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Contributions to the Pleistocene Coral Reefs of the Red Sea Coast, Egypt

إضافات على شعاب البليستوسين المرجانية بساحل البحر الأحمر، مصر

Abdelbaset Sabry El-Sorogy

عبدالباسط صبري السروجي

Geology Department, Faculty of Science, Zagazig University, Egypt
E-Mail: elsorogyabd@hotmail.com / elsorogyabd@yahoo.com

ABSTRACT: The Pleistocene coral reefs of the Red Sea coast form discontinuous strip in three morphological units, with elevations range from 10 to 35 m above the present sea level and with maximum width of about 550 m. The morphological steps of the studied reefal units are caused by on-lap during different sea levels, by tectonics, or by erosion during transgression. Facies patterns within reefs exhibit lateral and vertical changes. The lateral development of each unit begins at the shore, covering the whole lagoonal facies and ends at the upper reef slope. These changes either reflect transitions within the depositional environment or they are related to minor/major sea level fluctuations. The vertical pattern shows a transgressive sequence in the lower (youngest) and the upper (oldest) units and a regressive one in the middle unit. Eighty-eight scleractinian species have been identified. They belong to 3 suborders, 8 families, and 27 genera. The stratigraphic range of the majority of the identified species, which have been previously recorded from the recent sediments of study area is extended here to the Pleistocene age. The paleo- and -biogeographic distribution of the studied species indicated that all belong to Indo-Pacific affinity as well as Atlantic-Mediterranean for very few.

Keywords: *Scleractinian Corals, Pleistocene, Systematic Paleontology, Facies Change, Stratigraphic Setting, Red Sea, Egypt.*

المستخلص: تتواجد شعاب سكليراكتنيا البليستوسينية على ساحل البحر الأحمر في مصر على هيئة شريط غير متصل ينقطع وجوده في مداخل الأودية الكبرى حيث يحل محلها الحصى ونواتج تعرية الجبال المحيطة ، وتتواجد هذه الشعاب في ثلاثة وحدات بارتفاعات مختلفة تتراوح بين 10-35 مترا فوق مستوى سطح البحر الحالي وبعرض أقصاه 550 مترا. وتتميز الوحدات الشعابية بتغيرات سحنية جانبية ورأسية. وتتراوح السحنة الجانبية لكل وحدة من الرواسب الشاطئية إلى رواسب المنحدر الشعابي العلوي، وهذه التغيرات الجانبية ربما تعكس اختلاف في الإمداد داخل بيئة الترسيب أو ربما ترجع إلى تأرجحات صغيرة أو كبيرة في مستوى سطح البحر. وقد تبين من دراسة التتابع الرأسي للوحدات الشعابية أن الوحدتين السفلية والعلوية قد تكونتا أثناء تقدم للبحر، في حين أن الوحدة الوسطي قد تكونت أثناء تراجعه. وقد تم التعرف على 88 نوعا من مرجان السكلركتنيا تنتمي لثلاث تحت-رتب وثماني عائلات وسبعة وعشرون جنسا. والكثير من هذه الأنواع التي تم رصدها من الرواسب الحديثة بالمنطقة سابقا وصل مداها الجيولوجي الي البليستوسين. ووضح من التوزيع الجغرافي الحديث والقديم أن الأنواع المعرّفة تنتمي لإقليم الهندي – الهادي بالإضافة إلى أن القليل منها يتبع أيضا إقليم الأطلنطي – المتوسط.

كلمات مدخلية : *شعاب سكليراكتنيا، البليستوسين، علم الحفريات، تغيير سحنات، علم الطبقات، البحر الأحمر، مصر.*

INTRODUCTION

Recent coral reefs and elevated Pleistocene reef terraces are well developed along the coasts of the Red Sea. The line of fringing reefs is only interrupted in front of wadi moths. These drainage systems were already active during glacial lowstands of the sea level, leading to deep erosion patterns. The missing of fringing reefs in this special environment is not due to increased terrigenuous sediment input, but due to missing appropriate substrates (Dullo, 1990).

Walther (1888) has published the first reports on the occurrence of Pleistocene marine terraces along the Sinai coast. Extensive studies on morphology, stratigraphy, paleontology, geochemistry, diagenetic alteration, and tectonic evolution on the Pleistocene coral reefs of the Red Sea coast and their gulfs have been carried out (for an overview see Dullo, 1990 and El-Sorogy, 1997).

Reef growth was favored when accommodation space was created by eustatic sea-level rise or fault-block subsidence (transgressive phase). As the accommodation decreased, coral rubble and siliclastic sands prograded over reefal and lagoonal sediments, thus creating a shallowing-upward sequence (regressive phase). Terrigenous input was further stimulated by a more humid climate during interglacial times (Strasser *et al.*, 1992).

The present work aims to study the stratigraphic setting, facies changes and geometric relationships between reefal units, taxonomy, geographical distribution and habitats of Pleistocene scleractinian corals along the Red Sea coast, Egypt.

Twelve stratigraphic sections (Fig. 1) have been measured and sampled. They are, from north to south: Mersa El-Helog, 15 km south Hurghada (1), Deshet El-Dabaa, 24 km south Hurghada (2), Abu Soma area, 14 km north Safaga (3), Gasus area, 23 km south Safaga (4), Wadi Syatin,13 km north Quseir (5), Wadi Quseir El-Kadium area, 7 km north Quseir (6), Wadi Az-Zarib,10 km south Quseir (7), Sharm El-Bahari,13 km south Quseir (8), Mersa Mubarak, 53 km south Quseir (9), Mersa Shagra, 21 km north Mersa Alam (10), Ras Samadai, 15 km south Mersa Alam (11) and the area 40 km north Berenice (12).

More than 500 scleractinian specimens were collected and cleaned for identification and photography. All the studied materials are deposited at the Department of Geology, Faculty of Science, Zagazig University, Egypt

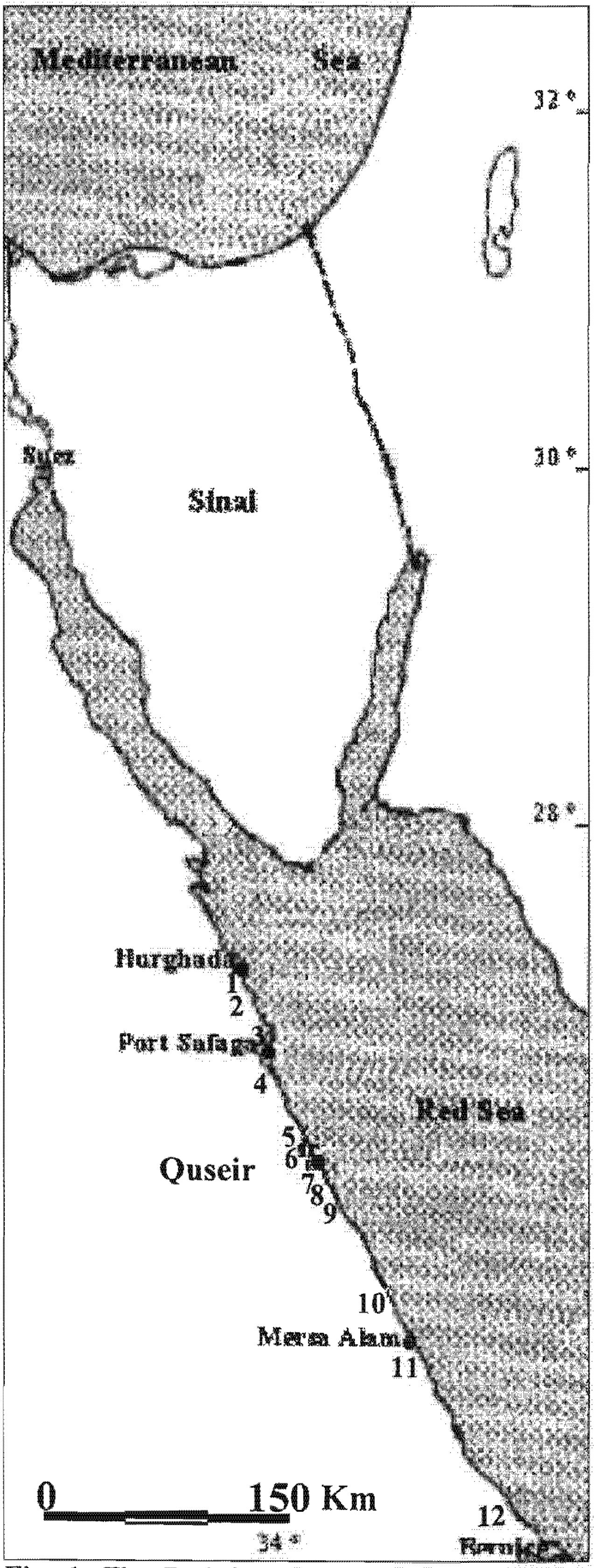

Fig. 1. The Red Sea Coast in Egypt and the Studied Section.

STRATIGRAPHIC SETTING

Stratigraphically, Pleistocene reefs form three units with elevations range from 10 to 35 m above the present sea level and with maximum width of about 550 m. The contact between the different reef units is not always obvious. They either on-lap onto ancient steep cliffs or form leveled stepped elevations on the coastal plain.

Lower Unit

This unit is easily traced along the Red Sea coast (Pl. 1, Fig. 1). Its width is 50 to 120 m. Ideal sections crop out in wadi Quseir El-kadium and in north Bernice area. It has three prominent morphological steps at elevations of 1.5 m, 3.5 m and 9 m respectively above the present sea level (Fig. 2). The lower unit rests on 0.45 to 1.25m thick, varicolored conglomerates (Pl. 2, Fig. 6). The conglomerates and gravels are interpreted as representing pluvial episodes that interrupted an overwise dry climate (Said 1990) favoring persistent reef growth.

In general, the lower unit characterizes by lateral and vertical facies changes (Fig. 2). Concerning the lateral changes, it starts in the west with a fossil shore and ends in the east with sediments of reef slope at the present shoreline. The vertical sequence starts at the base with coral assemblages of coral rock zone, with few *Stylophora pistillata* as well as *Porites lutea*, *Favia laxa*, *Favia pallida*, *Goniastrea pectinata*, and *Platygyra daedalae*. It is overlained by reef crest facies with branched framebuilders, among which *Millepora dichotoma* and *Pocillopora verrucosa*. It grades into the upper reef slope community marked by frequent branches of various species of *Acropora* as well as larger *Fugia* and *Galaxea fascicularis* (Pl. 1, Fig. 5, Pl. 2, Fig. 2). The sequence is overlained by sands and alluvial deposits in most of the studied sections. The most abundant molluscs and echinoids in the lower unit are *Periglypta reticulate, Spodylus (S.) gaedropus, Dosinia (D.) radiate, Turbo (Batillus) radiatus and Echinometra mathaei*_

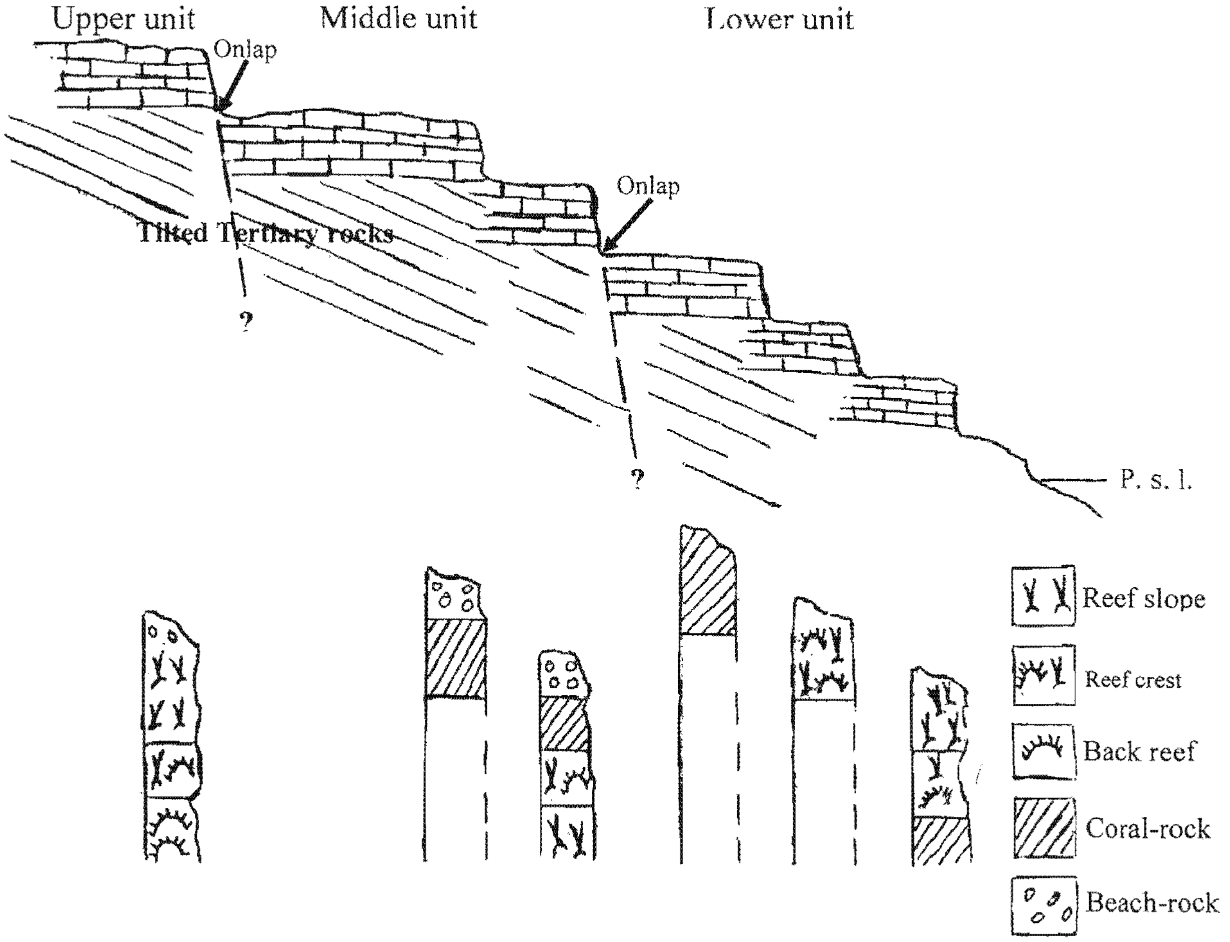

Fig. 2. Sketch Diagram Represents the Studied Reefal Units and their Vertical Facies Changes.

The lower unit has been dated of 110,000±8,000 years B.P. at the southern tip of Sinai Peninsula (Gvirtzman and Friedman 1977), 91,000 to 112,000 years at the Saudi Red Sea coast (Dullo 1990), 91,000±5,000 years along the Sudanese coast by Berry *et al.* (1966). Also Taviani and Hoang (1991) gave a date range of 125,000-138,000 years for corals from raised reef terraces (2-8 m altitude) on Zabarged island and Gvirtzman *et al.* (1992) gave a date range of 141,000-161,000 years for corals at the same level in southern Sinai. According to the last mentioned ages of similar reefs, the lower unit is considered to have been built during the last inter-glacial times (Oxygen isotope stage 5 of deep sea cores).

Middle Unit

The middle unit comprises of two morphological terraces of about 8 m thick with elevations of 14 and 19 m above present sea level (Fig. 2, Pl. 1, Figs. 2, 3). The most abundant fossils are *Porites lutea, Goniastrea retiformis, G. pectinata, Favia pallida, Favites flexuosa, Platygyra daedalea, Leptaria Phrygia, Acanthastrea echinata, Lobophyllia corymbosa, Stylophora pistillata, Galaxea fascicularis, Acropora pharaonis, Fungia fungites, Pocillopora damicornis, Cardites antiquata, Turbo (batillus) radiatus and Magillus antiquus.*

The vertical sequence (Fig. 2) of the middle unit in most sections as in Wadi Quseir El-Kadium, wadi Syatin and Abu Soma areas shows shallowing upward development (regressive pattern). It starts with coral communities of upper reef slope, followed upward by reef crest characterized by *Millepora dichotoma* (Pl. 2, Fig. 1), coral rock zone with small scleractinians (Pl. 2, Fig. 5) and beach rock. Finally, it is caped by fluviatile gravels. The shallowing upward facies indicates diminishing water depth, which is controlled by a combination of changes in sea level, subsidence rate and sediment accumulation (Strasser *et al.*, 1992).

In few localities, especially along the northern Red Sea coast as in Mersa El-Helog area the vertical sequences starts by a transgressive phase at the base and a regressive one towards the top. The obvious contradicting facies patterns (transgressive and regressive) result from erosional and constructional processes during slight rises or a still stand of sea level (Mergner and Schhuhmacher 1974, El-Sorogy 1997). Regressive patterns indicate reef progradation, which can continue to the point where no more shelf areas are available. This leads to the formation of over-hanging reef slopes, which are instable to erosion. Due to any reason, large blocks, comprising several facies units may slide down as rock fall deposits. Above such an erosional truncation a transgressive sequence may develop. On the other hand, regressive and transgressive patterns are also governed by terrigenous sediment input (vail et al. 1984).

The middle reef unit dated as 200,000-250,000 years B.P. in south Sinai Peninsula (Gvirtzman and friedman 1977) and 205,000 years along the Saudi Red Sea coast (Dullo 1990). Moreover, Gvirtzman *et al.* (1992) dated corals from the same stratigraphic level in southern Sinai at about 250,000-170,000 years. Taviani and Hoang (1991) gave a date of 200,000 to corals at 17 m altitude from Zabarged island, as it compared with the Oxygen isotope stage 7 of deep sea cores.

Upper Unit

The best exposures of this unit is located in Wadi Quseir El-Kadium and Gasus area. It disconformably overlies the rocks of Pliocene Shagra Formation (Pl. 1, Fig. 4), which include frequent pecteniids (*Chlamys senatoria*) and irregular sea-urchins (*Clypeaster reticulatus* and *Laganum depressum*). The contact is clearly visible in Wadi El-Quseir El-Kadium. The upper unit ranges in elevation from 10 m in Gasus section to 35 m above the present sea level in Mersa El-Helog section. It forms one morphological terrace (Fig. 2). The fossils are represented by moderatelly preserved scleractinians as *Porites nodifera, Lobophyllia corymbosa* (Pl. 1, Fig. 6), *Goniastrea pectinata, Fungia fungites*, mollusks (*Trachycardium isocardia, Tridacna squamosa*) and echinoids (*Heterocentrotus trigonarius*).

The whole sequence of the upper reef unit is transgressive (Fig. 2). It begins with coral community and red algae of back reef

(Pl. 2, Fig. 4) followed by massive coral facies correspond to a reef-crest to upper reef-slope environment (Pl. 2, Fig. 3), then it is overlained by alluvial sands and gravels.

Corals in the same stratigraphic levels in southern Sinai are dated at 330,000-290,000 years B.P. by Gvirtzman, *et al.* (1992). Terraces between 10 and 15 m altitude yielded ages of about 290,000-300,000 years and older. It probably corresponds to the Oxygen isotope stage 9 of deep sea cores.

SYSTEMATIC PALEONTOLOGY

The systematic revision, habitat and geographic distribution in this study are mainly based on previous palaeontological works conducted by Scheer (1967), Pillai and Scheer (1976), Scheer and Pillai (1983), Veron (1986, 2000), Veron and Pichon (1976, 1980, 1982), Veron *et al.* (1977), Sheppard and Sheppard (1991) and many others.

Table 1 illustrates the stratigraphic range of the identified species. Concerning the occurrences of the studied corals and due to the presence of most species in all the studied sections allover the Red Sea coast, the occurrence of the figured specimens are only taken into consideration.

Phylum Coelentrata Frey & Leuckart, 1847
Class Anthozoa Ehrenberg, 1834
Order Scleractinia Bourne, 1900
Suborder Astrocoeniina Vaughan & Wells, 1943
Family Pocilloporidae Gray, 1842
Genus *Stylophora* Schweigger, 1819
Stylophora kuehlmanni Scheer & Pillai, 1983
(Pl. 3, Fig. 1)

Table 1. Stratigraphic range of the identified species, compiled from different sources mentioned in the text. (* *species recorded for the first time from the study area*).

Identified species	Recent	Pleistocene	Pliocene	Miocene
Stylophora pistillata	------------	------------	------------	------------
Stylophora danae	------------	------------		
Stylophora subseriata	------------	------------		
Stylophora kuehlmanni *	------------	------------		
Seriatopora caliendrum *	------------	------------		
Pocillopora damicornis	------------	------------		
Pocillopora verrucosa	------------	------------		
Acropora valenciennesi *	------------	------------		
Acropora pharaonis	------------	------------		
Acropora hyacinthus	------------	------------		
Acropora hemprichii *	------------	------------		
Acropora forskali	------------	------------		
Acropora clathrata	------------	------------		
Acropora valida *	------------	------------		
Acropora latistella *	------------	------------		
Acropora tutuilensis *	------------	------------		
Acropora robusta *	------------	------------		
Acropora cytherea	------------	------------		
Acropora intermedia *	------------	------------		
Montipora spongiosa	------------	------------		
Siderastrea savignyana	------------	------------		
Coscinaraea monile	------------	------------		
Coscinaraea columna *	------------	------------		
Cycloseris patelliformis *	------------	------------		
Cycloseris doederleini	------------	------------		
Cycloseris erosaä	------------	------------		
Cycloseris cyclolites *	------------	------------		
Fungia (Pleuractis) scutaria	------------	------------		
Fungia (P.) paumotensis *	------------	------------		
Fungia (P.) moluccensis *	------------	------------		
Fungia (Verrillofungia) granulosa *	------------	------------		

Table 1. Cont.

Identified species	Recent	Pleistocene	Pliocene	Miocene
Fungia (V.) repanda	------------	-------------		
Fungia (V.) concinna *	------------	-------------		
Fungia (Danafungia) danai *	------------	-------------		
Fungia (D.) horrida	------------	-------------		
Fungia (D.) klunzingeri *	------------	-------------		
Fungia (Fungia) fungites	------------	-------------		
Ctenactis echinata	------------	-------------		
Goniopora planulata *	------------	-------------		
Goniopora minor *	------------	-------------		
Porites solida	------------	-------------	------------	------------
Porites lutea	------------	-------------		
Porites nodifera *	------------	-------------		
Porites compressa *	------------	-------------		
Porites (Synaraea) undulata *	------------	-------------		
Favia stelligera	------------	-------------		
Favia laxa *	------------	-------------		
Favia helianthoides *	------------	-------------		
Favia pallida	------------	-------------		
Favia speciosa	------------	-------------		
Favia favus	------------	-------------	------------	-------------
Favia lacuna *	------------	-------------		
Favia rotumana *	------------	-------------		
favia lizardensis *	------------	-------------		
Favia danae *	------------	-------------		
Favia veroni *	------------	-------------		
Favites pentagona	------------	-------------		
Favites acuticollis *	------------	-------------		
Favites abdita	------------	-------------		
Favites halicora	------------	-------------		
Favites complanata	------------	-------------	-------------	
Favites peresi *	------------	-------------		
Favites flexuosa	------------	-------------		
Goniastrea retiformis	------------	-------------	-------------	
Goniastrea pectinata	------------	-------------	------------	-------------
Goniastrea asperaä	------------	-------------		
Goniastrea australensis	------------	-------------		
Platygyra daedalea	------------	-------------	-------------	
Platygyra sinensis *	------------	-------------		
Platygyra crosslandi *	------------	-------------		
Leptoria phrygia	------------	-------------		
Hydnophora microconos	------------	-------------		
Hydnophora exesa *	------------	-------------		
Leptastrea transversa *	------------	-------------		
Leptastrea bottae	------------	-------------		
Cyphastrea microphthalma	------------	-------------		
Cyphastrea serailia	------------	-------------	-------------	
Echinopora lamellosa	------------	-------------		
Echinopora gemmacea	------------	-------------	------------	-------------
Echinopora fructiculosa *	------------	-------------		
Plesiastrea versipora	------------	-------------	------------	------------
Montastrea curta *	------------	-------------		
Galaxea fascicularis	------------	-------------		
Galaxea astreata	------------	-------------		
Blastomussa merleti *	------------	-------------		
Acanthastrea echinata	------------	-------------		
Lobophyllia corymbosa	------------	-------------		
Lobophyllia hemprichii	------------	-------------		

1983 *Stylophora kuehlmanni* Scheer & Pillai: p. 25, Pl. 3, Figs. 1-4.

2000 *Stylophora kuehlmanni* - Veron, 4 Figs.

Remarks: Corallum ramose, branches thin, often flattened and coalescent. Corallites wall slightly projecting at the upper half only, 0.4 to 0.5 mm in diameter, 1 to 2 mm apart. Septa six, subequal. Surface minutely but closely echinulate. The present species is closely similar to *Stylophora subseriata* based on the size and nature of calices, but *S. kuehlmanni* is characterized by flattened coalescent.

Distribution: Red Sea

Genus *Seriatopora* Lamarck, 1816

Seriatopora caliendrum Ehrenberg, 1834

(Pl. 3, Fig. 2)

1834 *Seriatopora caliendrum* Ehrenberg, p. 347.

1879 *Seriatopora caliendrum* - Klunzinger 2, p. 70, Pl. 7, Fig. 12, Pl. 8, Fig. 3.

1983 *Seriatopora caliendrum* - Scheer & Pillai: p. 27, Pl. 4, Fig. 4.

1991 *Seriatopora caliendrum* - Sheppard & Sheppard, p. 39, Pl. 8, Fig. 13.

2000 *Seriatopora caliendrum* - Veron, 4 figs.

Remarks: Branches obtuse at top. Average angle of branches 60°-80°. Directive septa join together forming a middle ridge at the bottom of the calicular fossa.

Distribution: Red Sea, Gulf of Aden, Philippines, Ryukyu Isls., Great Barrier reef.

Habitat: It is found on reef slopes between the surface and 25 m deep. It prefers sheltered water, and is more common on back reef than fore reef areas.

Family Acroporidae Verrill, 1902

Genus *Acropora* Oken, 1815

Key of identification of *Acropora*:

1- Branches without coalescene. Axials tubular, thin or thick-walled with 12 septa, from 3 to 3.5 mm in diameter, 2 mm exsert. Radials tubular, ascending or spreading, 2 to 4 mm long, 2 mm thick. Septa 12.... *A. valenciennesi*

2- Corallum caespito-corymbose with thick digitiform branches with tapering tips. Axials 4 mm at the top, 6 mm at the base. Radials conspicuous, uniform, equidistant, bursiform, 3 to 4 mm thick and long. Surface highly echinulate. Immersed corallites very few.... *A. hemprichii*

3- The axial corallites 2.5 to 2mm across, exsert 1.5 to 2 mm. Wall rounded, spongy. Six well-developed septa usually meet in the center of the calice, secondaries less developed. Radial corallites are usually a mixture of sizes and are strongly appressed and truncated obliquely and thus have elliptical apertures.... *A. valida*

4- The axial corallites measure 2 to 2.5 mm in diameter and from 1 to 1.5 mm exsert. The walls of the radial corallites are strong and well built. Many of them spreading at nearly 90° to the branch, while the others are ascending. Septa well developed.... *A. latistella*

5- The axial corallites cylindrical, with thick costulate wall, 2 mm in diameter, 2 to 3 mm exsert, 6 well developed septa. The radial corallites variable in length, long, tubiform, with lower lips longer than upper, larger ones 3 to 5 mm long.... *A. tutuilensis*

6- Branches sprawling in all directions. Corallites are of two main kinds: cylindrical, being most common near branch tips and immersed predominating on older, thicker sections.... *A. robusta*

7- The main stem is 3.5 cm in thick. It bifurcates and each division carries short branchelets (1.5 to 2 cm). The axial corallites are 2.5 to 3 mm in diameter. Septa in two cycles in both the radial and axial corallites. Corallum solid.... *A. intermedia*

Acropora valenciennesi (Milne Edwards and Haime), 1860

(Pl. 3, Fig. 3)

1860 *Madrepora valenciennesi* Milne Edwards and Haime, p. 137.

1983 *Acropora valenciennesi* - Scheer & Pillai, p. 35, Pl. 5, Figs. 6, 7.

1984 *Acropora valenciennesi* - Veron & Wallace, p. 238, Figs. 570-578.

1991 *Acropora valenciennesi* - Sheppard & sheppard, p. 55, Pl. 26, Figs. 32a, 32b.

2000 *Acropora valenciennesi* - Veron 1, p. 226, 5 Figs.

Distribution: Red Sea, East Africa, Ceylon.

Habitat: This species prefers sheltered but well-lit areas. It is found mostly between 5 and 20 m deep, in areas on lee sides of reefs.

Acropora hemprichii (Ehrenberg), 1834

(Pl. 3, Fig. 4)

1834 *Heteropora hemprichii* Ehrenberg, p. 33.

1906 *Acropora hemprichii* - Marenzeller, p. 39, Pls. 10, 11.

1983 *Acropora hemprichii* - Scheer & Pillai, p. 44, Pl. 8.
1991 *Acropora hemprichii* - Sheppard & Sheppard, p. 56, Pls.27-28, Figs. 34a-b.
2000 *Acropora hemprichii* - Veron 1, p. 194, 4 Figs.

Distribution: Red Sea, East coast of Africa, Mascarene Archipelago, Maldives, Minicoy, Great Barrier Reef, Ceylon, Solomon Isls.

Habitat: It forms extensive stands on shallow reefs (between 3 and 10 m deep) and single colonies occur in deeper water.

Acropora valida (Dana), 1846
(Pl. 3, Fig. 5)

1846 *Madrepora valida* Dana, p. 461, Pl. 35, Fig. 1.
1925 *Acropora valida* - Hoffmeister, p. 60, Pl. 12, Figs. 1a, 1b, 1c.
1984 *Acropora valida* - Veron & Wallace, p. 346, Figs. 517-523.
1986 *Acropora (Acropora) valida* - Veron: p. 185, Figs. 1-4.
1991 *Acropora valida* - Sheppard & Sheppard, p. 63, Pl. 35, Fig. 44.
2000 *Acropora valida* - Veron 1, p. 404, 6 Figs.

Distribution: Red Sea east to central America.

Habitat: Very abundant and occurs in a wide range of environments. Colonies seldom exceed 0.5 m in diameter.

Acropora latistella (Brook), 1892
(Pl. 3, Fig. 6)

1893 *Madrepora latistella* Brook, Cat. Genus Mad., p. 112, Pl. 9, Fig. B.
1925 *Acropora latistella*- Hoffmester, p. 65, Pl. 15, Figs. 1a, 1b.
2000 *Acropora latistella* - Veron 1, p. 348, 5 Figs.

Distribution: Port Denison, Thursday Island, fiji Islands.

Habitat: It is common in the reef flat and upper slope of many lagoonward reefs.

Acropora robusta (Dana), 1846
(Pl. 3, Fig. 7)

1846 *Madrepora robusta*, Dana, p. 475, Pl. 39, Fig. 3.
1984 *Acropora robusta* - Veron & Wallace, p. 201, Figs. 473-485.
1991 *Acropora robusta* - Sheppard & Sheppard, p. 56, Pl. 29, Fig. 36.
1993 *Acropora robusta* - Ciarapica and Passeri, p. 40, Pl. 12, Fig. 6.
2000 *Acropora robusta* - Veron 1, p. 216, 5 Figs.

Distribution: Red Sea, Indian Ocean from Malacca to Samoa and the Marshall Islands.

Habitat: This species occurs in very shallow water only, well exposed to wave action and completely cover areas of many square meters.

Acropora tutuilensis Hoffmeister, 1925
(Pl. 4, Fig. 1)

1925 *Acropora tutuilensis* Hoffmeister, p. 71, Pl. 19, Figs. 1a-1e.
2000 *Acropora tutuilensis* - Veron 1, p. 290.

Distribution: Red Sea, Samoa Island.

Habitat: Hoffmeiser (1925) dredged his specimens from 45 to 78 feet deep and also a very irregularly branching specimen grown in agitated water 12 feet deep.

Acropora intermedia (Brook), 1891
(Plate 4, Fig. 2)

1893 *Madrepora intermedia*, Brook: p. 31, Pl. 1, Fig. c.
1952 *Acropora intermedia* - Crossland, p. 200, Pl. 32, Fig. 1.
1976 *Acropora intermedia* - Pillai and Scheer, p. 24, Pl. 2, Fig. 1.

Distribution: Maldives, Southeast India, Great Barrier Reef.

Habitat: Shallow-water habitat.

Suborder Fungiina Verrill, 1865
Family Siderastreidae Vaughan & Wells, 1943
Genus *Coscinaraea* Edwards and Hime, 1848
Coscinaraea columna (Dana), 1846
(Pl. 4, Fig. 3)

1846 *Psammocora columna* Dana, p. 347, Pl. 25, Figs. 1, 1a, 1b.
1980 *Coscinaraea columna* - Veron & Pichon, p. 92, Figs. 152-157.
1991 *Coscinaraea columna* - Sheppard & Sheppard, p. 81, Figs. 71a-c.
2000 *Coscinaraea columna* - Veron 2, p. 160, 7 Figs.

Remarks: Colonies encrusting or massive, sometimes hillocky. Calices small, 2-3 mm in diameter, very shallow to completely superficial. Septa are considerably more beaded.

Distribution: Red Sea, Arabian Sea, east coast of Africa eastward to eastern Australia.

Habitat: It is common in the clear water at 10 m deep in a coastal embayment.

Family Fungiidae Dana, 1846
Genus *Cycloseris* Edwards & Haime, 1849

Key of identification of *Cycloseris:*

1- Corallum flat, thin. Scar of attachment often visible. First two cycles of septa increase in height towards the center of the disc and become highly exert around the axial fossa. Septa comparatively thin, edges of septa sharp. Costae regularly radiating from the center.... *C. patelliformis*
2- Corallum flat, thin. Scar of attachment often

visible. Septa uneven, first two cycles of septa moderately increasing in height around the fossa. Costae low, at the marginal part of the disc more distinctive. Septa thin, edges of septa lacerated.... *C. erosa*

3- Corallum approximately circular. Scar of attachment mostly not visible. Septa straight, symmetrical, major septa exert. Corallum perceptibly oval, underside concave. Costae alternating in size....*C. cyclolites*

Cycloseris patelliformis (Boschma), 1923
(Pl. 4, Fig. 4)

1923 *Fungia patelliformis* Boschma, p. 136, Pl. 9, Figs. 9, 11, 13-16a.
1974 *Cycloseris patelliformis* - Scheer & Pillai, p. 35, Pl. 17, Fig. 4.
1983 *Cycloseris patelliformis* - Scheer & Pillai, p. 74, Pl. 16, Fig. 1.
1991 *Cycloseris patelliformis* - Sheppard & Sheppard, p. 96, Pl. 63, Fig. 90.
2000 *Cycloseris patelliformis* - Veron 2, p. 246, 3 Figs.

Remarcks: *C. patelliformis* differs from *C. vaughani* (Boschma) in that the former is characterized by equal height costae, whilst the latter has alternating costae towards the periphery.

Distribution: Red Sea, Gulf of Aden eastward to Samoa and Hawaii.

Habitat: This is the commonest species found on soft fine sand between reefs in sheltered locations.

Cycloseris erosa (Doederlein), 1901
(Pl. 4, Fig. 5)

1901 *Fungia erosa* Doederlein, p. 73, Pl. 4, Figs. 1-1b, Pl.5, Figs. 4-4a.
1980 *Cycloseris erosa* - Veron & Pichon, p. 113, Figs. 178-179.
1983 *Cycloseris* cf. *erosa* - Scheer & Pillai, p. 75, Pl. 16, Figs. 5-7.
2000 *Cycloseris erosa* - Veron 2, p. 241, 4 Figs.

Distribution: Red Sea, Indonesia, Jaban, Great Barrier Reef.

Habitat: Soft inter-reef substrates.

Cycloseris cyclolites (Lamarck), 1801
(Pl. 4, Fig. 6)

1879 *Cycloseris cyclolites* - Klunzinger 3, p. 71.
1941 *Cycloseris cyclolites* - Yabe & Sugiyama, p. 76, Pl. 64, Figs. 2-4c, 8-8d, Pl. 65, Figs. 1-3a.
1974 *Cycloseris cyclolites* - Scheer & Pillai, p. 35, Pl. 17, Figs. 1, 2.
1980 *Cycloseris cyclolites* - Veron & Pichon, p. 108, Figs. 171-174, 753.
1991 *Cycloseris cyclolites* - Sheppard & Sheppard, p. 98.
2000 *Cycloseris cyclolites* - Veron 2, p. 236, 6 Figs.

Distribution: Red Sea, Gulf of Aqaba, Ceylon, Tuticorin, Andamans, Nicobars, Mergui Archipelago, East Indies, China Sea, Philippines, Honshu, Palau Isls., New Britain.

Habitat: Soft inter-reef and sometimes reef substrates.

Genus *Fungia* Lamarck, 1801

Key of identification of *Fungia*:

A- Corallum oval, flat or arched, thick and heavy. Wall irregularly and only in older specimens perforate.... Subgenus *Pleuractis*

1- Corallum flat or arched. Septa minutely dentate. Primary septa run from the central oral area to the perimeter Costae clearly distinguishable with numerous short spines.... *F.* (*Pleuractis*) *paumotensis*

2- Central part of the corallum strongly arched. Septa unequal, septal edges dentated or lacerated. Costae consisting of rows of granules. On the upper side mostly additional centers present.... *F.* (*Pleuractis*) *moluccensis*

B- Corallum circular. Costae cyclically unequal, but all with spines or granules....Subgenus *Verrillofungia*

1- Corallum flat or convex. Septa wavy, major ones thickened, with mostly granular edges, septal teeth fine, rounded. Coastal spines tuberculate, with fusion among themselves. Septal fusion conspicuous. Wall perforate.... *F.* (*Verrillofungia*) *granulosa*

2- Corallum flat or arched, even saucer-shaped. Costae with numerous small, granulose spines. Wall imperforate.... *F.* (*Verrillofungia*) *concinna*

C- Corallum circular. Only those costae, corresponding to lower cycles of septa, with long, echinulate spines. Costae of higher orders smooth.... Subgenus *Danafungia*

1- Corallum flat or arched. Seta unequal, lower order septa markedly exsert around the central fossa. Sometimes tentacular lobes present. Spines of lower order costae long and coarse. Wall perforate.... *F.* (*Danafungia*) *danai*

2- Corallum generally flat, often irregularly contorted. Septa of lower cycles markedly exert. Septal teeth uniform. Lower cycles of costae well developed with numerous conical spines. Wall perforate. Undersurface does not have slits between costae.... *F. (danafungia) klunzingeri*

Subgenus *Pleuractis* Verrill, 1864
Fungia (Pleuractis) paumotensis Stutchbury, 1833
(Pl. 4, Fig. 7)

1833 *Fungia paumotensis* Stutchbury, p. 485, Pl. 32, Fig. 6.
1980 *Fungia (Pleuractis) paumotensis* - Veron & Pichon, p. 162, Figs. 269-272.
1991 *Fungia (Pleuractis) paumotensis* - Sheppard & Sheppard, p. 103, Fig. 104.
2000 *Fungia paumotensis* - Veron 2, p. 282, 5 Figs.

Distribution: Red Sea and Gulf of Aden and from Malacca to Tahiti.

Habitat: This is a common species found mostly on hard reef substrate and coral rubble, preferring clear water.

Fungia (Pleuractis) moluccensis Horst, 1919
(Pl. 4, Fig. 8)

1919 *Fungia moluccensis* Horst, p. 65, Pl. 1.
1925 *Fungia moluccensis* - Boschma, p. 210, Pl. 6, Fig. 49, Pl. 7, Figs. 75, 76, Fig. 10, Fig. 128.
1980 *Fungia moluccensis* - Veron & Pichon, p. 165, Figs. 273-282, 756.
1983 *Fungia (Pleuractis) moluccensis* - Scheer & Pillai, p. 79, Pl. 17, Figs. 8, 9, Pl. 18, Fig.1.
1991 *Fungia (Pleuractis) moluccensis* - Sheppard & Sheppard, p. 103, Fig. 105.
2000 *Fungia moluccensis* - Veron 2, p. 284, 6 Figs.

Distribution: Red Sea, Nicobar Isls., Mergui Archipelago, Philippines, Moluccas, Great Barrier Reef.

Habitat: It is recorded from reef slopes and turbid environments.

Subgenus *Verrillofungia* Wells, 1966
Fungia (Verrillofungia) granulosa Klunzinger, 1879
(Pl. 4, Fig. 9)

1879 *Fungia granulosa* Klunzinger 3, p. 65, Pl. 7, Fig. 3, Pl. 8, Fig. 3.
1979 *Fungia granulosa* - Schuhmacher, p. 214, Figs. 5, 225, 19, 20.
1980 *Fungia granulosa* - Veron & Pichon, p. 156, Figs. 257-263.
1983 *Fungia (Verrillofungia) granulosa* - Scheer & Pillai, p. 80, Pl. 18, Fig. 2.
1991 *Fungia (Verrillofungia) granulosa* - Sheppard & Sheppard, p. 102, Fig. 100.
2000 *Fungia granulosa* - Veron 2, p. 276, 4 Figs.

Distribution: Red Sea, Philippines, Moluccas, Great Barrier Reef.

Habitat: This is a common species in sheltered areas, on soft substrates, coral rubble and hard substrates, from near the surface to 20 m deep.

Fungia (Verrillofungia) concinna Verrill, 1864
(Pl. 4, Fig. 10)

1864 *Fungia concinna* Verrill, p. 50.
1980 *Fungia (Verrillofungia) concinna* - Veron & Pichon, p. 150, Figs. 245-250.
1983 *Fungia (Verrillofungia) concinna* - Scheer & Pillai, p. 81, Pl. 18, Figs. 6-8.
1991 *Fungia (Verrillofungia) concinna* - Sheppard & Sheppard, p. 102, Fig. 101.
2000 *Fungia concinna* - Veron 2, p. 270, 4 Figs.

Distribution: Red Sea, Zanzibar, Seychelles, Philippines, Japan, Great Barrier Reef, Marshal Isls., Tuamotu Archipelago, Coraline Islands, Samoa.

Habitat: Reef slopes and lagoons.

Subgenus *Danafungia* Wells, 1966
Fungia (Danafungia) danai Edwards and Haime, 1851
(Pl. 5, Fig. 1)

1851 *Fungia danai* Milne Edwards and Haime, p. 11, Pl. 10, Fig. 1.
1980 *Fungia (Danafungia) danai* - Veron & Pichon, p. 134, Figs. 214-217.
1983 *Fungia (Danafungia) danai* - Scheer & Pillai, p. 82, Pl. 19, Figs. 1, 2.
2000 *Fungia danai* - Veron 2, p. 262, 5 Figs.

Distribution: Red Sea, Seychelles, Philippines, Japan, Great Barrier Reef, Marshal Isls., Tuamotu Archipelago, Coraline Islands, Samoa, New Caledonia, Fiji, Tahiti.

Habitat: Reef slopes and lagoons.

Fungia (Danafungia) klunzingeri Doederlein, 1901
(Pl. 5, Fig. 2)

1901 *Fungia klunzingeri* Doederlein, p. 358.
1902 *Fungia klunzingeri* - Doederlein, p. 124, Pl. 15, Figs. 1, 1a, Pl. 16, Fig. 4.
1979 *Fungia klunzingeri* - Schuhmacher, p. 225, Figs. 19, 20.
1980 *Fungia klunzingeri* - Veron & Pichon, p. 144, Figs. 234-235.
1983 *Fungia (Danafungia) klunzingeri* - Scheer & Pillai, p. 84, Pl. 19, Figs. 7, 8.
1991 *Fungia (Danafungia) klunzingeri* - Sheppard & Sheppard, p. 102, Fig. 98.
2000 *Fungia klunzingeri* - Veron 2, p. 266, 6 Figs.

Distribution: Red Sea, Great Barrier Reef.

Habitat: Reef slopes and lagoons.

Family Poritidae Gray, 1842
Genus *Goniopora* Blainville, 1830

Key of identification of *Goniopora*:

1- Corallum massive or columnar. Calices 3 to 5 mm in diameter, wall thickened. Septa in three cycles, extending to columella. Columella trabecular, Pali present.... *G. planulata*

2- Corallum submassive. Calices 2 to 3 mm in diameter, oval or rounded, 1 mm deep. Third cycle of septa incomplete. Columella very well developed.... *G. minor*

Goniopora planulata **(Ehrenberg), 1834**
(Pl. 5, Fig. 3)

1834 *Astraea planulata* Ehrenberg, p. 319.
1879 *Goniopora planulata* - Klunzinger, 2, p. 45, Pl. 5, Fig. 24, Pl. 8, Fig. 23.
1976 *Goniopora planulata* - Pillai & Scheer, p. 49, Pl. 19, Fig. 3.
1983 *Goniopora planulata* - Scheer & Pillai, p. 92, Pl. 23, Figs. 1, 2.
1991 *Goniopora columna* - Sheppard & Sheppard, p. 70, Pls. 42, 43, Fig. 56.
2000 *Goniopora columna* - Veron 3, p. 368, 7 Figs.

Distribution: Red Sea eastward to Fiji.

Habitat: It is common in sheltered, sandy or lagoonal areas in depths between 2 and 15 m deep.

Goniopora minor **Crossland, 1952**
(Pl. 5, Fig. 4)

1952 *Goniopora minor* Crossland, p. 233, Pl. 48. Figs. 1, 3.
1955 *Goniopora minor* - Nemenzo, p. 51, Pl. 8, Fig. 5.
1983 *Goniopora minor* - Scheer & Pillai, p. 94, Pl. 23, Figs. 5, 6.
1991 *Goniopora minor* - Sheppard & Sheppard, p. 73, Fig. 58.
2000 *Goniopora minor* - Veron 3, p. 366, 6 Figs.

Distribution: Red Sea, Arabian Sea, Seychelles, Maldives, Great Barrier Reef, Minicory, Philippines.

Habitat: It is found on reef slopes down to 20 m deep.

Genus *Porites* Link, 1807

Key of identification of *Porites*:

1- Corallum ramose. Branches thick, compressed or flabellate. Corallites 1. 25 to 1.50 mm in length, 1.5 mm deep. Ventral triplet free. Five pali often prominent.... *P. compressa*

2- Corallum ramose. Branches digitiform or only little at the top. Corallites polygonal, 1.5 to 1.75 mm in length, very shallow. Ventral triplet forms a trident. Pali poorly developed.... *P. nodifera*

3- Corallum massive. Surface with gibbosities. Calices 0. 5 to 0.6 mm in diameter, very shallow. Pali present. Surface coenenchyme between the corallites rises to form conical or lengthly ridges enclosing valleys and small rounded calices.... *P. (Synaraea) undulata*

Porites nodifera Klunzinger, 1879
(Pl. 5, Fig. 5)

1879 *Porites nodifera* Klunzinger 2, p. 41, Pl. 5, Fig. 17, Pl. 6, Fig. 13.
1954 *Porites nodifera* - Rossi, p. 57, Pl. 9, Figs. 1, 2.
1983 *Porites nodifera* - Scheer & Pillai, p. 100, Pl. 25, Figs. 3, 4.
1991 *Porites nodifera* - Sheppard & Sheppard, p. 65, Fig. 47.
2000 *Porites nodifera* - Veron 3, p. 296, 8 Figs.

Distribution: Red Sea, Arabian Sea, Arabian Gulf.

Habitat: Shallow water species, generally living less than 5 m deep and tolerant of high salinities.

Subgenus *Synaraea* Verrill, 1864

Porites (Synaraea) undulata Klunzinger, 1879
(Pl. 5, Fig. 6)

1879 *Synaraea undulata* Klunzinger, 2, p. 48, Pl. 5, Fig. 30, Pl. 6, Fig. 12.
1983 *Porites (Synaraea) undulata* - Scheer & Pillai, p. 102, Pl. 25, Figs. 9, 10.

Distribution: Red Sea, Seychelles.

Porites compressa Dana, 1846
(Pl. 5, Fig. 7)

1846 *Porites compressa* Dana, p. 553, Pl. 53, Figs. 5, 5a.
1974 *Porites compressa* - Pillai & Scheer, p. 459, Fig. 6c.
1983 *Porites compressa* - Scheer & Pillai, p. 101, Pl. 25, Figs. 5, 6.
1991 *Porites compressa* - Sheppard & Sheppard, p. 65, Fig. 46.
2000 *Porites compressa* - Veron 3, p. 344.

Distribution: Red Sea, Mascarene Archipelago, Gulf of Mannar, Philippines, Palau Isls., Hawaii..

Habitat: This species prefers areas of low exposure, where it is found on gently sloping substrates. It tolerates sedimented conditions well, and may be found in sedimented water and near sandy patches in back-reef conditions.

Suborder Faviina Vaughan & Wells, 1943

Family Faviidae Gregory, 1900

Genus *Favia* Oken, 1815

Key of identification of *Favia*:

1- Corallum massive. Corallites 4 to 6 mm in diameter. Wall exsert. Septa 30 to 35.... *F. laxa*

2- Corallum massive, hillocky. Corallites 7 to 9 mm in diameter. Septa 18 to 24, very uniform in size, with a distinct crown of paliform lobes. A second set of septa very indistinct. Costae correspond to all septa, very regular.... *F. helianthoides*

3- Corallum massive. Corallites subplocoid, circular to irregular in shape, crowded. Septa thin, uniformly spaced, Subequal, most reaching the columella, costae of adjacent corallites do not meet leaving a narrow ambulacral groove. Paliform lobes absent .... *F. lacuna*

4- Corallum flat. Corallites subplocoid to crowded cerioid, irregular in shape, 9 to 12 mm in diameter, may have three centers. Septa thin, irregular, plunge steeply inside the wall. Paliform lobes poor or absent.... *F. rotumana*

5- Corallum encrusting or submassive. Corallites more rounded, regular, 12 to 15 mm in diameter. Septa thin, very spiny. Costae bear long spines. Wall and coenosteum generally blistered.... *F. lizardensis.*

6- Corallum massive, small. Corallites conical with thick walls. Septo-costae irregular, thick. Costae strongly bedded. Paliform lobes weakly developed.... *F. danae*

7- Corallum massive. Corallites compacted, irregular projecting, irregular outline, up to 10 mm deep. Paliform lobes absent.... *F. veroni*

Favia laxa (Klunzinger), 1879
(Pl. 5, Fig. 8)

1897 *Orbicella laxa* Klunzinger, 3, 49, Pl. 5, Fig. 3, Pl. 10, Figs. 9a, b.
1914 *Favia laxa* - Matthal, 99, Pl. 24, Figs. 5, 6, pl. 37/2.
1983 *Favia laxa* - Scheer & Pillai, 106, Pl. 26, Figs. 7, 8.
1991 *Favia laxa* - Sheppard & Sheppard, 123, Pl. 86, Figs. 128a, b.
2000 *Favia laxa* - Veron 3, 105, 3 Figs.

Distribution: Red Sea, Reunion, Great Barrier Reef, Solomon Isls.

Habitat: It tolerates all habitats except very exposed and very turbid, from 10 to 25 m depth on clear water reef slopes.

Favia helianthoides Wells, 1954
(Pl. 5, Fig. 9)

1954 *Favia helianthoides* Wells, 458, pl. 174, Figs. 2-6.
1974 *Favia helianthoides* - Wijsman-Best, 257, Pl. 4, Fig. 3.
1983 *Favia helianthoides* - Scheer & Pillai, 107, Pl. 26, Figs. 9, 10.
2000 *Favia helianthoides* - Veron 3, 110, 3 Figs.

Distribution: Red Sea eastwards to east Australia, Molucca Sea, Solomao Isls., Marshall Isls.

Habitat: Shallow reef environments

Favia lacuna Veron, 2000
(Pl. 5, Fig. 10)

2000 *Favia lacuna* Veron 3, 111, 2 Figs.

Remarks: Veron *et al.* (2000) stated that *F. lacuna* looks like a small *Oulophyllia* underwater.

Distribution: Red Sea

Habitat: Shallow exposed reef environments

Favia rotumana (Gardiner), 1898
(Pl. 5, Fig. 11)

1925 *Favia rotumana* (Gardiner): Hoffmester, 24, Pl. 1, Figs. 3a-c.
1977 *Favia rotumana* - Veron, Pichon & Wijsman-Best, 40, Figs. 62-66.
1991 *Favia rotumana* - Sheppard & Sheppard, 124, Fig. 134.
2000 *Favia rotumana* - Veron 3, 121, 10 Figs.

Remarks: *F. mathaei* and *F. rotumana* have irregular septa but the former is characterized by circular and smaller corallites.

Distribution: Indo-Pacific as Funafuti, Rotuma, Wakaya, Hereheretue Isl., Samoa..

Habitat: Upper reef slope.

favia lizardensis Veron, Pichon and Wijsman-Best, 1977
(Pl. 5, Fig. 12)

1977 *Favia lizardensis* Veron, Pichon and Wijsman-Best, 45, Figs. 74-78.
1991 *Favia lizardensis* - Sheppard & Sheppard, 124, Fig. 132.
2000 *Favia lizardensis* - Veron 3, 120.

Remarks: *F. lizardensis* has corallites of similar size to *F. favus* but the former has more compact corallites with uniform septo-costae.

Distribution: Red Sea

Habitat: It occurs on reef slopes to 25 m deep.

Favia danae Verrill, 1872
(Pl. 6, Fig. 1)

1918 *Favia danae* - Vaughan, 108, Pl. 39, Figs. 1, 1a.
1924 *Favia danae* - Matthal, 12, Pl. 1, Fig. 2.
2000 *Favia danae* - Veron 3, 123, 4 Figs.

Remarks: *F. danae* is similar to *F. favus* but the later is characterized by more uniform septo-costae and less bedded costae.

Distribution: Red Sea, northern and eastern Australia.

Habitat: A wide range of reefs and rocky foreshores of subtropical locations.

Favia veroni Moll and Borel-Best, 1984
(Pl. 6, Fig. 2)

2000 *Favia veroni* - Veron 3, 128, 5 Figs.

Remarks: *F. maxima* has similar sized corallites to *F. veroni* but the former is characterized by conspicuous paliform lobes, more exert and more widely spaced corallites.

Distribution: Red Sea, east Africa and south Indies.

Habitat: Reef slopes.

Genus *Favites* Link, 1807

Key of identification of *Favites*:

1- Corallum massive. Corallites polygonal, wall thin, acute at the top. Corallites 5 to 8 mm in length, about 3 to 4 mm deep. Septa 24 to 36 with feebly developed dentation. No paliform lobes.... *F. acuticollis*

2- Corallum submassive, hemispherical. Surface level. Corallites polygonal, wall acute at the top, 12 to 16 mm and up to 20 mm long and up to 10 mm deep. Septa very narrow with equidistant serration at the edges. Pali conspicuous on major septa.... *F. peresi*

Favites acuticollis (Ortmann), 1889
(Pl. 6, Fig. 3)

1889 *Prionastraea acuticollis* Ortmann, 528, Pl. 16, Fig. 11.
1972 *Favites acuticollis* - Wijsman-Best, 32, Pl. 6, Fig. 4.
1983 *Favites acuticollis* - Scheer & Pillai, 117, Pl. 29, Fig. 3.
2000 *Favites acuticollis* - Veron 3, 141.

Distribution: Red Sea, Chagos Archipelago, Ceylon, Indonesia, New Caledonia, New Hebrides.

Favites peresi Faure & Pichon, 1978
(Pl. 6, Fig. 4)

1978 *Favites peresi* Faure & Pichon: 107, Pl. 1-5, Figs. 4, 5.
1983 *Favites peresi* - Scheer & Pillai, 113, Pl. 28.
1991 *Favites peresi* - Sheppard & Sheppard, 129, Pl. 93, Fig. 140.

Remarks: The general features of *F. peresi* (growth form and corallite size) are more or less similar to *F. abdita*, but the corallite wall is more acute in *F. peresi* than in *F. abdita*.

Distribution: Red Sea, Gulf of Oman, Madagascar.

Habitat: This is a common member of the high diversity faviid zone at mid-depths on unsedimented reef slopes. It is very rarely found on exposed reef crests, reef flats or sedimented sites.

Genus *Goniastrea* Edwards & Haime, 1848
Goniastrea aspera Verrill, 1895
(Pl. 6, Fig. 5)

1977 *Goniastrea aspera* - Veron, Pichon & Wijsman-Best, 83, Figs. 157-163.
2000 *Goniastrea aspera* - Veron 3, 168, 6 Figs.

Remarks: Corallites generally monocentric, rarely with two to three centers running together. Corallites angular. Septa in three cycles, long and short septa alternate. Paliform lobes may developed. Wall thick.

Distribution: Indo-Pacific from Red Sea east wards to Philippines and the Great Barrier Reef.

Habitat: Usually intertidal habitats where different colonies may adjoin to form flat expanses frequently over 5 m across. Also it occurs in protected turbid environments.

Genus *Platygyra* Ehrenberg, 1834

Key of identification of *Platygyra*:

3- Valleys mostly short with 2 to 3 centers or monocentric, 3 to 4 mm wide and equally deep. Wall imperforate. Septa thin, little exsert. Wall acute at the top.... *P. sinensis*

4- Valleys mostly short with 2 to 3 centers or monocentric, 3 to 4 mm wide and equally deep. Wall imperforate. Septa thickened at the wall, exsert, with frosted teeth. Wall of uniform thickness from top to bottom, 1.5 to 2 mm.... *P. crosslandi*

Platygyra sinensis (Edwards & Haime), 1848
(Pl. 6, Fig. 6)

1857 *Coeloria sinensis* Edwards & Haime, 416.
1954 *Platygyra sinensis* - Wells, 462, Pl. 175, Fig. 3.
1972 *Platygyra sinensis* - Wijsman-Best, 48, Pl. 11, Fig. 3.
1977 *Platygyra sinensis* - Veron, Pichon & Wijsman-Best, 105, Figs. 201-206, 457.
1983 *Platygyra sinensis* - Scheer and Pillai, 125, Pl. 30, Fig. 6.
1991 *Platygyra sinensis* - Sheppard & Sheppard, 132, Pl. 99, Fig. 150.
2000 *Platygyra sinensis* - Veron 3, 186, 6 Figs.

Distribution: Red Sea, East Africa, Sigapore, Philippines, Japan, Great Barrier Reef, Mergui Archipelago, Lakshadweep, China Sea, Coraline Isls., Ceylon, Maldives, Indonesia, Japan, New Guinea, Marshall Isls., Cook Isls., Fiji, Samoa, Solomon Isls..

Habitat: It is a very common inhabitant of reef flates and shallow areas down to about 3 m deep.

Platygyra crosslandi (Matthal), 1928
(Pl. 6, Fig. 7)

1928 *Coeloria crosslandi* Matthal, 48, pl. 47, Figs. 1, 2, Pl. 56, Fig. 8.
1983 *Platygyra crosslsndi* - Scheer and Pillai, 125, Pl. 30, Figs. 8, 9.
1991 *Platygyra crosslandi* - Sheppard & Sheppard, 134, Fig. 151.
2000 *Platygyra crosslandi* - Veron 3, 180, 5 Figs.

Remarks: *P. crosslandi* is similar to *P. pini* but the later is characterized by shorter, more uniform valleys and less development of columelae.

Distribution: Red Sea and east Africa.

Habitat: This appears to be a shallow water species, which is not very common.

Genus *Hydnophora* Fischer de Waldheim, 1807
Hydnophora exesa (Pallas), 1766
(Pl. 6, Fig. 8)

1766 *Madrepora exesa* Pallas, p. 290.
1972 *Hydnophora exesa* - Wijsman-Best, p. 51, Pl. 13, Figs. 1-4.
1983 *Hydnophora exesa* - Scheer & Pillai, p. 128, Pl. 31, Figs. 4, 5, Pl. 33, Fig. 12.
1991 *Hydnophora exesa* - Sheppard & Sheppard, p. 117, Pl. 82, Fig. 122.
2000 *Hydnophora exesa* - Veron 2, p. 370, 7 Figs.

Remarks: Corallum massive, explanate or subramose. Monticules conical or elongated, conical ones 5 to 10 mm in height and basal thickness.

Distribution: Red Sea, eastward to Cook Islands and Ellis Island.

Habitat: The species is widespread in sheltered and moderately exposed habitats, also occurring from 10 to 25 m deep on exposed reef slopes.

Genus *Leptastrea* Edwards & Haime, 1848
Leptastrea transversa Klunzinger, 1879
(Pl. 6, Fig. 9)

1879 *Leptastrea transversa* Klunzinger 3, p. 46, Pl. 6, Fig. 2.
1918 *Leptastrea transversa* - Vaughan, p. 94, Pl. 31, Figs. 1, 1a.
1952 *Leptastrea transversa* - Crossland, p. 115, Pl. 54, Figs. 1-3.
1983 *Leptastrea transversa* - Scheer & Pillai, p. 131, Pl. 31, Figs. 9, 10.
1991 *Leptastrea transversa* - Sheppard & Sheppard, p. 139, Fig. 160.
2000 *Leptastrea transversa* - Veron 3, p. 238, 5 Figs.

Remarks: Corallites rounded or polygonal, sometimes slightly elongated, 3 to 5 mm long. Septa in four cycles, nearly all of the first two cycles equally developed. Septal sides and edges granular. Columella in the form of a vertical ridge along the long axis of the calices.

Distribution: A common and widespread species from Red Sea to Tahiti.

Habitat: It occurs in reef slopes of a wide variety of exposures, and both clear and moderately turbid water.

Genus *Echinopora* Lamarck, 1816
Echinopora fructiculosa (Ehrenberg, 1834)
(Pl. 6, Fig. 10)

1879 *Echinopora fructiculosa* (Ehrenberg): Klunzinger, p. 55, Pl. 6, Fig. 4.
1991 *Echinopora* cf. *fructiculosa* - Sheppard & Sheppard, p. 142, Pl. 110, Figs. 165a-b.
2000 *Echinopora fructiculosa* - Veron 3, p. 257, 4 Figs.

Remarks: Corallum entirely ramose. Corallites occur all around the branches. Costae are lightly spines, or may be ridges entirely devoid of spines. Primary septa bear tall, thin paliform lobes. Corallites 5 to 8 mm in diameter.

Distribution: Red Sea, East Africa, Seychelles.

Habitat: It is found on sheltered fringing reefs on gentle gradients, commonly near sandy patches between 4 and 20 m deep.

Genus *Montastrea* Blainville, 1830
Montastrea curta (Dana, 1846)
(Pl. 6, Fig. 11)

1977 *Montastrea curta* - Veron, Pichon & Wijsman-Best, p. 137, Figs. 257-263.
1991 *Montastrea curta* - Sheppard & Sheppard, p. 135, Pls. 102, 103, Fig. 154.
2000 *Montastrea curta* - Veron 3, p. 216, 9 Figs.

Remarks: *M. curta* is closely similar to *Favia laxa*, but the later is characterized by strongly alternating septa.

Distribution: Red Sea and throughout the Indo-Pacific.

Habitat: It is generally restricted to moderately clear water in the mid-depths of fore-reef slopes.

Family Mussidae Ortman, 1890
Genus *Blastomussa* Wells, 1968
Blastomussa merleti (Wells), 1961
(Pl. 6, Fig. 12)

1961 *Bantomia merleti* Wells, p. 189, Figs. 1-4.
1980 *Blastomussa merleti* - Veron and Pichon, p. 234, Figs. 392-394.
1983 *Blastomussa merleti* - Scheer and Pillai, p. 149, Pl. 35, Figs. 5, 6, 10, 11.
1991 *Blastomussa merleti* – Sheppard and Sheppard, p. 111, Pl. 74, Figs. 113a-c.
2000 *Blastomussa merleti* - Veron 3, p. 4, 6 Figs.

Remarks: Corallum phaceloid, Corallites cylindrical, 3 to 6 mm apart. Calices 4-8 mm in diameter. Septa in two complete cycles with a set of incomplete tertiaries.

Distribution: Red Sea, Arabian Sea, Aldabra, Madagascar, Great Barrier Reef, New Caledonia.

Habitat: It is favor small crevices or steep parts of reef slopes and may be recorded down to at least 50 m depth in fairly dark and cryptic conditions as well as in moderately lit areas. It is rarely encountered in shallow or exposed conditions.

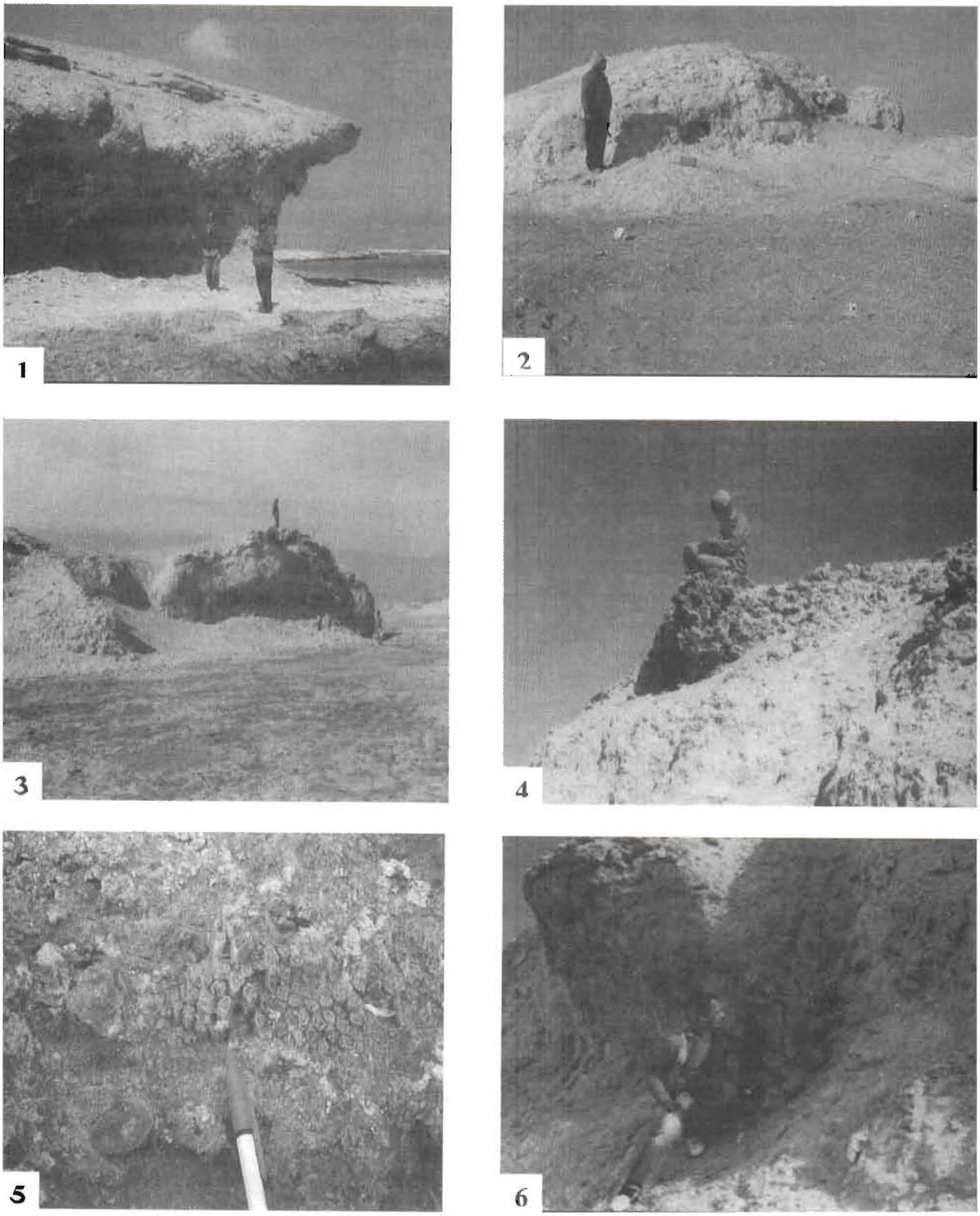

Plate 1:

Fig. 1. Lower unit, 7.5m hight above the present sea level. North Bernice area.

Fig. 2. Middle unit, 220m away from the coast, 2.5m hight, Mersa Mubarak aera.

Fig. 3. Middle unit, 150m away from the coast, 7.5m hight, Wadi El-Quseir area.

Fig. 4. Upper unit, disconformably overlains the Pliocene rocks of Shagra Formation, North Quseir.

Fig. 5. Upper part of the lower unit with Galaxea and Fungia (deep reef slope), Wadi Gasus..

Fig. 6. Upper unit, with large colonies of *Lobophyllia corymbosa* (reef slope facies), Wadi Quseir El- Kadium area.

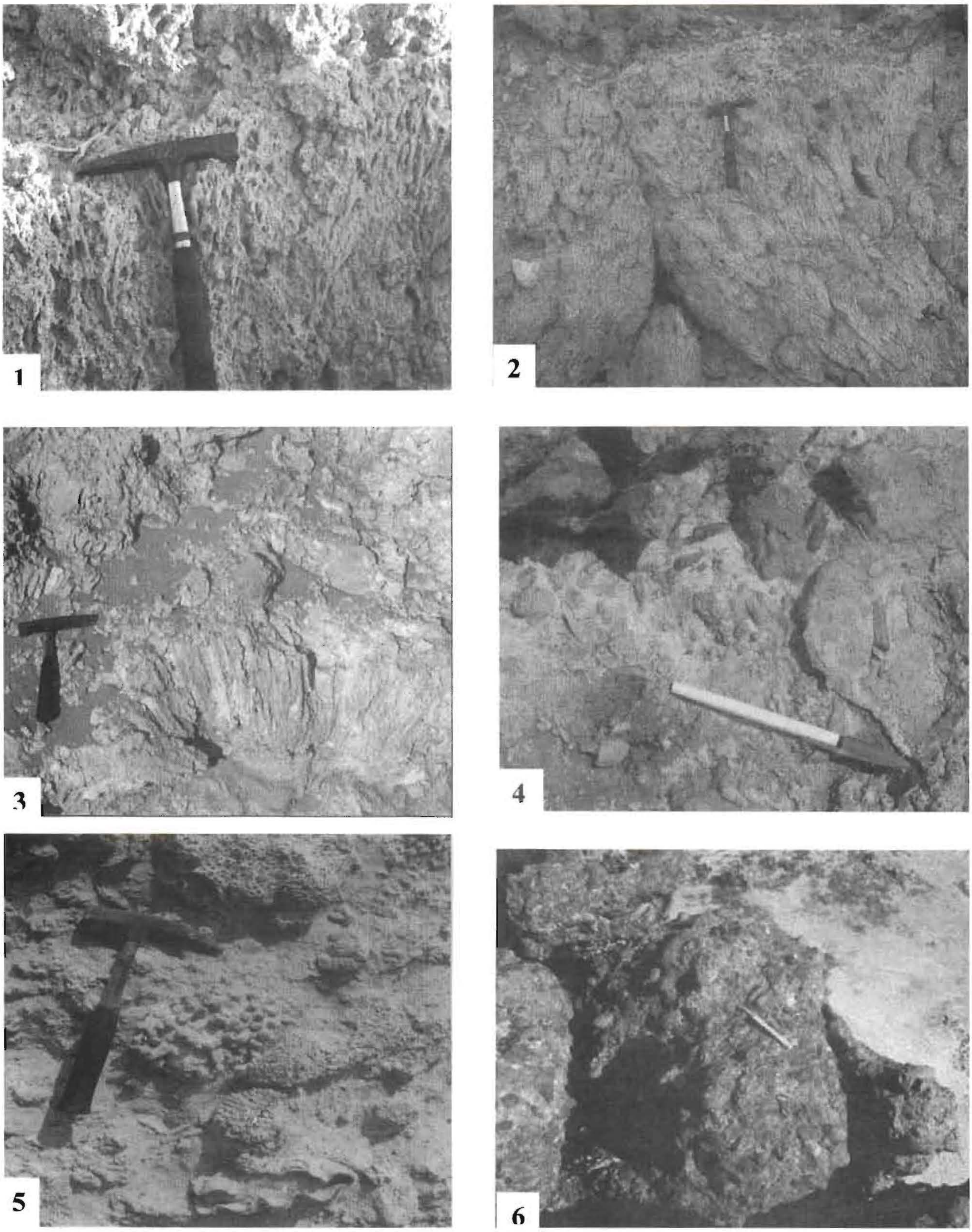

Plate 2:

Fig. 1. *Millepora dichotoma* forming the reef crest facies in the middile unit, Abu Soma area.
Fig. 2. Large colonies of *Galaxea fascicularis* (reef slope facies), lower unit, North Bernice aera.
Fig. 3. Large colonies of *Porites nodifera* (upper reef slope facies), upper unit, Gasus area.
Fig. 4. Upper unit, with abundance regular echinoid spines (Back –reef facies), Wadi Syatin.
Fig. 5. Middle unit, with small scleractinian colonies (reef flat facies), Gasus area.
Fig. 6. Varicolored conglomerates in the lower most part of lower unit, North Bernice area.

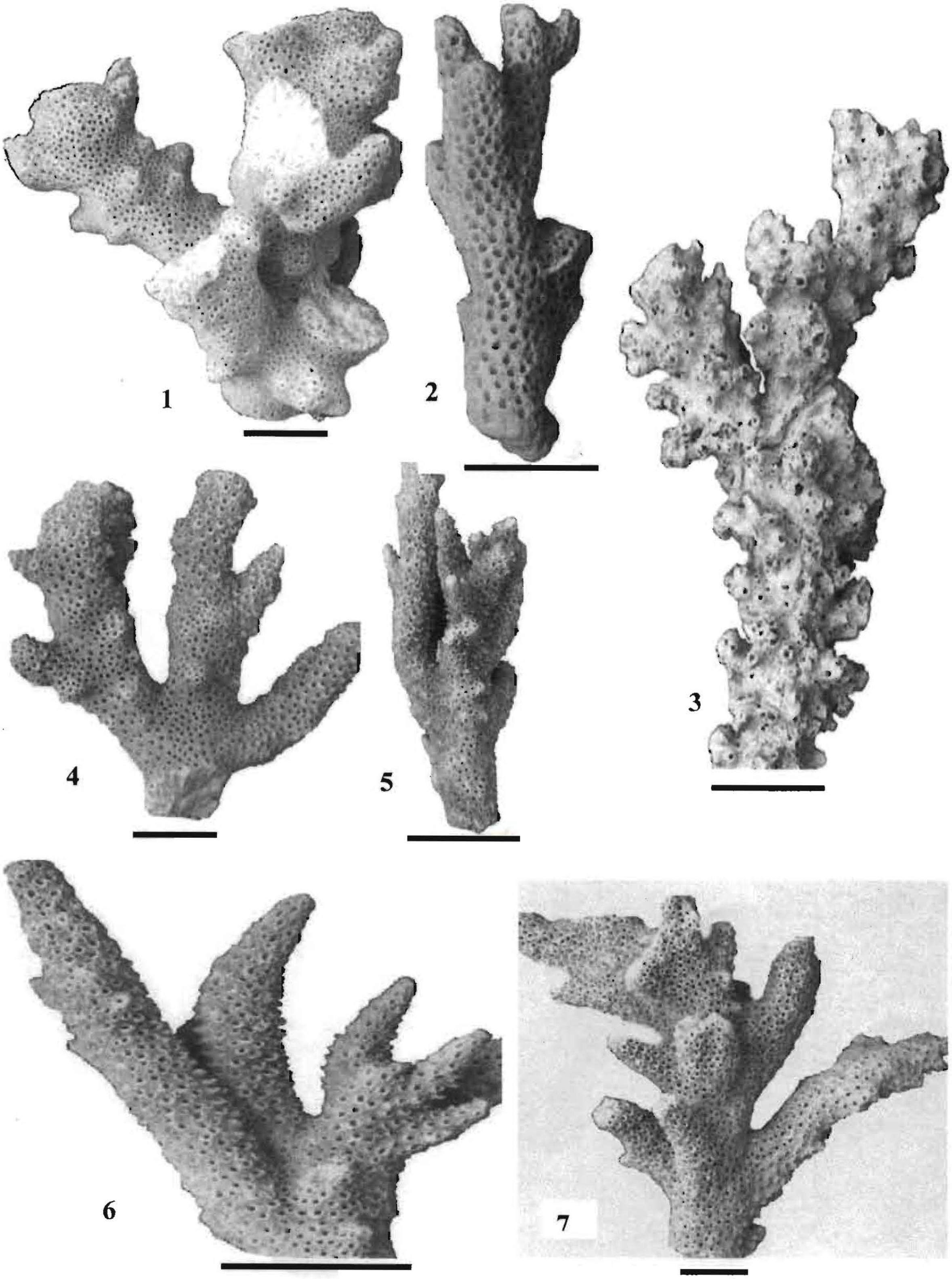

Plate 3:

Fig. 1. *Stylophora kueblmanni* Scheer & Pillai, 1983, south Quseir area, X 0.75.
Fig. 2. *Seriatopora caliendrum* Ehrenberg, 1834, north Bernice area, X1.25.
Fig. 3. *Acropora valenciennesi* (Milne Edwards and Haime), 1860, north Bernice area, X1.
Fig. 4. *Acropora hemprichii* Ehrenberg, 1834, south Safaga area, X 0.75.
Fig. 5. *Acropora valida* (Dana), 1846, Hamatah area, X1.**Fig. 6.** *Acropora latistella* (Brook), 1892, north Bernice area, X1.
Fig. 7. *Acropora robusta* (Dana), 1846, Wadi Gasus, Safaga area, X0.6.
Bar scale = 20mm

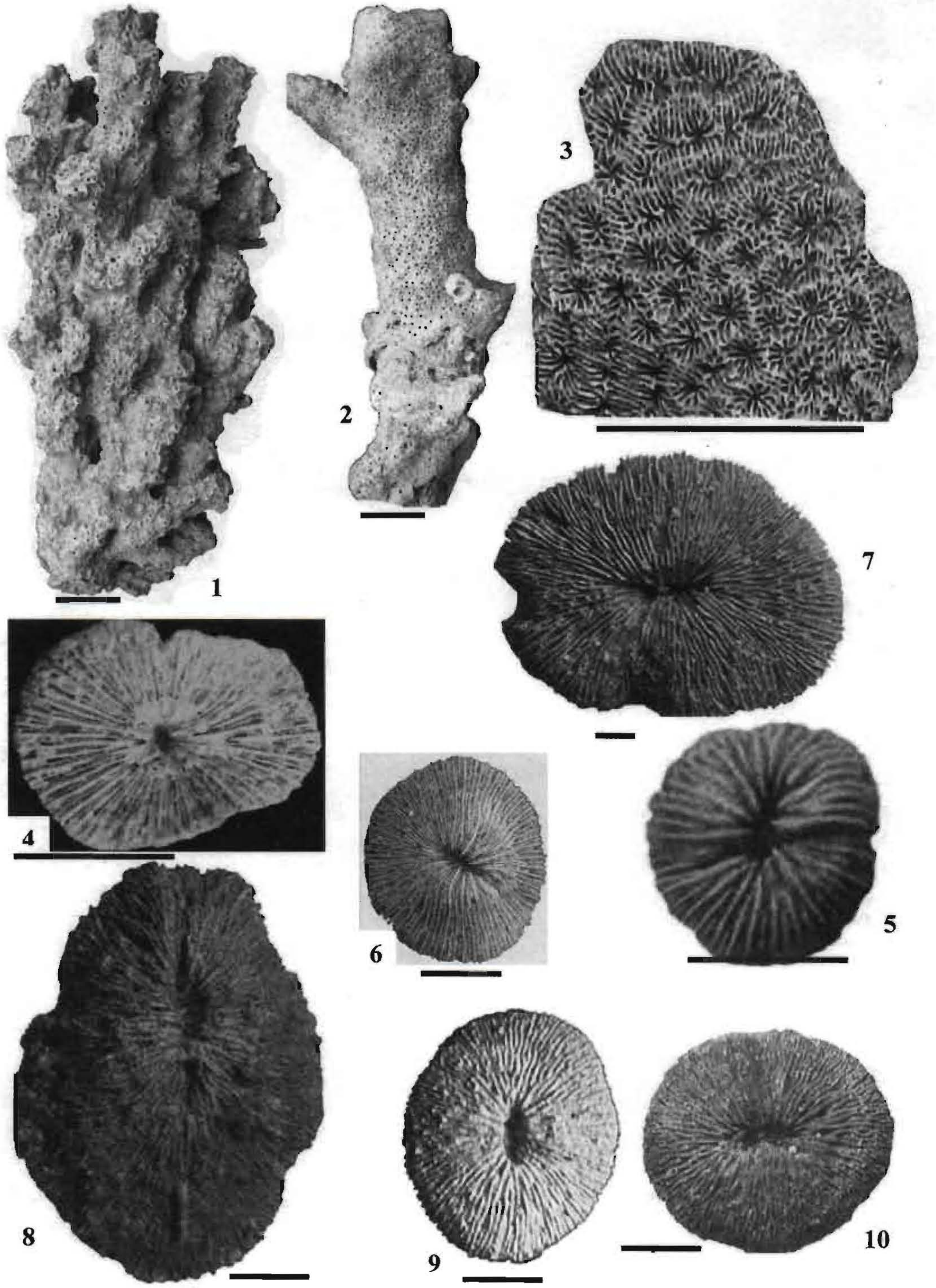

Plate 4:
Fig. 1. *Acropora tutuilensis (Hoffmeister, 1925), Wadi Syatin area, X 0.6.*
Fig. 2. *Acropora intermedia* (Brook, 1891), Wadi Syatin area, X 0.6.
Fig. 3. *Coscinaraea columna* (Dana, 1846), North Bernice area, X 2.5.
Fig. 4. *Cycloseris patelliformis* (Boschma, 1923), Abu Soma area, X 1.5.
Fig. 5. *Cycloseris erosa* (Doederlein, 1901), Wadi Syatin, North Quseir area, X 1.5.
Fig. 6. *Cycloseris cyclolites* (Lamarck, 1801), North Bernice area, X 0.75.
Fig. 7. *Fungia (Pleuractis) paumotensis* (Stuchbury, 1833), Wadi Gasus, Safaga area, X 0.75.
Fig. 8. *Fungia (Pleuractis) moluccensis* (Horst, 1919), Wadi Gasus, , X 0.75.
Fig. 9. *Fungia (Verrillofungia) granulosa* (Klunzinger, 1879), Mersa El-Helog area, X 0.75.
Fig. 10. *Fungia (Verrillofungia) concinna* Verrill, 1864, North Bernice area, X 0.75.
Bar scale = 20mm

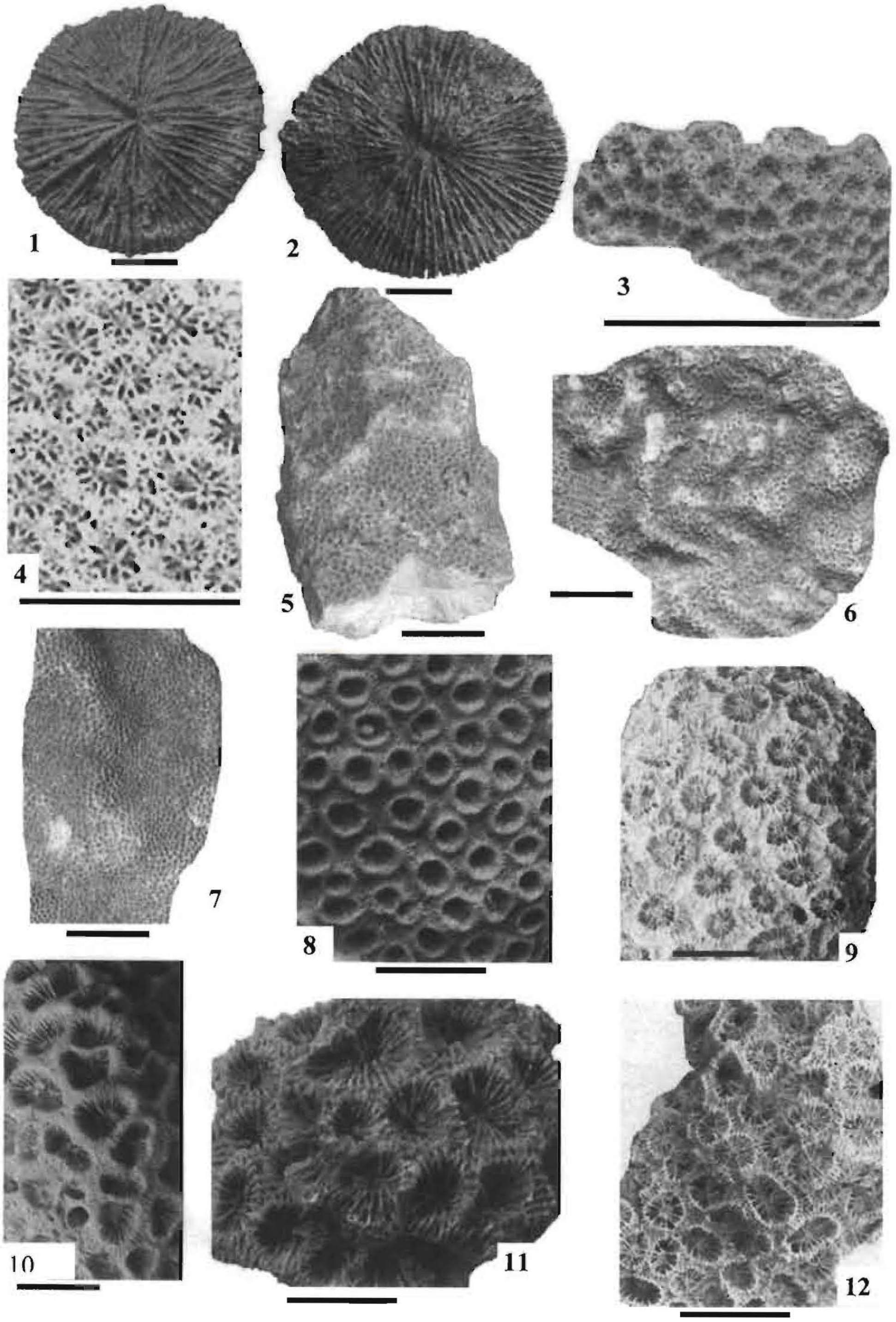

Plate 5:

Fig. 1. *Fungia (Danafungia) danai* (Edwards and Haime, 1851), Mersa Shagra area, X 0.6.

Fig. 2. *Fungia (Danafungia) klunzingeri* (Doederlein, 1901), Abu Soma area, X 0.6.

Fig. 3. *Goniopora planulata* **(Ehrenberg, 1834), North Bernice, X 2.5.**

Fig. 4. *Goniopora minor* **(Crossland, 1952), Wadi Quseir El- Kadium area, X 1.5.**

Fig. 5. *Porites nodifera* (Klunzinger, 1879), Abu Soma area, X 0.75.

Fig. 6. *Porites (Synaraea) undulata* (Klunzinger, 1879), North Bernice, X 0.75.

Fig. 7. *Porites compressa* (Dana, 1846), Sharm El- Bahari area, X 0.75.

Fig. 8. *Favia laxa* (Klunzinger, 1879), Gasus area, X 1.

Fig. 9. *Favia helianthoides* (Wells, 1954), North Mersa Alam area, X 0.75.

Fig. 10. *Favia lacuna* (Veron, Turak, & De Vantier 2000), Abu Soma area, X 0.75.

Fig. 11. *Favia rotumana* (Gardiner, 1898), Wadi Zraieb, X 1.

Fig. 12. *favia lizardensis* (Veron, Pichon, and Wijsman-Best, 1977), Mersa Mubarak area, X 1.

Bar scale = 20mm

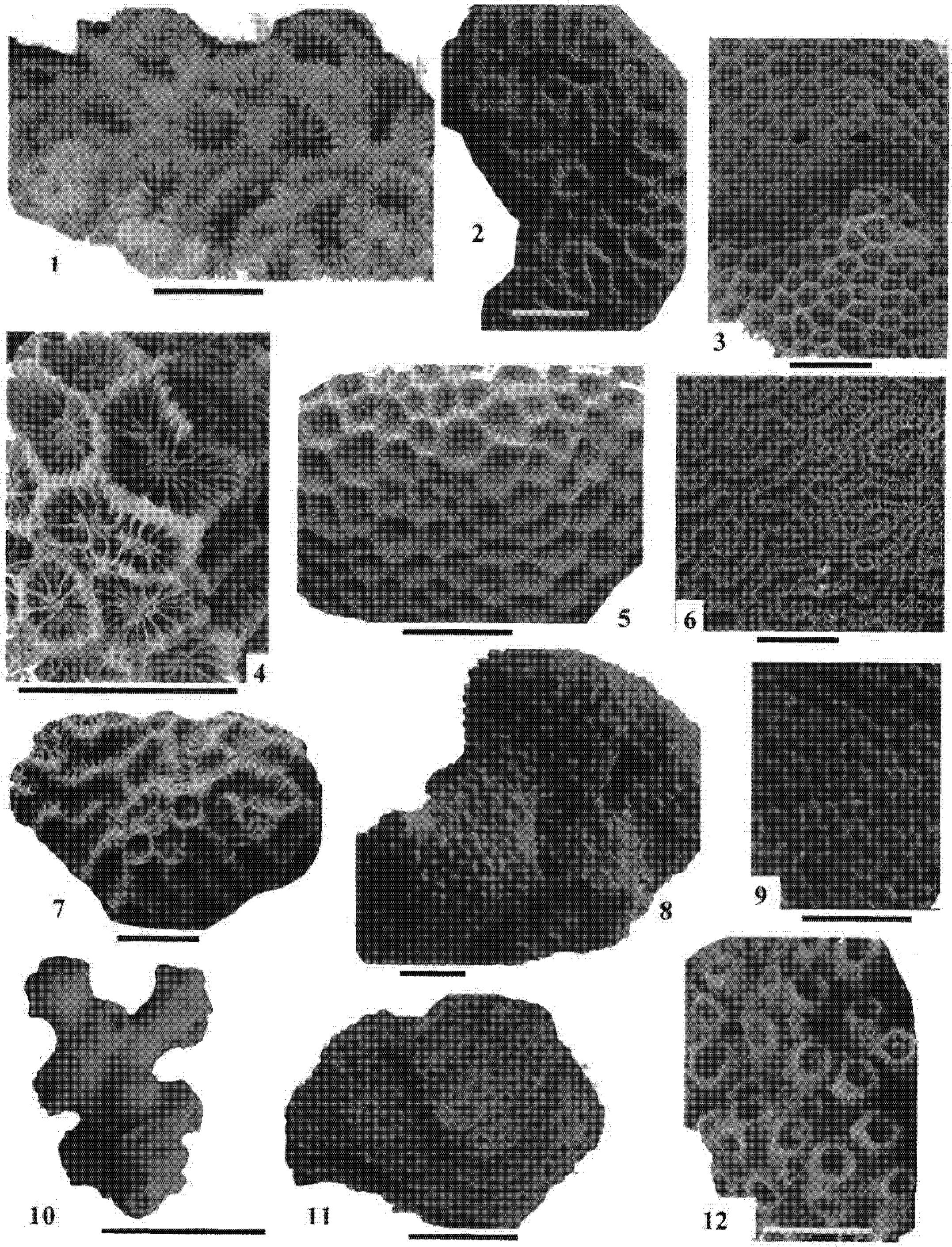

Plate 6

Fig. 1. *Favia danae* (Verrill, 1872), Abu Soma area, X1.
Fig. 2. *Favia veroni* (Moll, and Borel-Best, 1984), North Bernice, X 0.7.
Fig. 3. *Favites acuticollis* (Ortmann, 1889), Wadi Az- Zarib area, X 0.75.
Fig. 4. *Favites peresi* (Faure, & Pichon, 1978), Wadi Az- Zarib area , X 2.
Fig. 5. *Goniastrea aspera* (Verrill, 1905), North Bernice area, X 1.
Fig. 6. *Platygyra sinensis* (Edwards, & Haime, 1848), Deshet El- Dabaa area, X 0.75.
Fig. 7. *Platygyra crosslsndi* (Matthal, 1928), Ras Samadai area, X 0.75.
Fig. 8. *Hydnophora exesa* (Pallas 1766), North Bernice area, X 0.6.
Fig. 9. *Leptastrea transversa* (Klunzinger, 1879), Ras Samadai area, X1.
Fig. 10. *Echinopora fructiculosa* (Ehrenberg, 1834), Wadi Syatin area, X 1. 5.
Fig. 11. *Montastrea curta*, Gasus area, X 1.
Fig. 12. *Blastomussa merleti* (Wells, 1961), Wadi Quseir El- Kadium area, X 1.
Bar scale = 20mm

CONCLUSION

The Pleistocene coral reefs of the Red Sea coast occur in three stratigraphically sequences and form terraces of different elevations above the present sea level. Their morphology, biotic associations and sediments of these Pleistocene reefs are comparable to their recent counterparts. The depositional sequences of the lower and the upper reef units are transgressive, while the middle unit has a regressive facies pattern. This indicates a similar mode of formation with those in the northern Red Sea and the Gulf of Aqaba (Dull, 1990, Al-Rifaiy and Cherif 1988).

The vertical sequences of the lower and upper reefs start at the base with coral assemblages of coral rock zone. It is overlained by reef crest facies. It grades into the upper reef slope community. The sequence is overlained by sands and alluvial deposits in most of the studied sections. The depositional sequence of the middle reef shows shallowing upward. It starts with coral assemblage of upper reef slope community and overlain by reef crest facies, which grades into the coral rock zone. The sequence is finally capped in most sections by sands and alluvial fan deposits.

Eighty-eight scleractinian species have been identified from the studied reefs. They belong to 3 suborders, 8 families, and 27 genera. The range of the majority of the studied species, which have been previously recorded from the Recent sediments of the study area are extended here to the Pleistocene. The paleo-and-biogeographic distribution of the studied species indicated that all belong to Indo-Pacific affinity as well as Atlantic-Mediterranean for very few.

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