerogyra* Edwards and Haime, 1848

Type species: *Plerogyra laxa* Edwards and Haime, 1848.

Diagnosis. Flabello-meandroid corals with large-sized vesicular exotheca and large highly excert septa. A columella is absent. The wall is perithecal.

Plerogyra sinuosa (Dana, 1846)

Fig. C7 - 8

Euphyllia sinuosa Dana, 1846

Plerogyra sinuosa (Dana): Matthai (1928), Veron and Pichon (1980) cum syn., Scheer and Pillai (1983) cum syn., Nakamori (1986), Veron (1986), Sheppard and Sheppard (1991)

Meandroid and flabello-meandroid corals with wide (up to 40mmm) valleys of corallites. Valleys are more or less connected by a light blistery coenosteum. Calices are round, deep, and funnel-shaped.

There are four-five orders of septa, not well distinguished by cycle, but characterized by a great diversity of sizes and shapes. First order septa are large, up to 1.5 mm thick and excert up to 10 mm. They can be flat or bent in a knee- or arc-shape, almost fusing or spaced at a distance of up to 5 mm. Higher order septa are thin, and slightly reinforced with tapering towards the periphery. They are 2-2.5 times shorter, do not reach the calice base, being formed mainly in the calice's upper half. The axial margins of large septa are vertical and that of small ones semicircular. The lateral surfaces of all septa are covered by numerous fine spines. The dissepiments are large, prominent, inclined towards the axis, and form an endothecal zone of four to five rows.

Living corals are covered by large (not less than 20 mm diameter) grape-shaped tissue vessicles in shades of pale-yellow-gray.

Similar species *P. simplex* has smaller vesicles than those of *P. sinuosa*.

Common, mainly in the lower part of the reef slope.

Location. Known on the majority of reefs from the Gulf of Tonkin to the Gulf of Siam and the Spratly Islands, depth 10-35 m.

Distribution. Widely distributed in the tropical zone of the Indo-Pacific from the Red Sea to the Marshall Islands.

Genus *Physogyra* Quelch, 1884

Type species: *Physogyra aperta* Quelch, 1884=*Plerogyra lichtensteini* Edwards and Haime, 1851.

Diagnosis. Meandroid corals with compact rows of corallites with widely spaced excert septa and a wide endothecal zone of large dissepiments. The columella is absent.

Physogyra lichtensteini (Edwards and Haime, 1851)

Fig. C7 - 7

Plerogyra lichtensteini Edward and Haime, 1851

Physogyra lichtensteini (Edwards and Haime): Matthai (1928), Veron and Pichon (1980) cum syn., Veron (1986), Sheppard and Sheppard (1991)

The rounded massive colonies with meandroid corallites (10-15 mm wide) are fused with each other. The widely separated valleys are interconnected with light blistery coenosteum. The calices are open, and moderately deep. The external colony surface is vesicular and costate.

There are up to 20 thin, straight, sometimes knee-shaped bent septa, which are barely distinguishable by cycles and orders. Differences in septal thickness and length can be found in peripheral submonocentric corallites. All septa are slightly excert over the exotheca with large vesicles and are spaced 3-5 mm apart. The septa are rarely longer than 5 mm, their axial ends are vertical, and more rarely they are steeply inclined. At the very axis some of them can make a sharp L-shaped bend, and fuse with each other. Dissepiments are large (4-6 mm), prominent, and slightly inclined up to U-shaped. They form one to two rows in the calice and fill the space between corallites.

The large grape-like tissue vesicles of living corals have a gray-blue color.

Similar specie,s *Plerogyra sinuosa* has meandroid and flabello-meandroid corals with wide (up to 40mmm) valleys of corallites, which are more or less connected by a light blistery coenosteum.

Relatively common.

Location. Known on many reefs except for the Gulf of Tonkin, depth 10-20 m.

Distribution. Widely distributed in the tropical zone of the Indo-Pacific from Madagascar to the Marshall Islands.

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GLOSSARY

Abiotic (factor) - describes a physico-chemical factor (in contrast to a biotic or biological factor) of the environment in which an organism lives.

Alcyonaceans - animals belonging to the phylum Cnidaha, with eight tentacles, generally living in colonies, often called soft corals.

Allele - a particular form of a gene at a particular locus.

Allopatric populations - populations that are contiguous but separated by space across which migration occurs only at very low frequency.

Anthropogenic - resulting from human activities.

Aragonite - a natural form of calcium carbonate.

Azooxanthellate corals - corals which do not have zooxanthellae.

Benthic - living on or near the bottom of the ocean. The benthos is the group of organisms living on or near the bottom of the ocean.

Biodiversity - the term has recently acquired many meanings, but can be considered synonymous with 'systematic diversity'.

Biogeography - the study of the geographic distribution of life and the reasons for it. In practice, biogeography is divisible into observations of distributions and explanations of those observations.

Biological species concept - species as are defined as genetically similar populations capable of interbreeding and which, through genetically determined isolation mechanisms, evolve in a way isolated or distinct from other populations (Mayr, 1963).

Biomass - total mass of living organisms, population explosion of an animal or plant.

Biotope - a geographic area that is under the influence of environmental parameters, the dominant characteristics of which are homogeneous. Biotopes are generally the smallest ecological units that can be delimited by convenient boundaries and which are characterised by their biota.

Branching colonies - any growth-form where branches are formed.

Caespitose -a descriptive term for branches which interlock similarly in three dimensions. Applied only to the genus *Acropora.*

Calcite - a natural form of calcium carbonate.

Calcitic skeletons - skeletons primarily composed of the calcite form of calcium carbonate. All Rugosa and molluscs have calcite skeletons.

Calice - the upper surface of a corallite to which the soft parts of an individual polyp are attached.

Cerioid corals - massive corals that have corallites sharing common walls.

Climax - ideal equilibrium state reached by a community in a particular environment.

Coenosteum - thin horizontal skeletal plates between corallites.

Colonial corals - corals composed of many individuals. There is no clear distinction between single individuals with many mouths and colonies of individuals with single mouths.

Commensal - a species which lives in association with another, but without harming it. hidden.

Community - a group of organisms of different species that co-occur in the same habitat or area and interact through trophic and spatial relationships. Communities are typically characterised by reference to one or more dominant species.

Concepts of species — terminology issues common terms and concepts are used differently by different authors.

Corallite - the skeleton of an individual coral polyp.

Corallum - the skeleton of a coral colony.

Corymbose - a descriptive term for colonies which have horizontal interlocking branches and also have short upright branchlets, usually used for some *Acropora* species.

Dissepiments - blistery horizontal plates of calcium carbonate adjoining corallites.

Ecological niche - all the conditions relating to habitat, feeding regime and habits specific to a given species.

Ecomorphs - morphological variants of species that may have an environmental and/or genetic origin.

Epibiota - animals and plants living attached to or resting upon a substratum, or on another living organism.

Epibiotic - living as epibiota

Gastropods - class of molluscs crawling around on a large ventral foot, often having a dorsal spiral shell.

Genetic distance - any of several measures of the degree of genetic difference between populations, based on differences in allele frequencies.

Genotype - the set of genes possessed by an individual organism.

Habitat – a vague word indicating the particular type of environment occupied by an organism.

Hermatypic - literally 'reef building' but commonly used as a descriptor for marine invertebrates that have photosynthetic plants living symbiotically within their tissues.

Holotype - the specimen on which a named species is based.

Hydrozoans - class of cnidarians including, among others, the fire coral *Millepora platyphylla*.

Meandroid - massive corals that have corallite mouths aligned in valleys such that there are no individual polyps.

Molluscs - phylum of invertebrate animals with soft bodies and generally a shell.

Mutation - a vague term for processes that cause a change in a nucleotide sequence in an organism.

Nominal species - species that exist in name only. These are usually synonymised with operational species.

Paliform lobes - upright skeletal rods or plates at the inner margin of septa formed by upward growth of the septum

Phaceloid corals - corals that have corallites adjoined only towards their base.

Phenotype - the sum total of observable structural and functional properties of an organism; the product of the interaction between the genotype and the environment.

Photosynthetic - related to chlorophyll-linked assimilation.

Phylogeny - the evolutionary history of a group or lineage.

Phylogenesis - the evolutionary history of a taxon.

Phylogenetics - the description of evolutionary relationships using cladistic methods.

Planulae - larvae of coral.

Plocoid coral - massive corals that have corallites with separate walls.

Polychaete - segmented worm with numerous lateral bristles, belonging to the phylum Annelida.

Polyp - an individual coral including soft tissues and skeleton.

Population - a group of conspecific organisms that exhibit reproductive continuity. It is generally presumed that ecological and reproductive interactions are more frequent among members within a population than with members of other populations.

Reef flat - the flat intertidal part of reefs that are exposed to wave action.

Reef slope - the sloping part of reefs below the reef flat.

Scleractinian (corals) - corals living in symbiosis with microscopic algae, the zooxanthellae. They produce calcium carbonate in quantities sufficient to build coral reefs. Most 'hard' corals are Scleractinia.

Sessile (fauna) - attached fauna in contrast to mobile fauna (unattached).

Septa - radial skeletal elements projecting inwards from the corallite wall.

Spur-and-groove zone - morphological feature of the upper part of the outer slope, made up of ridges (spurs) aligned more or less perpendicular to the outer slope and separated by grooves.

Sympatric populations - populations that encounter one another with 'moderate' frequency. Such populations may be different isolating mechanisms.

Synonymy - the list of names considered by a taxonomist to apply to a given taxon other than the name by which the taxon should be known.

Systematics - the study of evolutionary and genetic relationships of organisms.

Taxon - a taxonomic unit. Taxa are arranged in hierarchies of taxonomic levels.

Taxonomy - the naming and classification of organisms.

Type specimen - the specimen on which a nominal (named) species is based.

Zoanthid - animal belonging to the phylum Cnidaria, with anemone-like appearance and no skeleton, either solitary or colonial.

Zooxanthellae - unicellular dinoflagellate algae living in the tissues of certain animals (corals and giant clams), to which they supply nutritional substances directly useable by their host.

Zooxanthellate corals - Corals which have photosynthetic endosymbiotic algae.

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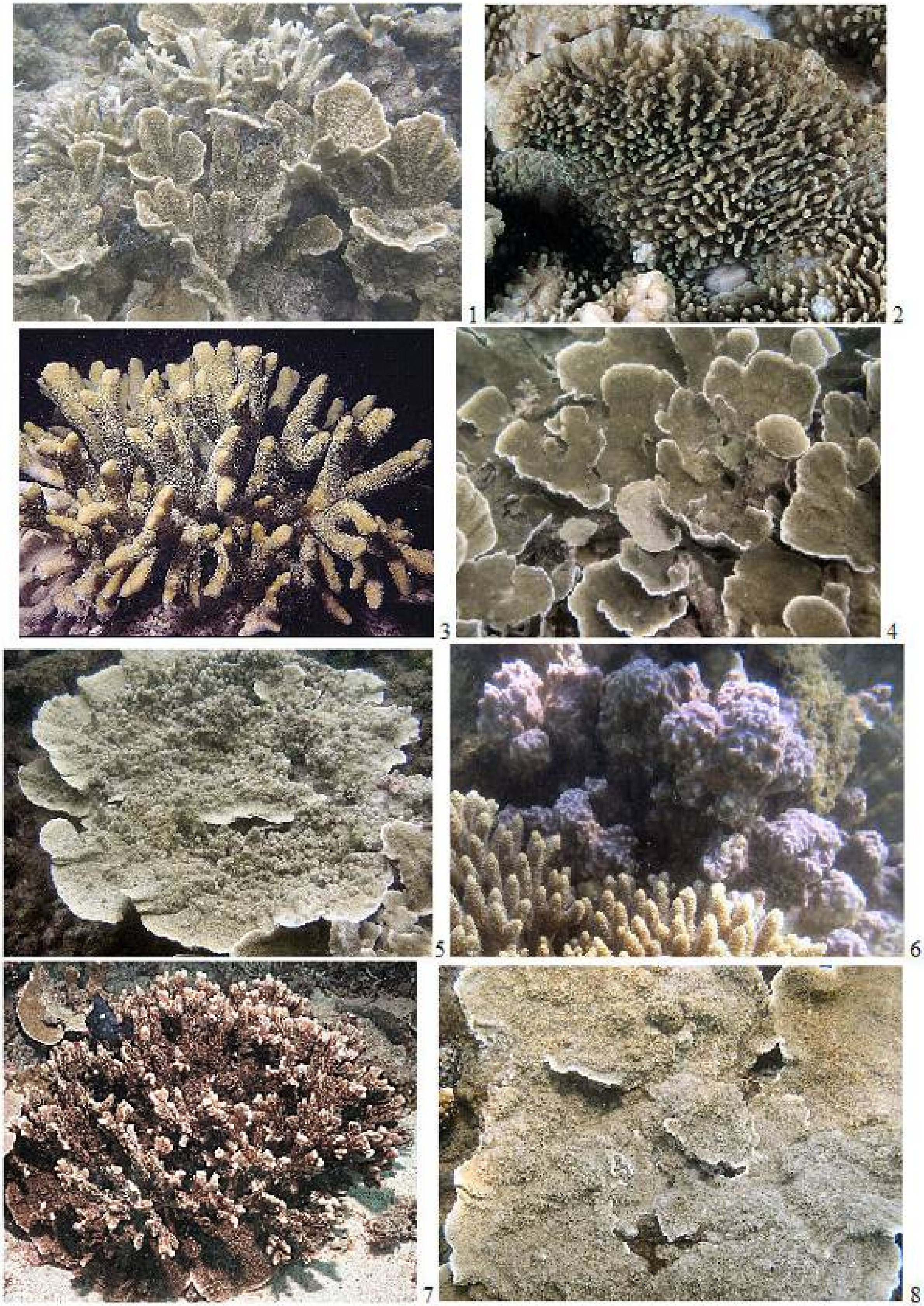
Color figures.

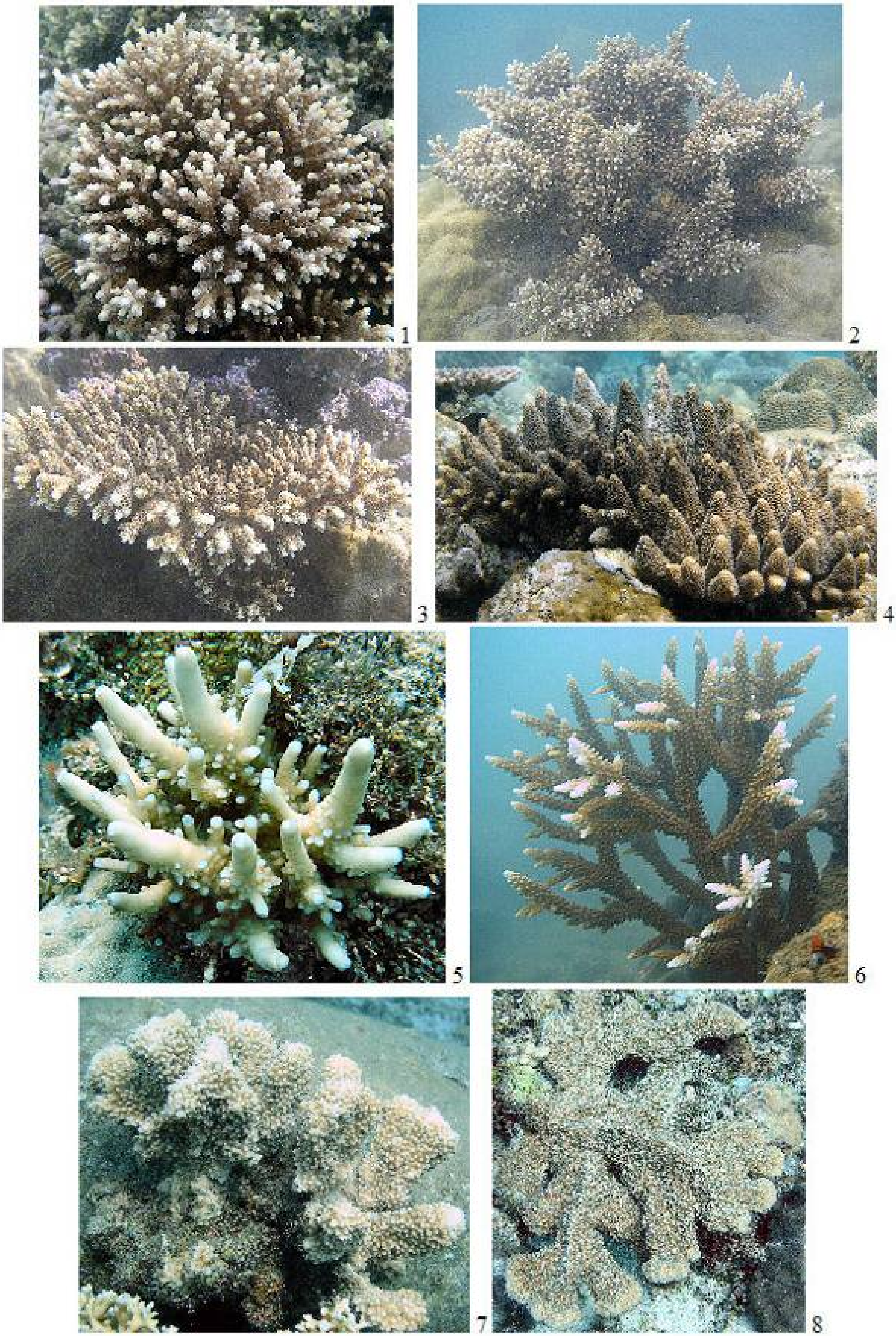
All corals are photographed in Nha Trang Bay of Khanh Hoa Province

Color figures 1. 1 - *Pocillopora damicornis*, 2 - *P. eydouxi,* 3 - *P. verrucosa*, , 4 – *P. woodjonesi*, 5 – *P. capitata*, 6 – *P. kelleheri*, 7 - *Stylophora pistillata*, 8 -*Seriatopora hystrix*



Color figures 2. 1 – *Montipora aquetuberculata*, 2 – *M. crassituberculata*, 3 – *M. digitata*, 4 – *M. hispida*,
5 – *M. tuberculosa*, 6 – *M. undata*, 7 – *M. vietnamensis*, 8 – *M. turtlensis*

Color figures 3. 1 – *Acropora acuminata*, 2 - *A. cytherea*, 3 - *A. dendrum*, 4 - *A. digitifera,* 5 - *A. florida,* 6 - *A. formosa,* 7 - *A. gemmifera,* 8 - *A. abrotanoides,*

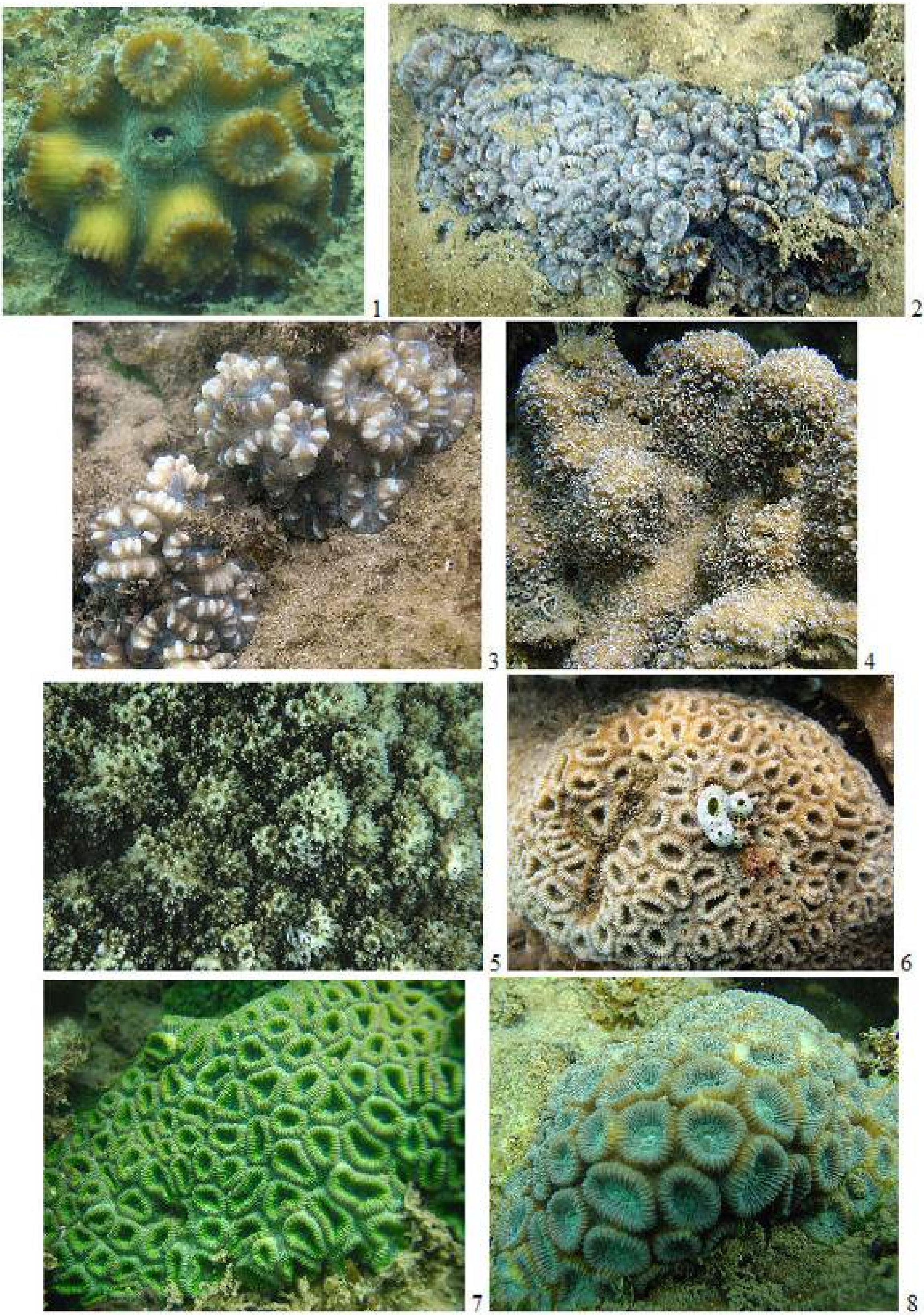


Color figures 4. 1 – *Acropora latistella*, 2 - *A. longicyathus*, 3 – *A. millepora*, 4 – *A. monticulosa*, 5 – *A. multiacuta*, 6 – *A. nobilis*, 7 – *Isopora palifera*, 8 – *I. cuneata*

Color figures 5. 1 – *Acropora aculeus*, 2 – *A. clatrata*, 3 – *A. microphthalma*, 4 – *A. humilis*, 5 – *A. grandis,* 6 – *A. hyacinthus*, 7 – *A. nasuta*, 8 – *A. anthocercis*

Color figures 6. 1 – *Anacropora forbesi*, Spratly Islands, 2 – *Acropora brueggemanni*, 3 – *Astreopora myriophthalma*, 4 – *Coeloseris mayeri*, 5– *Gardineroseris planulata*, 6 – *Pachyseris rugosa*, 7 – *P. speciosa*, 8 – *Pavona frondifera*

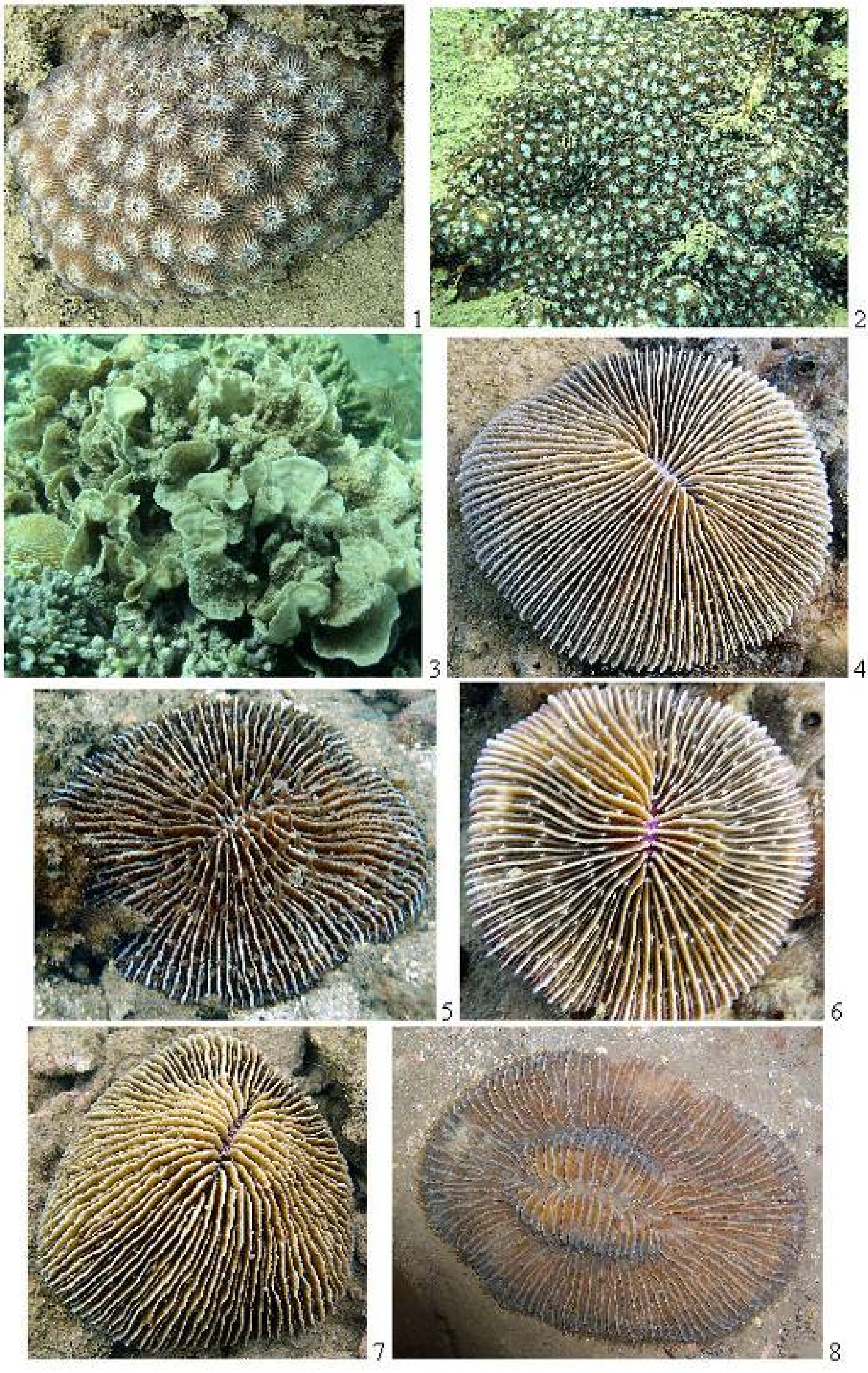
Color figures 7. 1 – *Turbinaria peltata*, 2 – T. *reniformis*, 3 – *T. mesenterina*, 4 – *T. frondens*, 5 – *Euphyllia ancora*, 6 – *E. glabrescens*, 7 – *Physogyra lichtensteini*, 8 – *Plerogyra sinuosa*



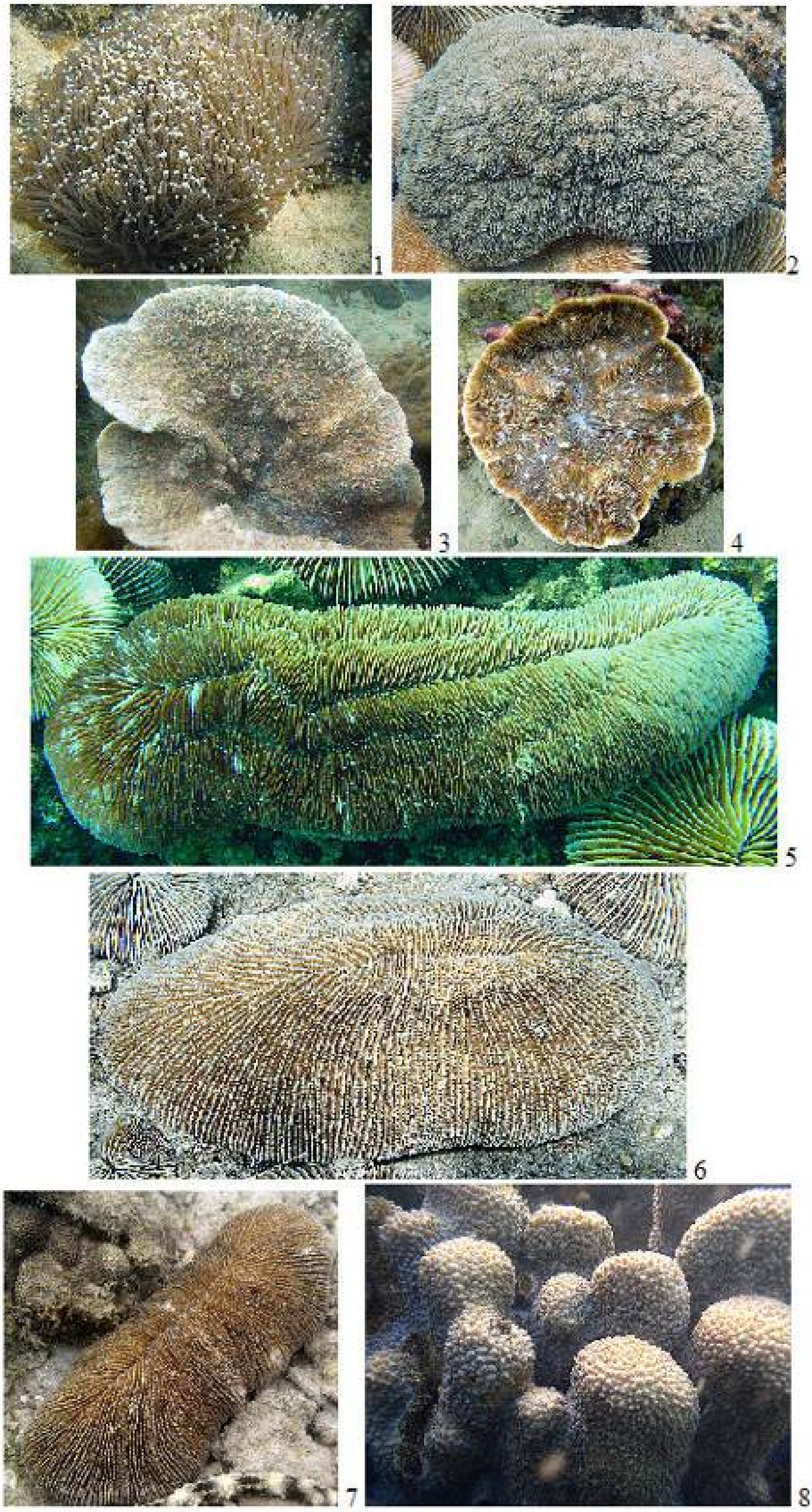
Color figures 8. 1 – *Barabattoia amicorum*, 2 – *Caulastrea furcata*, 3 – *C. tumida*, 4 – *Cypastrea chalcidicum*, 5 – *C. japonica*, 6 – *Favia speciosa*, 7 – *F. lizardensis*, 8 – *F. maritima*

Color figures 9. 1 – *Favia maxima*, 2 – *F. rotumana*, 3 – *F. vietnamensis*, 4 – *Favites chinensis*, 5 – *Ft. complanata*, 6 – *Ft. flexuosa, 7 - F. veroni, 8 – Ft. abdita*

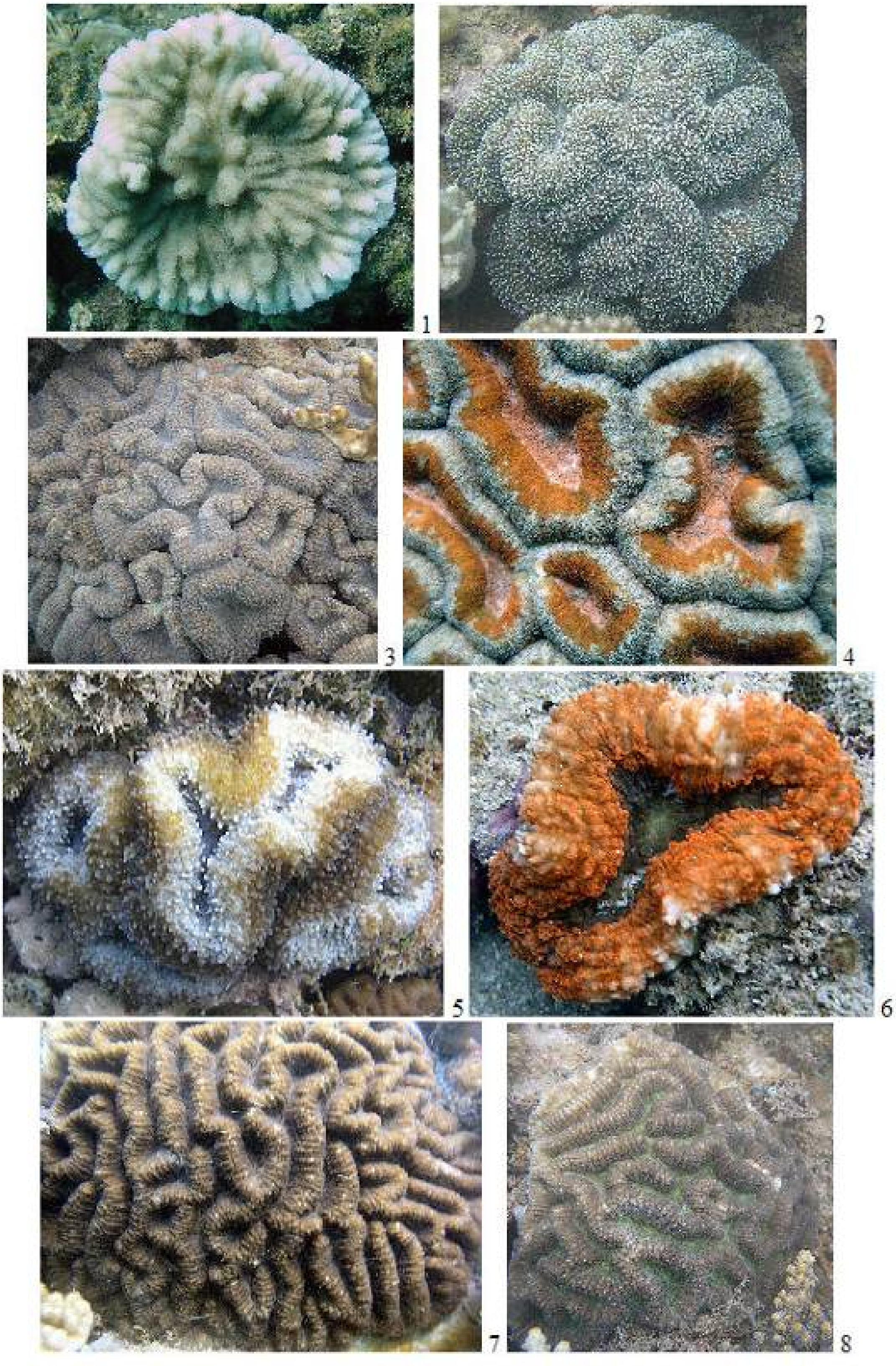
Color figures 10. 1 – *Goniastrea aspera*, 2 – *G. pectinata*, 3 – *Platygyra lamellina*, 4 – *P. daedalea*, 5 – *Leptoria phrygia*, 6 – *Oulophyllia bennetae*, 7 – *O. crispa*, 8 – *Montastrea colemani*



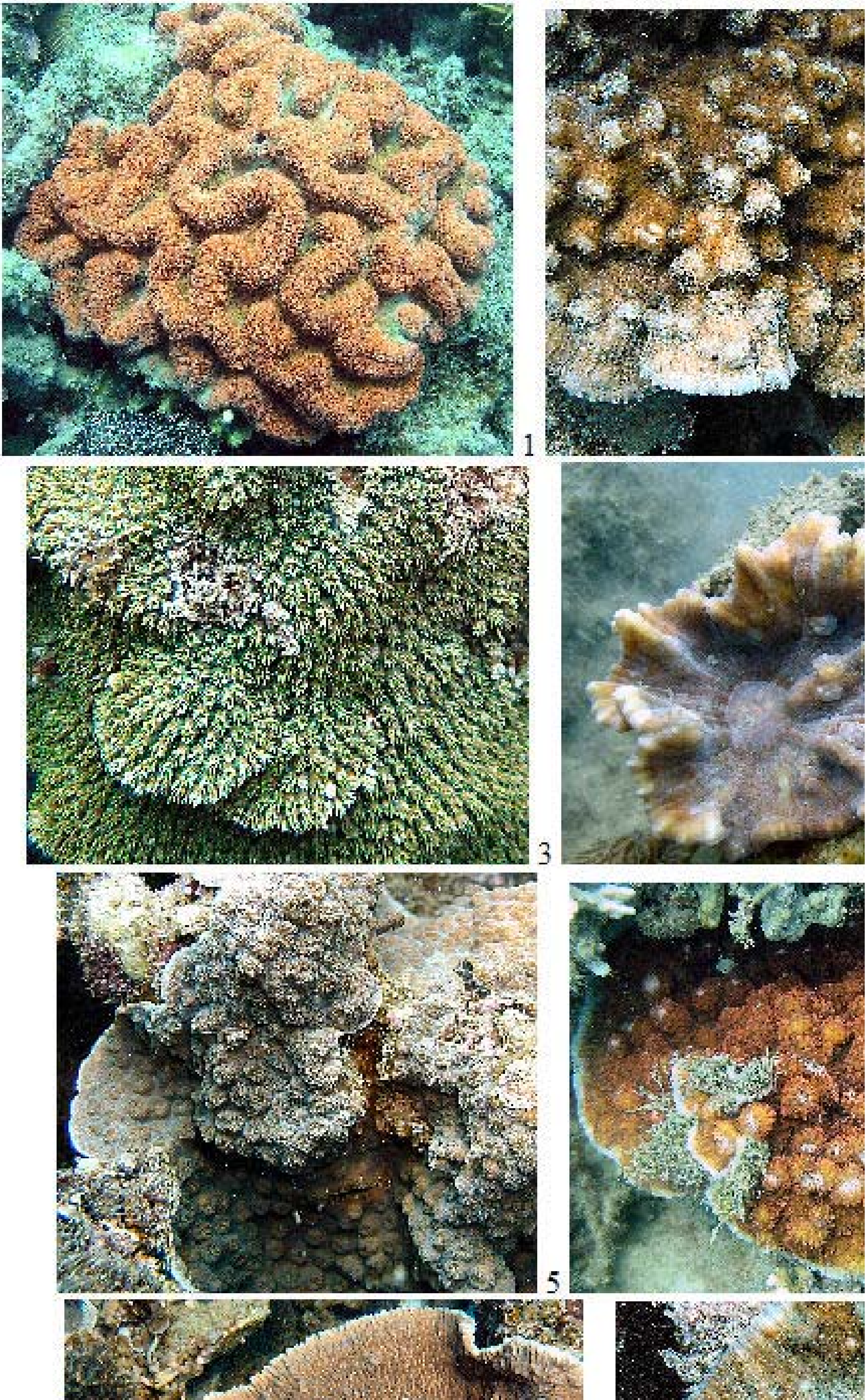
Color figures 11. 1- *Diploastrea heliopora*, 2 – *Leptastrea pruinosa*, 3 – *Echinopora lamellosa*, 4 – *Fungia fungites*, 5 – *F. danai*, 6 – *F. concina*, 7 - *F. corona*, 8 – *Pleuractis paumotensis*



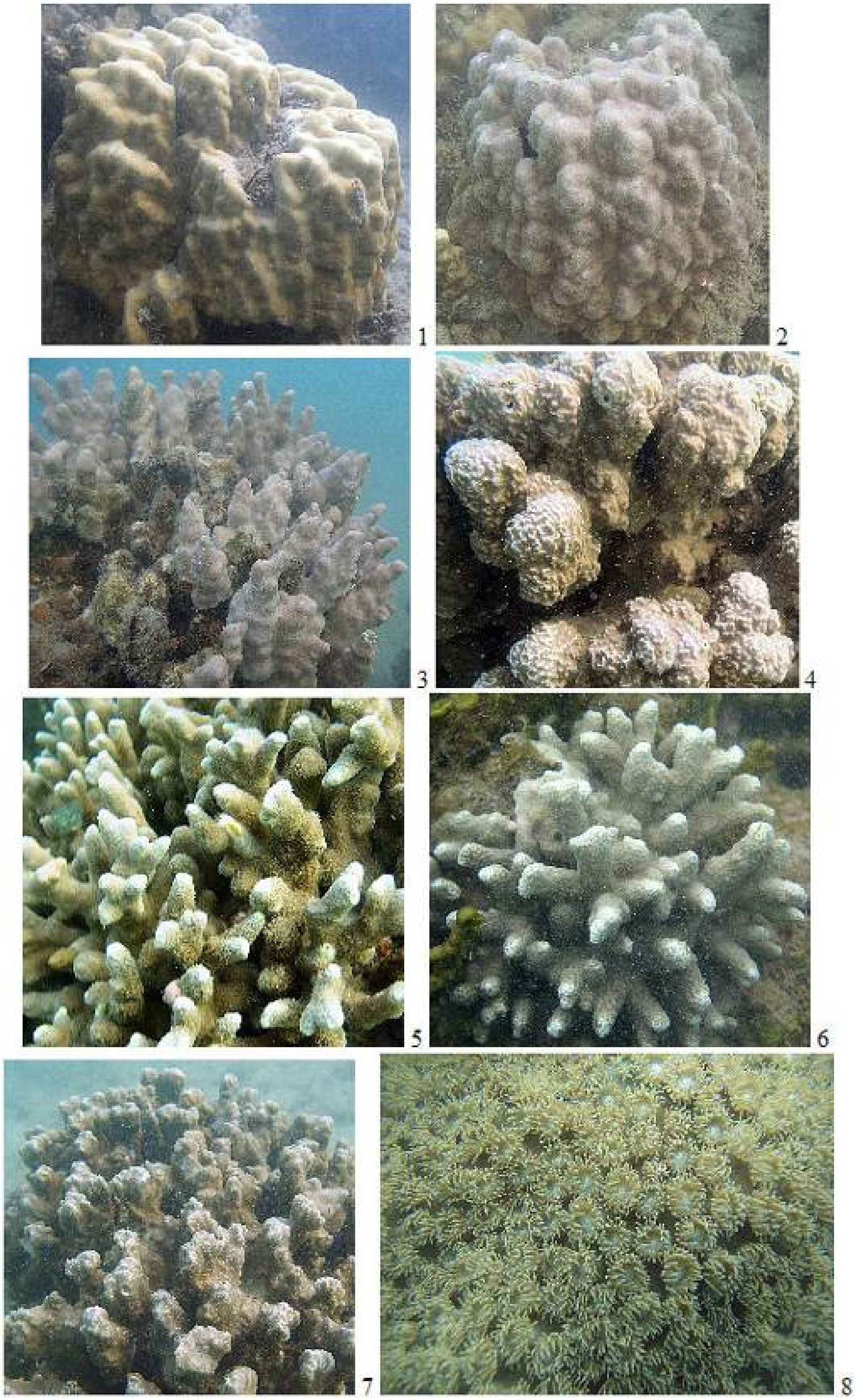
Color figures 12. 1 – *Heliofungia actiniformis*, 2 – *Sandalolitha robusta*, 3 – *Podobacia crustacea*, 4 – *Lithophyllon undulatum*, 5 – *Herpolitha limax*, 6 – *Ctenactis echinata*, 7 – *Fungia seychellensis*, 8 – *Hydnophora microconos*



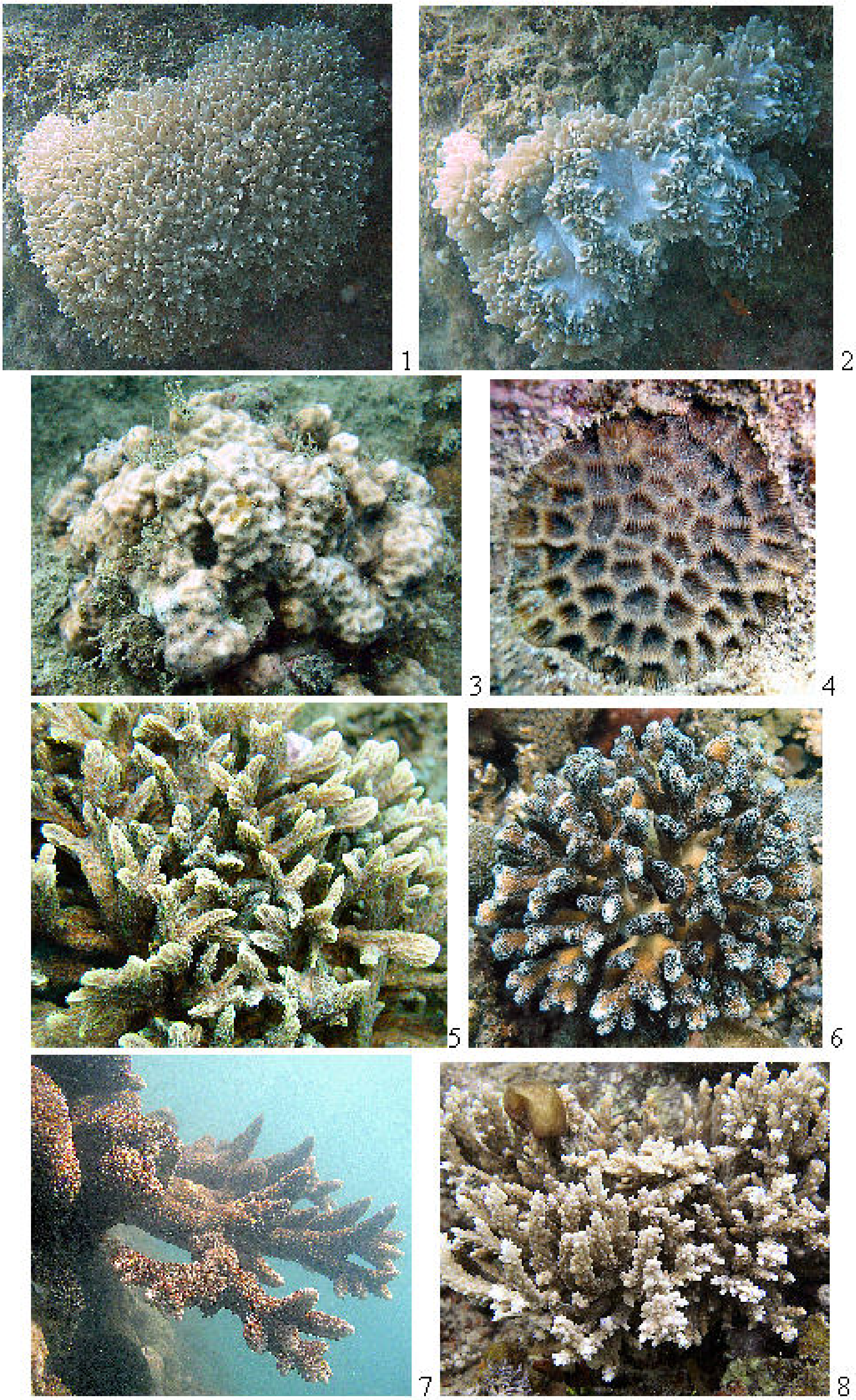
Color figures 13. 1 – *Merulina ampliata*, 2 – *Lobophyllia flabellioformis*, 3 – *L. robusta*, 4 – *L. hemprichii*, 5 – *L. corymbosa*, 6 – *Symphyllia erythrea*, 7 – *S. recta*, 8 – *S. radians*


1
3
5

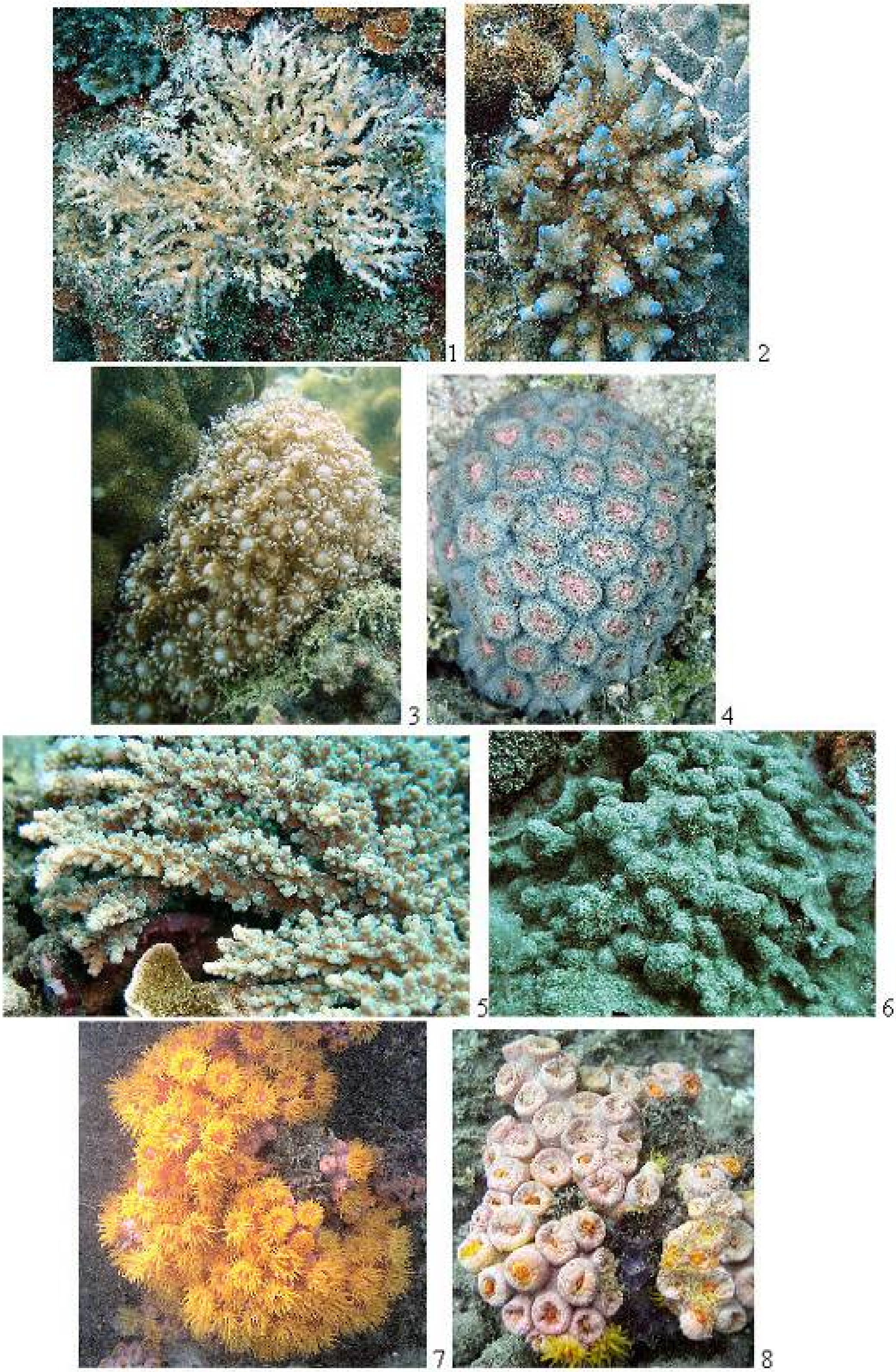
Color figures 14. 1 – *Symphyllia agaricia*, 2 – *Mycedium elephantotus*, 3 – *Galaxea fascicularis*, 4 – *Pectinia paeonia*, 5 – *Echinophyllia echinoporoides*, 6 – *E. orpheensis*, 7 – *E. patula*, 8 – *E. ehinata*



Color figures. 15. 1 – *Porites lobata*, 2 – *P. australiensis*, 3 – *P. deformis*, 4 – *P. monticulosa*, 5 – *P. cylindrica*, 6 – *P. nigrescens*, 7 – *P. rus*, 8 – *Goniopora columna*

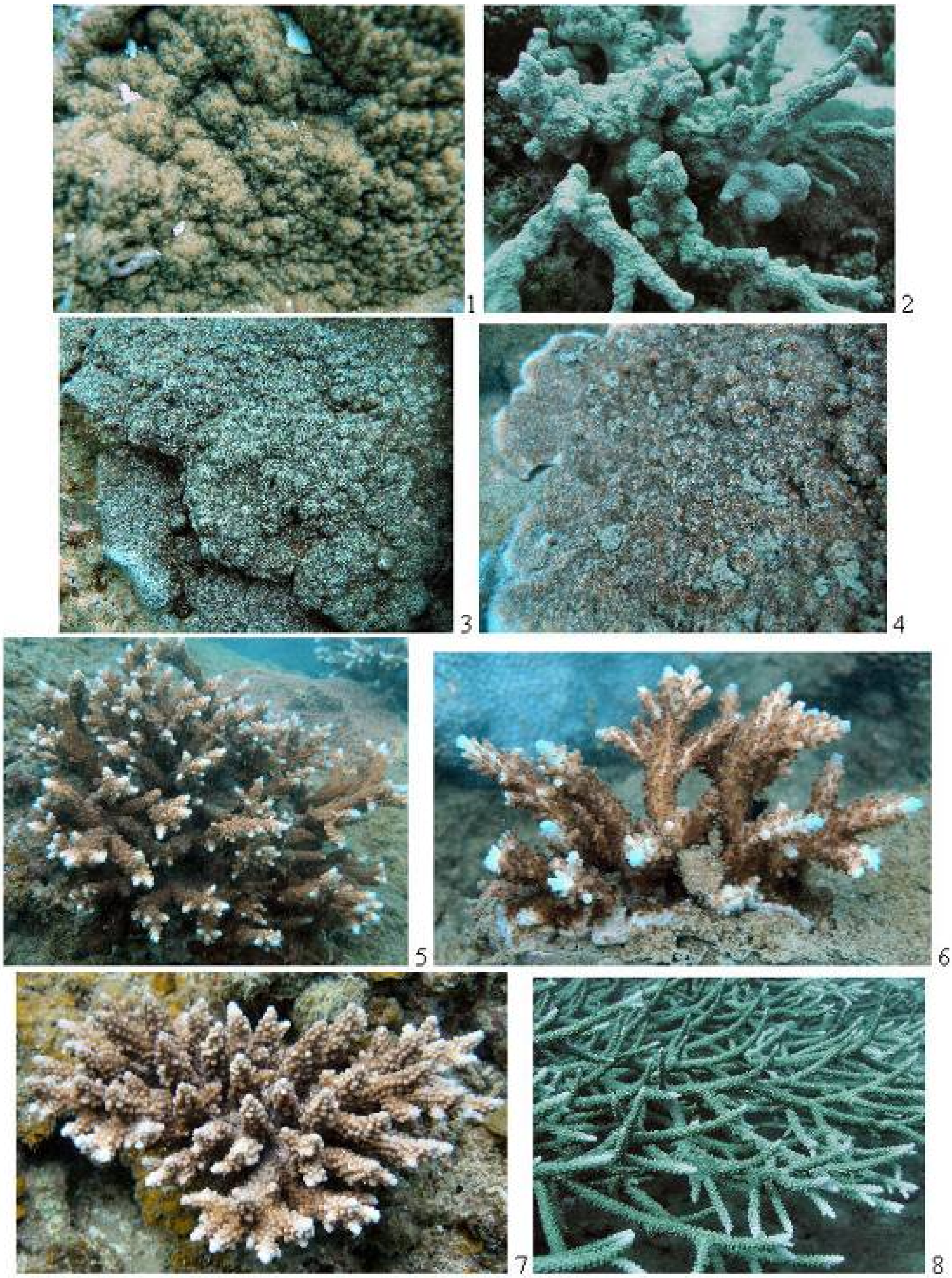


Color figures 16. 1 – *Physogyra lichtensteini*, 2 – the same disturbed colony, 3 – *Psammocora profundacella*, 4 – *Pseudosiderastrea tayami*, 5 – *Hydnophora rigida*, 6 – *Stylophora pistilata*, 7 – *Acropora robusta*, 8 – *A. valida*



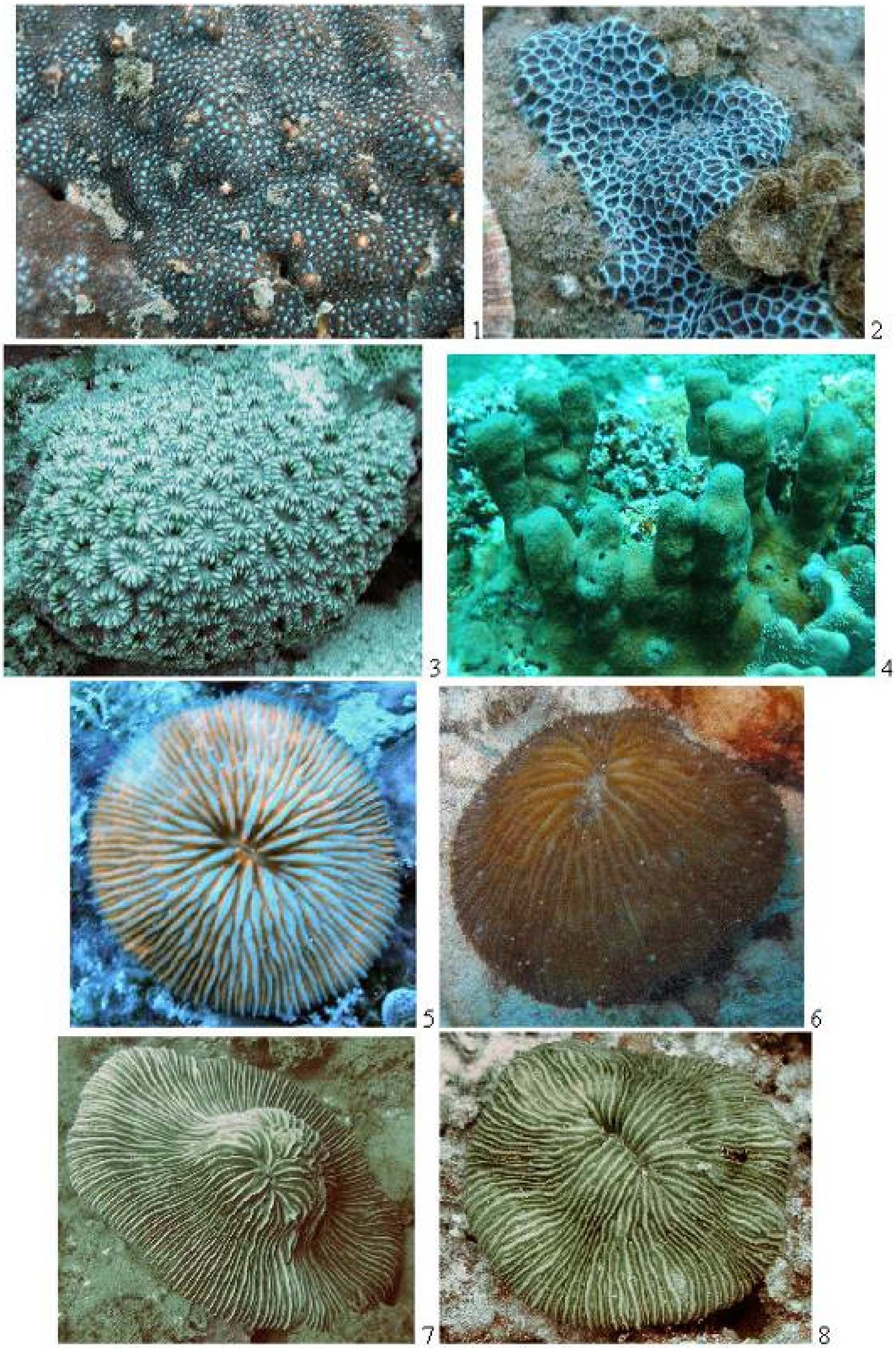
Color figures 17. 1 – *Acropora speciosa*, 2 – *A. loripes*, 3 – *Goniopora lobata*, 4 – *Montastrea magnistellata*, 5 – *A. sarmentosa*, 6 – *Montipora venosa* (Re Island), 7 - *Tubastrea coccinea*, 8 - the same disturbed colony

Color figures 18. 1 – *Porites atenuata* , 2 – *Pavona danai*, 3 – *Tubastrea micranta*, 4 – *Dendrophyllia arbuscula*, 5 – *Millepora platyphyla*, 6 – *Millepora dichotoma,* 7 – *Tracyphyllia geoffroyi,* 8 – *Oulophyllya levis*



Color figures 19. 1 – *Montipora turgescens*, 2 – *M. porites*, 3 – *M. nodosa*, 4 – *M. efflorescens,* 5 – *Acropora abrolhonsensis*, 6 – *A. elseyi*, 7- *A. samoensis*, 8 – A. *valenciennesi*

Color figures 20. 1 – *Acropora solitaryensis*, 2 – *A. valida*, 3 – *Plesiatrea versipora*, 4 - *Astreopora ocellata,* 5 – *Pectinia alcicornis*, 6 – *Cyphastrea microphthalma*, 7 – *Pavona frondifera*, 8 - *P. decussata*

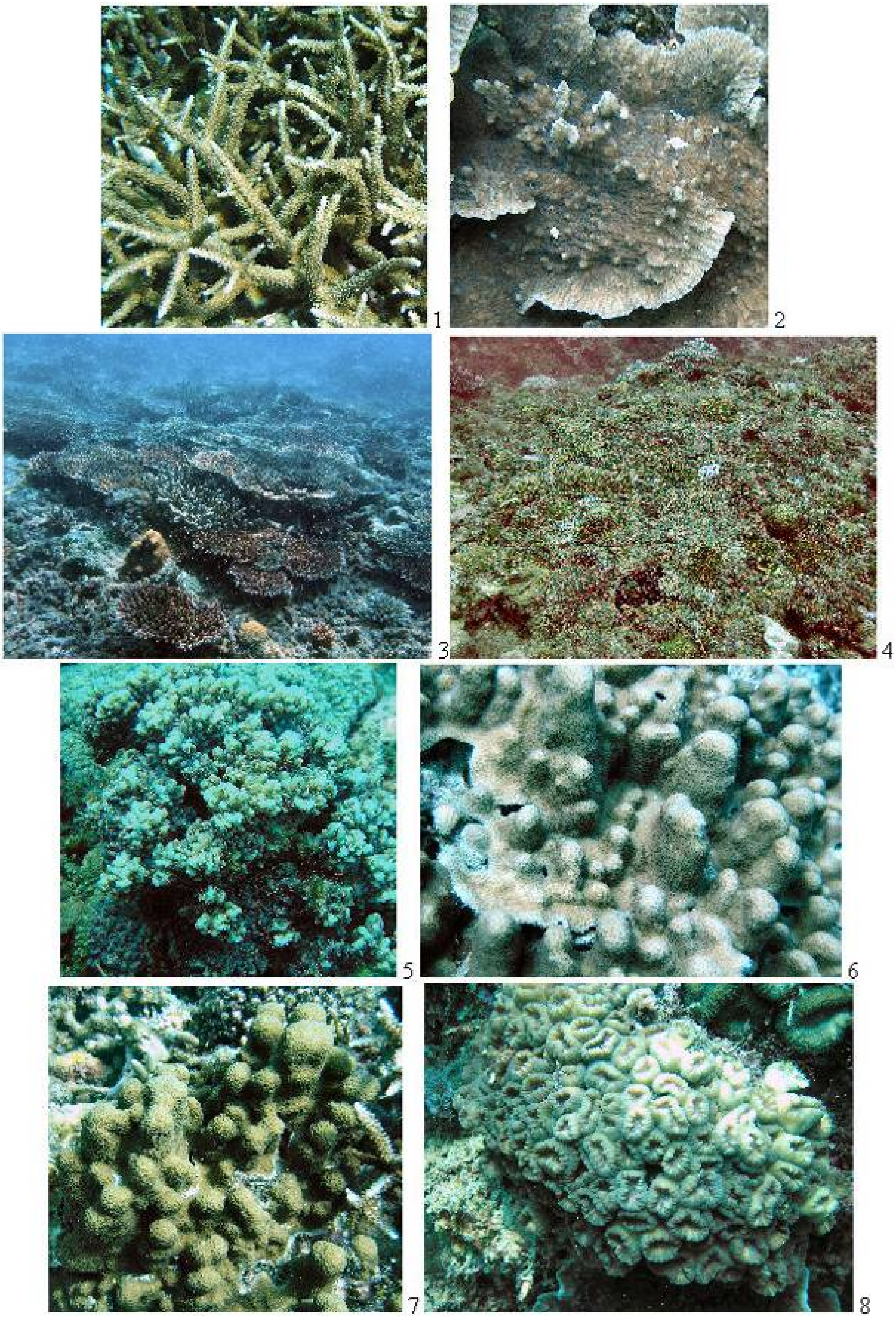


Color figures 21. 1 – *Leptastrea purpurea*, 2 – *L. transversa*, 3 –*Montastrea valenciennesi*, 4 – *Cyphastrea serailia*, 5 - *Cycloseris costulata*, 6– *C. cyclolites*, 7– *Fungia scabra*, 8– *F. repanda*

Color figures 22. 1 – *Fungia scutaria*, 2 – *Polyphyllia talpina*, 3 – *Sandalolitha dentata*, 4 – *Pleuractis moluccensis*, 5 - *Acantastrea hemprichii*, 6 – *Favia favus*, 7 – *Symphyllia valenciennesi*, 8– S. *hassi*

Color figures 23. 1 – *Euphyllia divisa*, 2 – *Lobophyllia flabellioformis*, 3 – *Oulophyllia crispa*, 4 – *Pectinia lactuca*, 5 – *Scolymia australiensis*, 6 – *Pavona cactus*, 7 – *Euphyllia glabrescens*, 8 – *Euphyllia yaeyamaensis* (Re Island)

Color figures 24. 1- *Echinophyllia aspera*, 2 – *Platygyra pini,* 3 – *Montipora monasteriata,* 4 – *Pectinia alcycornis*, 5 – *Acropora insignis,* 6 – *A. vaughani,* 7 – *Psammocora superficialis*, 8 – *Stylophora subseriata* (all samples in this table are from Thocu Island)



Color figures 25.   1 – *Acropora parilis*, 2 – *Merulina scabricula*, 3 – Coral settlements and coralogenous deposits on structural reef, 4 – Encrust coral polyspecific settlementsn on unstructural reefs, 5 – *Hydnophora exesa*, 6 – *Porites annae, 7 – P. annae, 8 – Caulastrea tumida* (all from Thu Islands)