

Scleractinia of Taiwan (IV): Review of the Coral Genus *Acropora* from Taiwan

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Carden C. Wallace and Chang-Feng Dai (1997) Scleractinia of Taiwan (IV): Review of the coral genus *Acropora* from Taiwan. *Zoological Studies* 36(4): 288-324. The coral genus *Acropora* is reviewed from Taiwan for the first time. Forty species belonging to the coral genus *Acropora* occurring in waters of Taiwan are briefly described and illustrated. The *Acropora* fauna of Taiwan is seen to come from an essentially Pacific Ocean or broad Indo-Pacific fauna: all 40 species found also occur on the Pacific coast of Australia; 2 species (*Acropora verweyi* and *A. azurea*) are not found in the central Indo-Pacific (Indonesian) region, although *A. verweyi* is also found in the western Indian Ocean. The dominant species in the Taiwan Straits, *Acropora formosa*, occurs in extensive polymorphic populations, which invite further exploration of species boundaries within this species in this locality. The 40 species of *Acropora* herein recorded from Taiwan show an 89% similarity in species composition compared with 49 species recorded from islands in the Capricorn group of SE Australia, which is at a similar latitude south. The *Acropora* fauna of Taiwan is seen to be less diverse compared with 74 species recorded from Japan to the north, 67 species recorded from the Philippines to the south; 83 species recorded from Indonesia, and 51 species recorded from the South China Sea. This variation is possibly due to differences in sampling effort and species interpretation; however, differences in the areas of reef available for colonization, and fewer types of reef habitat within Taiwanese waters, would also imply that many species recorded from those other localities will not be found in Taiwan.

Key words: *Acropora*, Scleractinia, Taxonomy, Taiwan.

Among the Scleractinia (Cnidaria: Anthozoa), the genus *Acropora* contains the largest number of species, occurs in all tropical oceans, and dominates most reef habitats (Wallace and Willis 1994). Species of *Acropora* are also highly polymorphic and have always carried problems of identification. The taxonomy of *Acropora* has been revised twice in recent years, with reference primarily to eastern Australian species (Wallace 1978, Veron and Wallace 1984). These works established criteria for synonymising species names representing variants within species that are recognizable as morphologically continuous in the field. As a part of a series of revisions of the scleractinian fauna of Taiwan, this review examines collections made in the process of this research as well as during field work conducted in 1993 specifically to examine the species composition of *Acropora* on reefs of Taiwan.

sition of *Acropora* on reefs of Taiwan.

The coral genus *Acropora* has been reported from Taiwan by several authors (e.g., Kawaguti 1942 1953, Ma 1959, Jones et al. 1972, Yang et al. 1975). Most of the previous records are in the form of species checklists compiled from field surveys or coral collections. Kawaguti (1953) listed 35 species and Ma (1959) gave illustrations of 27 species of *Acropora* from Taiwan. Jones et al. (1972) recorded 33 *Acropora* species from the reefs in southern Taiwan and Yang et al. (1975) listed 19 *Acropora* species from Hsiao-Liuchiu, an island off southwest Taiwan. However, due to the confused status of species identification at that time, the species lists provided by the previous authors include some synonyms and the validity of some species identification is doubtful.

Following documentation of the reef coral com-

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munities of Taiwan (Dai 1989, Hoeksema and Dai 1991, Dai 1993), studies of physiology, life histories, and population biology of the corals of Taiwan have flourished. Much of this research includes species of the large genus *Acropora* (Fang et al. 1989 1991, Dai 1991, Dai et al. 1992). However, the identification of *Acropora* species is still a problem and needs to be clarified. The purpose of this paper is to clarify the identity of species of *Acropora* occurring on Taiwan's reefs, to indicate their patterns of distribution, and to provide a guide to laboratory and field identification of the species. A total of 40 species are briefly described and illustrated herein. As research efforts on Taiwan's reefs continue, further records of additional species could be expected.

Collections examined are lodged in the Museum of Tropical Queensland, Australia (MTQ), the Institute of Oceanography at National Taiwan University (TUIO), and the National Museum of Marine Biology and Aquarium in Kaohsiung.

MATERIALS AND METHODS

Specimens

This revision of the coral genus *Acropora* from Taiwan waters is based mainly on field research and collections made during the Workshop on Reef Coral Identification and Taxonomy, Institute of Marine Biology, National Sun Yat-sen University, Kaohsiung, 1993 (Wallace and Wolstenholme 1993) supported by the National Science Council, R.O.C. As a part of this workshop, field surveys were made at the Penghu Islands off the southwestern coast in the Taiwan Strait and Nanwan (South Bay) in southern Taiwan, respectively (see Fig. 1). Additional field surveys were made at Shenao in northern Taiwan, Maoao in northeastern Taiwan, and Lutao (Green Island) off southeastern Taiwan (see Fig. 1) by the junior author, both before and after the Workshop. These localities were selected to represent the *Acropora* fauna of Taiwan.

Previous surveys have shown that scleractinians are found in all the waters around Taiwan except in the sandy area on the west coast (Randall and Cheng 1977). The main reef area is around the southern tip of the island, the Hengchun Peninsula where well-developed fringing reefs are found (Jones et al. 1972, Dai 1991). These reefs are characterized by diverse and abundant scleractinians and alcyonaceans. Field surveys were conducted at 3 sites in Nanwan Bay. Additional collections made at other localities were also studied. Coral reefs and

coral communities are also well-developed around offshore islands including Lutao (Green Island), Lanyu (Orchid Island), and Penghu (the Pescadores). Lutao and Lanyu, located southeast off Taiwan, are in the pathway of the warm Kuroshio current. These reefs are densely covered by abundant scleractinians and alcyonaceans and their *Acropora* fauna are very similar. Three sites at Lutao were surveyed. The Penghu Islands are a cluster of 64 islands located about 50 km west of Taiwan in the Taiwan Strait. Coral communities dominated by scleractinian corals are widely distributed in the shallow subtidal areas of these islands. Field surveys were conducted at sites on the northern and southern reefs of the Penghu Islands. The northern, northeastern, and eastern rocky coasts of Taiwan have flourishing or patchy coral communities, but reef development is generally absent. These coral communities are dominated by scleractinians (mainly Faviidae and Pectiniidae) and only a few *Acropora* species can be found. Two localities, Shenao and Maoao, were selected for field survey.

Coral colonies were photographed in the field using an underwater camera (Nikonos V and SB

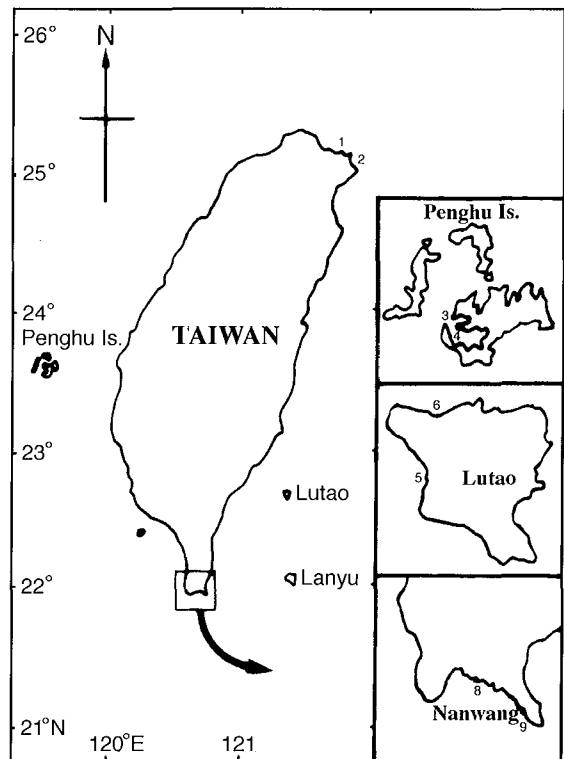


Fig. 1. Map of Taiwan, indicating sites (1-9) where specimens are recorded. 1: Shenao, 2: Maoao, 3: Fenguei, 4: Chinwan, 5: Nanliao, 6: Chaikochiao, 7: Haisenping, 8: Tiaoshi, 9: Hsiangchiawan.

103) and a portion of each colony was collected during dives made at the study sites. A set of specimens was deposited in the Museum of Tropical Queensland (MTQ), Australia, and duplicates of these specimens were deposited in the National Museum of Marine Biology and Aquarium, Kaohsiung, and in the Institute of Oceanography, National Taiwan University (TUIO), Taipei. The MTQ specimens were registered onto that Museum's RBASE database and compared with specimens from the "AIMS Monograph" reference coral collection (Veron and Wallace 1984), located at MTQ. Specimens were examined by light microscopy using a Wild M8 microscope with eyepiece graticule and lit by fiber-optic lighting. Skeletal dimensions are based on those given in Veron and Wallace (1984), and modified to incorporate any variations seen in the Taiwan specimens. Electron micrographs were taken using a Phillips XL20 scanning electron microscope at James Cook University, Townsville, Australia.

Taxonomic arrangement and descriptions

Groupings of species defined in Veron and Wallace (1984) and Wallace (1994) are used here. Some of these species groups have a unique character and are thought to be monophyletic, but others are not clearly defined as monophyletic.

Synonymies are based on those given in Veron and Wallace (1984), with the addition of page reference details and the omission of any references other than to the original description. An exception to this is when the original author redescribed a spe-

cies, e.g., for Brook (1893) following Brook (1891 or 1892).

Descriptions given in this paper are brief, since no new species are defined. Further details of skeletal variation within species from another 10 localities can be seen in Wallace (1978), Veron and Wallace (1984), Wallace and Wolstenholme (1993), and Wallace (1994). The illustrations in this paper are an important component of the descriptions, indicating the appearance of species on Taiwan's reefs, and the fine details of skeletal structure.

Terminology

The genus *Acropora* has the characters of the family Acroporidae (synapticulotheca, simple septa and no columella or dissepiments) and is defined by its mode of growth, in which a central or axial corallite extends and buds off subsidiary or radial corallites at branch tips (Wells 1956, Wallace 1978, Veron and Wallace 1984).

Growth form: The mode of growth leads to a variety of growth form options, so that characteristic growth forms of species are often difficult to define clearly. The colony shapes listed describe the usual shape of the colonies in the field (see Fig. 2).

Radial corallites: The shape of radial corallites is both difficult to define and variable. However a number of terms are used to describe the main shapes seen and these are illustrated in Fig. 3.

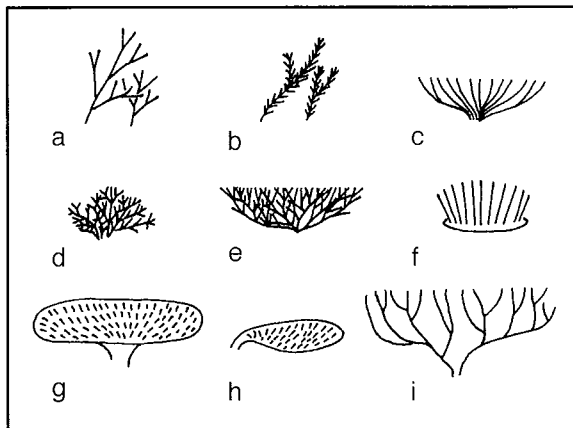


Fig. 2. Diagrammatic representation of colony shape categories used in text. a: arborescent, b: hispidose, c: corymbose, d: caespitose, e: caespito-corymbose, f: digitate, g: table, h: plate, i: arborescent table.

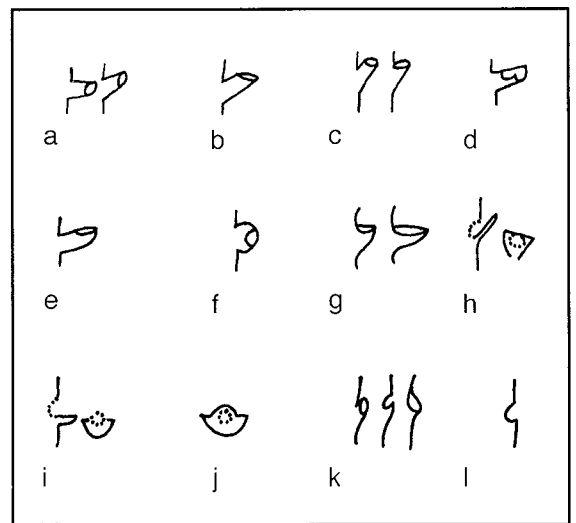


Fig. 3. Diagrammatic representation of corallite shape categories used in text. a: tubular, round opening; b: tubular, oblique opening; c: tubular, appressed; d: tubular, dimidiate opening; e: tubular, nariform opening; f: rounded tubular; g: nariform; h: labellate, scaly lip; i: labellate, flaring lip; j: cochleariform; k: subimmersed; l: immersed.

Some species exhibit a gradation from one shape to another (for example, from appressed tubular to nariform). Radial corallites can be very evenly sized and shaped, or irregular in these features, and this is sometimes used in character definition. A few species and, in particular, the *Acropora robusta* species group, exhibit dimorphism in radial corallites.

Coenosteum: In usual coral terminology, coenosteum refers to the skeletal material between the corallites. In *Acropora*, the material between the radial corallites is actually the wall of the axial corallite, however, by convention, the word "coenosteum" is used to describe the walls of the radial corallites and the material between them. The coenosteum can be the same on and between radial corallites (probably the plesiomorphic condition) or differentiated between the 2 locations. Coenosteal character states are given in Fig. 4.

RESULTS AND DISCUSSION

Forty species are recorded in this study. Among them, 35 species are recorded from the southern tip of Taiwan, 14 species from the Penghu Islands in the

Taiwan Strait, 22 species from Lutao off southeastern Taiwan, and 6 species from northern Taiwan.

Taiwan occupies a position on the western border of the Pacific Ocean, at the convergence of the Philippine and the Eurasian tectonic plates (Ho 1982). It is bisected by the Tropic of Cancer, making it equivalent latitudinally to the Capricorn group of islands at the southern end of the Great Barrier Reef. The 40 species of *Acropora* herein recorded from Taiwan compare with 49 species recorded from islands in the Capricorn group, SE Australia, which is at a similar latitude south (from specimen database, MTQ). The 2 locations show an 89% similarity in species composition, a major difference being the common occurrence of *A. solitaryensis* and rarity of *A. divaricata*, in Taiwan.

The 40 species recorded to date in Taiwan compare with 74 named species recorded from Japan to the north (Veron 1992, Nishihira and Veron 1995), 67 species recorded from the Philippines to the south (Nemenzo 1967 1971, Veron and Hodgson 1989); 83 species recorded from Indonesia (Wallace and Wolstenholme 1998), and 51 species recorded from the South China Sea (M. Collard collector, Museum of Tropical Queensland database and type

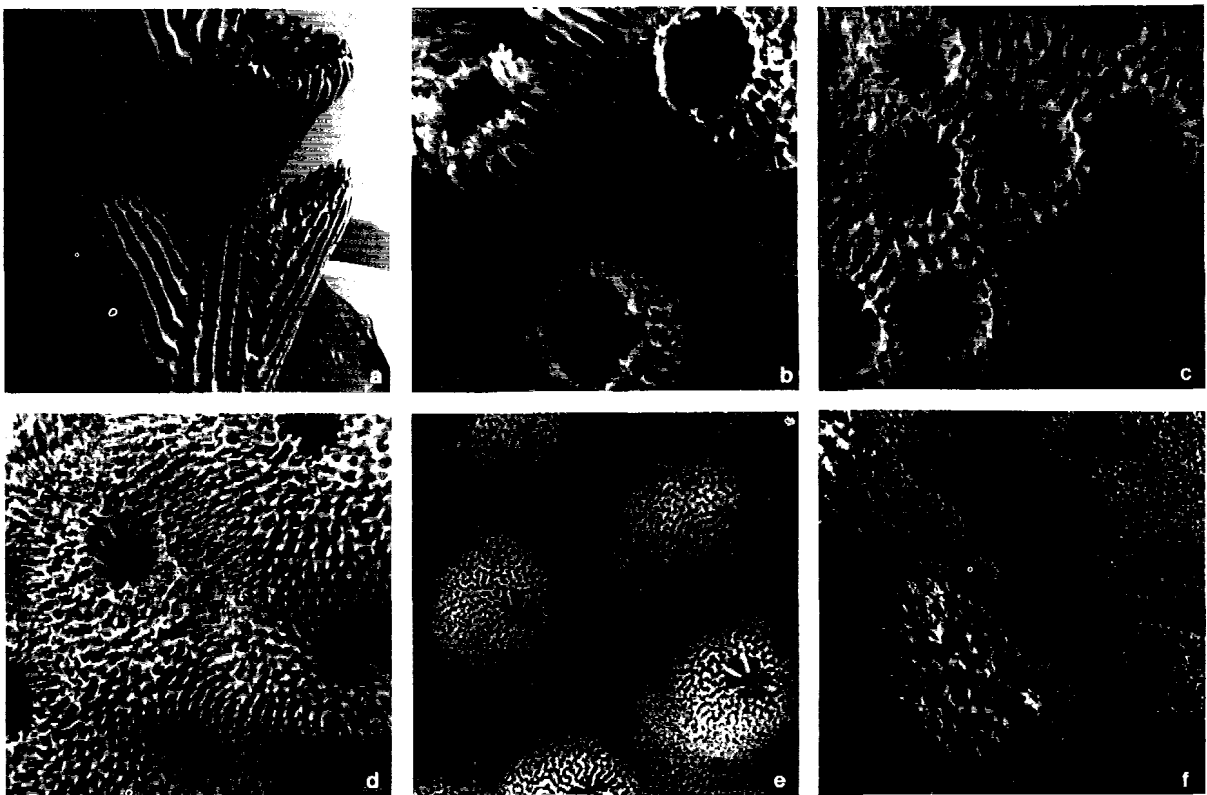


Fig. 4. Some coenosteum types mentioned in text. a: costate; b: reticulate; c: reticulate with simple spinules; d: evenly distributed spinules; e: a dense arrangement of spinules; f: a dense arrangement of elaborated spinules.

localities). These records are not strictly comparable because of (a) differences in sampling effort, the records from the Philippines, Japan and Indonesia being the most comprehensive; and (b) some differences in species interpretation among the works. The records herein should be regarded as preliminary, as more species may be found from greater sampling effort; however, differences in the areas of reef available for colonization, and fewer types of reef habitat represented within Taiwanese waters, would indicate that many species recorded from those other localities will not be found in Taiwan. For example, contained lagoons, barrier reefs, and deep slopes are rare in Taiwan, hence the considerable number of species that are typical to these habitats would not be expected to occur.

Although several species are, as yet, regarded as endemic to Japan (Nishihira and Veron 1995), the Philippines (Nemanzo 1967 1971), or Indonesia (Wallace 1994 1997, Wallace and Wolstenholme 1998), this paper has not described species endemic to Taiwan. This is to be expected, given the small overall area and reduced number of habitats in the region.

Family Acroporidae Verrill
Genus *Acropora* Oken, 1815

Type species: *Millepora muricata* Linnaeus, 1758

Subgenus *Acropora* Oken, 1815

Single axial corallite forms axis of branch. Coenosteum formed of spinules.

The *Acropora humilis* group

Radial corallites short tubular with dimidiate opening; coenosteum reticulate with simple spinules; colony corymbose or digitate or with a small amount of secondary branching.

***Acropora (Acropora) humilis* (Dana, 1846)**
(Figs. 5, 48)

Madrepora humilis Dana, 1846: p. 483, pl. 31, fig. 4; pl. 41, fig. 4.

Madrepora fruticosa Brook, 1892: p. 457; 1893: p. 138, pl. 18, fig. A.

Madrepora guppyi Brook, 1892: p. 458; 1893: p. 158, pl. 23, fig. D.

Madrepora spectabilis Brook, 1892: p. 462; 1893: p. 141, pl. 16, fig. B.

Madrepora obscura Brook, 1893: p. 129, pl. 32, fig. A.

Specimens: MTQ: G45814, Penghu; G45905, Penghu, Fenguei; G35500, Nanwan, Tiaoshi;

G45936, Lutao, Chaikochiao; TUIO: C7155, Penghu; C7156, Penghu, Fenguei; C7157, Lutao.

Diagnosis: Laboratory: Branches up to 30 mm diameter and tapering; axial corallite outer diameter 3.0-8.0 mm, inner diameter 1.0-1.6 mm, primary septa to 1/2 R, secondary septa to 1/4 R; radial corallites evenly distributed, short tubular with dimidiate openings and thickened walls, primary septa to 1/3 R, secondary septa incomplete, to 1/4 R; coenosteum a dense arrangement of laterally flattened elaborated spinules, sometimes formed into costae, throughout. *Field:* Sturdy, digitate to corymbose colonies with large obvious axial corallites; known colors cream, brown, blue, purple, cream with blue tips, yellow-green; found in reef top and upper slope habitats.

Remarks: This is a very variable species and specimens from Taiwan reflect this; the Penghu specimens, in particular, have very thick-walled, crowded radial corallites and relatively thin and elongate branches.

***Acropora (Acropora) gemmifera* (Brook, 1892)**
(Figs. 6, 49, 50)

Madrepora gemmifera Brook, 1892: p. 457; 1893: p. 142, pl. 21.

Madrepora australis Brook, 1892: p. 453; 1893: p. 155, pl. 23, fig. C.

Specimens: MTQ: G45843, Nanwan, Tiaoshi; G47592, G47611, Lutao, Chaikochiao; TUIO: C7158, Nanwan, Tiaoshi; C7159, C7160, Lutao, Chaikochiao.

Diagnosis: Laboratory: Branches up to 25 mm diameter and tapering; axial corallites outer diameter 2.8-4.2 mm, inner diameter 1.0-1.3 mm, primary septa to 3/4 R, secondary septa to 2/3 R; 2 sizes of radial corallites: larger radial corallites short tubular, with dimidiate openings and thickened walls, smaller radial corallites subimmersed, primary septa to 3/4 R, secondary septa incomplete to 1/4 R; coenosteum a dense arrangement of laterally flattened elaborated spinules, sometimes formed into costae, throughout. *Field:* Sturdy, digitate to corymbose colonies; large axial corallites and 2 distinct sizes of radial corallites are obvious; known colors cream, brown, blue, purple, cream with blue tips; found in reef top and upper slope locations.

Remarks: It is often difficult to distinguish between the 2 species *Acropora humilis* and *A. gemmifera* (see remarks in Wells 1954, Wallace 1978, Veron and Wallace 1984). For both of these species, the taxonomic resolution, including decisions about synonyms, is incomplete and is currently being examined (J. Wolstenholme, pers. comm.).

***Acropora (Acropora) samoensis* (Brook, 1891)**
(Figs. 7, 51)

Madrepora samoensis Brook, 1891: p. 468; 1893: p. 143, pl. 31, fig. A, pl. 6, fig. C.

Specimens: MTQ: G45807 -9, Nanwan, Tiaoshi; TUIO: C7161 -3, Nanwan, Tiaoshi.

Diagnosis: Laboratory: Caespito-corymbose with terete branches (same thickness throughout) up to 30 mm diameter; axial corallites outer diameter 3.0-4.5 mm, inner diameter 1.2-1.4 mm; radial corallites tubular with round to oblique or dimidiate openings, may be interspersed with immersed corallites; coenosteum. **Field:** Colony caespito-corymbose with frequent branching; radial corallites separate, not touching; known colors cream or pale brown; found in subtidal reef top, lagoonal, and upper slope situations.

Remarks: Radial corallites of the Taiwan specimens have thinner walls and more pointed outer walls to the radial corallites than specimens from elsewhere.

***Acropora (Acropora) digitifera* (Dana, 1896)**
(Figs. 8, 52, 53)

Madrepora digitifera Dana, 1846: p. 454.

Madrepora leptocyathus Brook, 1891: p. 463; 1893: p. 159, pl. 16, fig. C.

Madrepora brevicollis Brook, 1892: p. 454; 1893: p. 159, pl. 27, figs. A, B.

Madrepora baeodactyla Brook, 1892: p. 453; 1893: p. 158, pl. 13, figs. A, B.

Acropora wardii Verrill, 1902: p. 248, pl. 36, fig. 13, pl. 36B, fig. 4, pl. 36F, fig. 4.

Specimens: MTQ: G45816 -7, Penghu; G35492, Nanwan; TUIO: C7164, Penghu.

Diagnosis: Laboratory: Corymbose, branches moderately tapering, up to 20 mm diameter; axial corallites outer diameter 2.8-3.8 mm, inner diameter 0.8-1.6 mm, primary septa to 2/3 R, secondary septa incomplete to 1/4 R; radial corallites dimidiate, evenly arranged closely together with thickened walls and little or no inner wall so that lower wall looks like a lip; primary septa to 3/4 R, secondary septa incomplete to 1/4 R; coenosteum a dense arrangement or laterally flattened spinules, sometimes formed into costae, throughout. **Field:** Colonies digitate to corymbose; branches short and thin relative to those of other members of group; radial corallites closely arranged on branches; known colors cream or pale brown, usually with blue tips; found in intertidal reef top locations.

Remarks: Specimens from Penghu are irregular in colony shape with some long branches and

thicker than usual radial corallite walls (see Fig. 8).

The *Acropora lovelli* group

Radial corallites evenly sized and shaped, appressed rounded tubular with large round openings; coenosteum containing unelaborated spinules and similar on and between radial corallites; colony shape variable.

***Acropora (Acropora) verweyi* Veron and Wallace, 1984**

(Figs. 9, 54)

Acropora verweyi Veron and Wallace, 1984: p. 192, fig. 446, p. 193, figs. 449, 450, p. 94, fig. 453.

Specimens: MTQ: G43851, Nanwan, Tiaoshi; G45915 -6, Maoao; TUIO: C7156 Nanwan, Tiaoshi; C7167, Maoao.

Diagnosis: Laboratory: Caespitose, with branches terete, to 9 mm diameter; axial corallites outer diameter 2.8-3.5 mm, inner diameter 0.8-1.1 mm, primary septa to 3/4 R, secondary septa present to 1/2 R or reduced and incomplete; radial corallites evenly sized, tubular appressed with round openings, wall around opening a little thickened; primary septa to 1/4 R, secondary septa absent or a few just visible as points; coenosteum evenly distributed simple spinules throughout. **Field:** Small, irregular caespitose colonies up to 30 cm diameter, with obvious radial corallites because of wide open calices and thickened walls; known color cream or pale brown with yellow or purple axial polyps; found mostly in reef top habitats.

Remarks: This species tends to occur within a limited reef zone toward the seaward edge of reef tops, where it can be quite common. Its geographic distribution is unusual: although found extensively on reef flats throughout the Pacific Ocean, South China Sea, Seychelles, Western Australia (MTQ collection), Thailand, and Vietnam (Veron 1993), this species has not been recorded from over 140 site samples throughout the Indonesian archipelago (Wallace and Wolstenholme 1998).

***Acropora (Acropora) glauca* (Brook, 1893)**
(Figs. 10, 55)

Acropora glauca Brook, 1893: p. 164, pl. 34, fig. D.

Specimens: MTQ: G45794 -7, G45802 -3, G45847, G47606, Penghu; G47612, Lutao, Chai-kochiao; TUIO: C7168 -9, Penghu; C7170, Lutao.

Diagnosis: Laboratory: Corymbose with branches short and terete up to 16 mm in diameter; axial

corallites outer diameter 3.1-4.1 mm, inner diameter 1.0-1.3 mm, primary septa to 3/4 R, secondary septa to 2/3 R, occasionally a 3rd cycle is partially developed; radial corallites evenly distributed, equal in shape and size, appressed rounded tubular with large round openings, primary septa to 3/4 R, secondary septa to 1/2 R; coenosteum reticulate or finely costate throughout. **Field:** Colonies corymbose to anastomosed corymbose plates with side to central attachment; radial corallites very evenly shaped and arranged; known color pale cream, brown, or dark green; found on reef tops and upper slopes.

Remarks: Records indicate that this species is restricted to fringing reefs: it is not present on barrier reefs in eastern Australia (Veron and Wallace 1984) but is found on coastal reefs in western, north (Darwin region), and eastern Australia, as well as Japan and reefs of the South China Sea (Veron and Wallace 1984, Veron 1993, MTQ database). It is a common species on reefs of Taiwan.

The *Acropora robusta* group

Radial corallites dimorphic: long tubular corallites with dimidiate openings interspersed with sub-immersed forms; coenosteal structure dimorphic: costate on radials, reticulate between; colony shape variable.

Acropora (Acropora) robusta (Dana, 1846) (Figs. 11, 56)

Madrepora robusta Dana, 1846: p. 475, pl. 39, figs. 3, 3a, pl. 31, figs. 3a, b, c.

Madrepora conigera Dana, 1846: p. 440, pl. 32, figs. 1, 1a.

Madrepora pacifica Brook, 1891: p. 465; 1893: p. 39, pl. 30, fig. B.

Madrepora ambigua Brook, 1892: p. 451; 1893: p. 70, pl. 8, fig. C.

Madrepora decipiens Brook, 1892: p. 456; 1893: p. 51, pl. 14, figs. B to D.

Madrepora smithi Brook, 1893: p. 34, pl. 26, fig. B.

Madrepora brooki Bernard, 1900: p. 120.

Acropora ponderosa Nemenzo, 1967: p. 57, pl. 20, figs. 3, 4.

Specimens: MTQ: G45841, Nanwan, Tiaoshi; TUIO: C7171, Nanwan, Tiaoshi.

Diagnosis: Laboratory: Branches arborescent to digitate (depending on position in colony), 10 to 40 mm diameter; axial corallites outer diameter 2.1-3.5 mm, inner diameter 0.5-1.5 mm, primary septa to 3/4 R, secondary septa to 1/3 R; radial corallites dimorphic: long tubular corallites with dimidiate openings are interspersed with subimmersed forms: dimorphism not obvious on digitate central branches, but distinctive towards branch tips; coenosteum dimorphic: costate on radials, reticulate between. **Field:** Sturdy low arborescent colonies with

digitate central branches and curving peripheral branches; known colors green with pink branch tips or pale brown; found on shallow reef tops and edges.

Remarks: This is a common Indo-Pacific coral which does not vary greatly throughout its range.

Acropora (Acropora) danai (Edwards and Haime, 1860) (Figs. 12, 57)

Madrepora deformis Dana, 1846: (non Michelin) p. 484, pl. 43, fig. 1.

Madrepora danai Edwards and Haime, 1860: p. 560.

Madrepora danae Verrill, 1864: p. 41.

Madrepora irregularis Brook, 1892: p. 458; 1893: p. 50, pl. 14, figs. E, F.

Madrepora rotumana Gardiner, 1898: p. 258, pl. 23, fig. 2.

Specimens: MTQ: G45810, Nanwan, Tiaoshi; TUIO: C7172, Nanwan, Tiaoshi.

Diagnosis: Laboratory: Broad branches extend horizontally and proliferate into small, fused branchlets distally, some upright branches at center of colony; axial corallites outer diameter 2.0-2.5 mm, inner diameter 0.7-1.2 mm, primary septa to 2/3 R, secondary septa to 1/4 R; radial corallites dimorphic: long tubular corallites with dimidiate openings are interspersed with subimmersed forms: dimorphism most obvious towards edge of colony, primary septa to 1/3 R, secondary septal cycle incomplete or absent, to 1/4 R; coenosteum dimorphic: costate on radials, reticulate between. **Field:** Colonies consist of thick main branching units which proliferate distally as short branchlets; known colors brown or pinkish-brown; found on shallow reef tops and edges.

Remarks: This species co-occurs with *A. robusta*; the 2 species are very similar in all characters except the proliferation of small branches at the branch tips in *A. danai*, and *A. danai* never has the green/pink coloration seen in many *A. robusta* colonies.

Acropora (Acropora) intermedia (Brook, 1891) (Figs. 13, 58)

Madrepora intermedia Brook, 1891: p. 463; 1893: p. 31, pl. 1, fig. C.

Acropora vanderhorsti Hoffmeister, 1925: p. 70, pl. 18, fig. 2.

Specimens: MTQ: G43838, G43846, Nanwan, Tiaoshi; G47617, Nanwan; G47580, Lutao, Haisenping; G47599, Lutao, Chaikochiao; G45947, Lutao, Nanliao; TUIO: C7173 -4, Nanwan, Tiaoshi; C7175, Lutao, Haisenping; C7176, Lutao, Chaikochiao, C7177, Lutao, Nanliao.

Diagnosis: Laboratory: Arborescent branches

given off at wide angles (45° to 90°), up to 25 mm diameter and tapering gradually; axial corallites outer diameter 2.5-4.0 mm, inner diameter 0.8-1.1 mm, primary septa to $2/3$ R, secondary septa to $1/4$ R; radial corallites

dimorphic: long tubular radial corallites with dimidiate or oblique openings primary septa to $2/3$ R, secondary septa to $1/4$ R; between these are immersed corallites in which septa are hardly

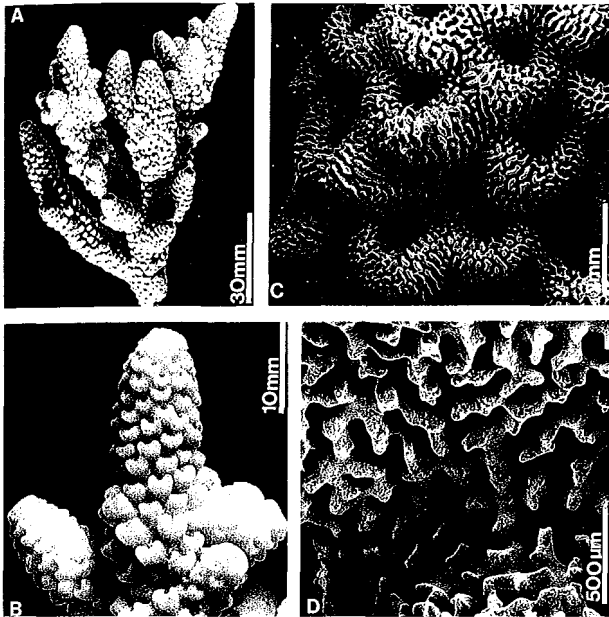


Fig. 5. *Acropora (Acropora) humilis*, G45905: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

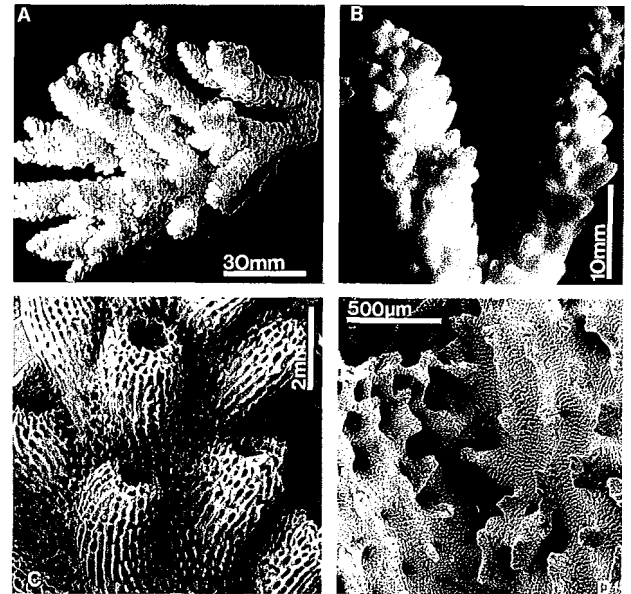


Fig. 7. *Acropora (Acropora) samoensis*, G45808: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

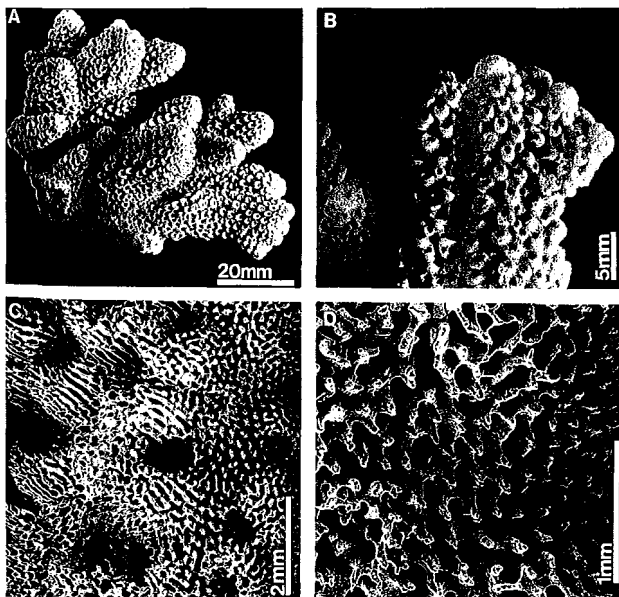


Fig. 6. *Acropora (Acropora) gemmifera*, G45843: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

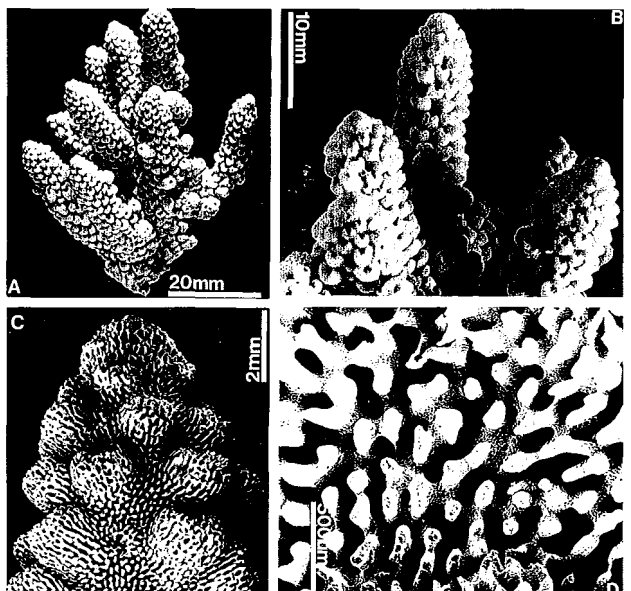


Fig. 8. *Acropora (Acropora) digitifera*, G45816: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

visible; coenosteum strongly costate on radial corallite walls, reticulate between corallites. **Field:** Arborescent, forming compact colonies or large thickets; radial corallite dimorphism and dimidiate openings

of large radials clearly visible; known colors cream, brown, pale green, or blue; found in most subtidal reef locations.

Remarks: This species was recorded as *Acro-*

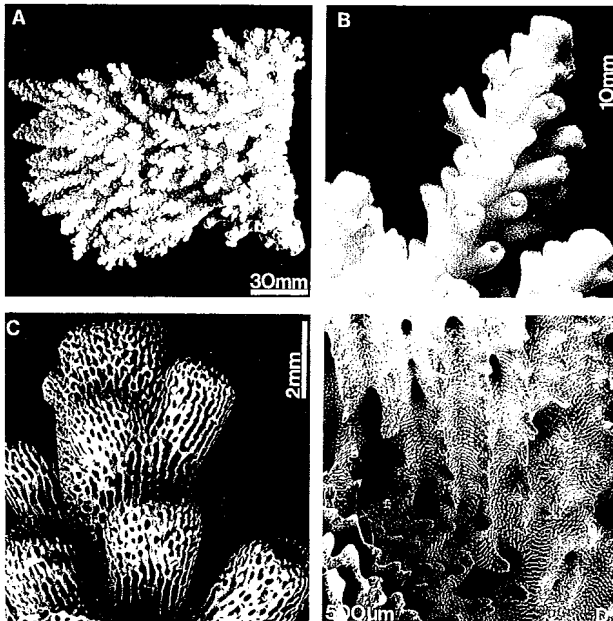


Fig. 9. *Acropora (Acropora) verweyi*, G43851: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

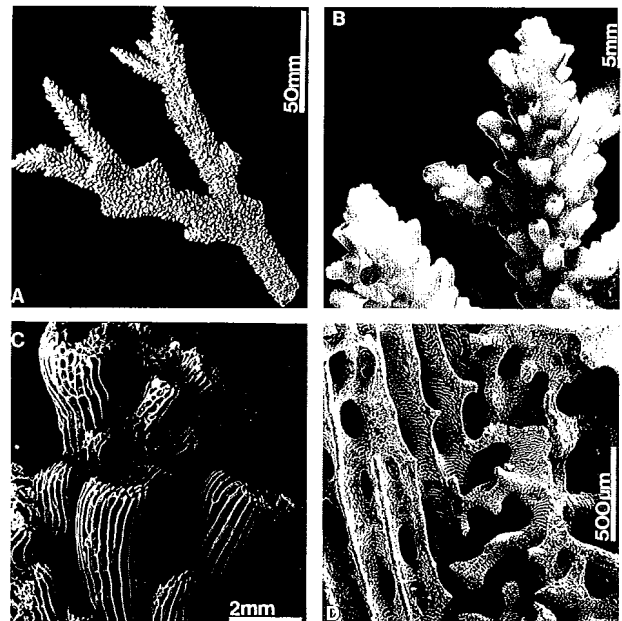


Fig. 11. *Acropora (Acropora) robusta*, G45641: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

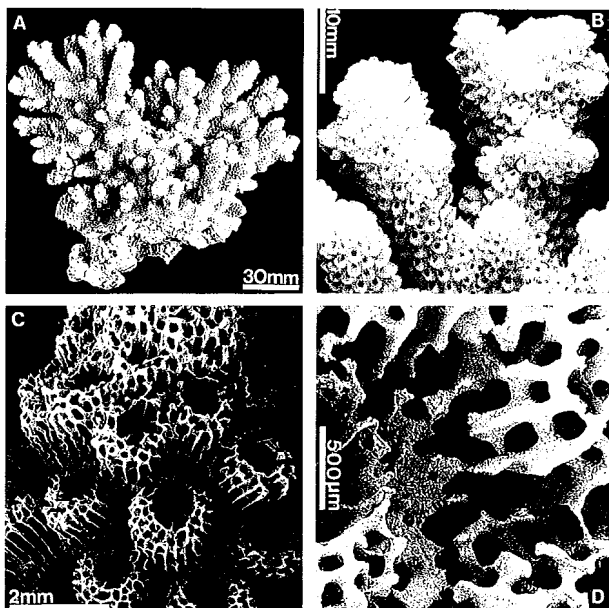


Fig. 10. *Acropora (Acropora) glauca*, G45803: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

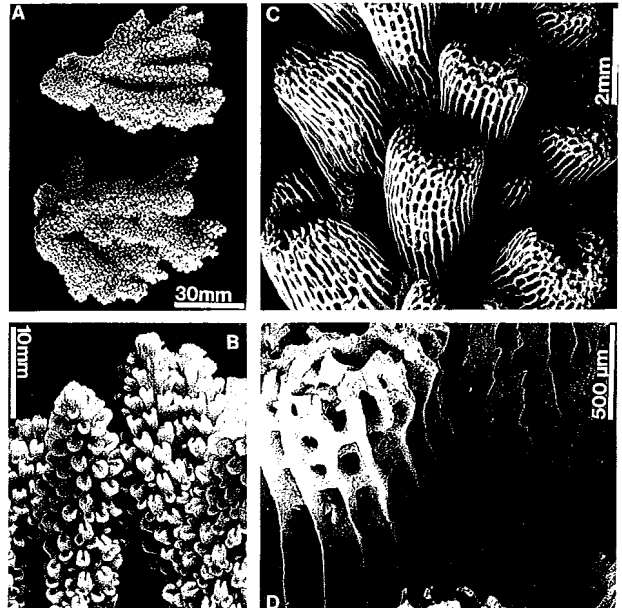


Fig. 12. *Acropora (Acropora) danai*, G45810: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

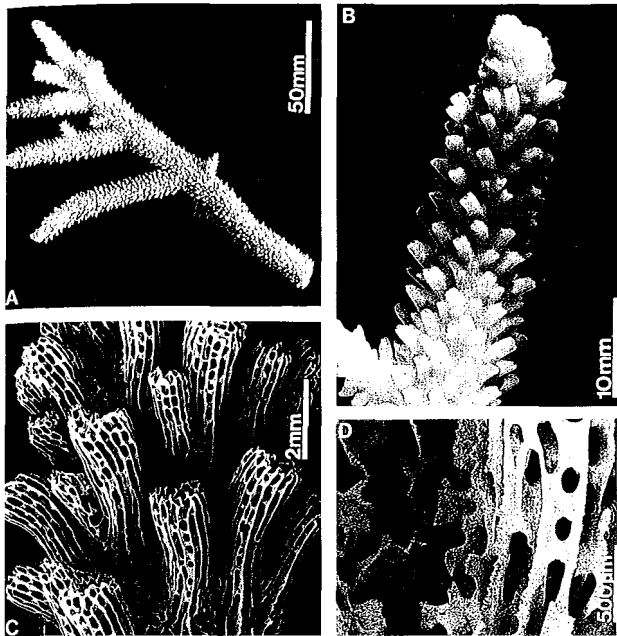


Fig. 13. *Acropora (Acropora) intermedia*, G43846: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

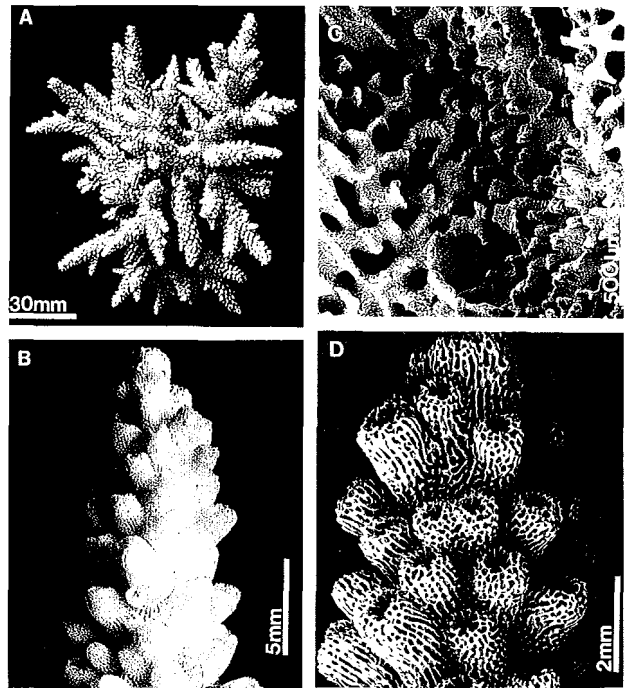


Fig. 15. *Acropora (Acropora) formosa*, G45774: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing coenosteum between radial corallites; (D) electron micrograph showing radial corallites.

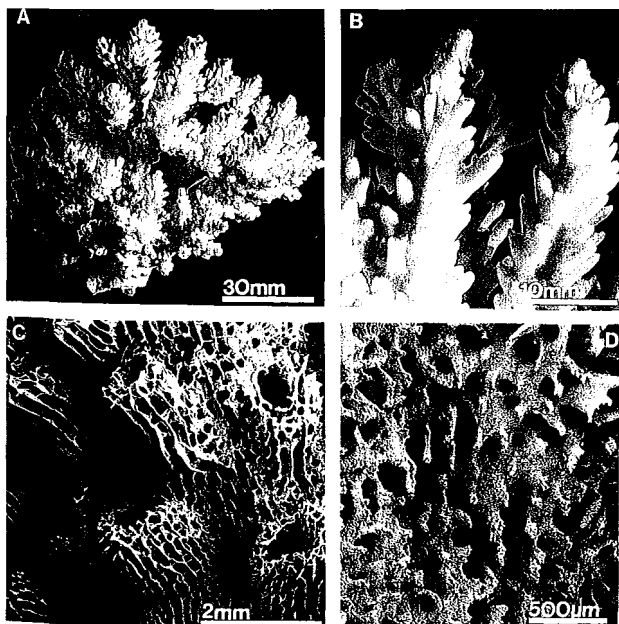


Fig. 14. *Acropora (Acropora) listeri*, G35494: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

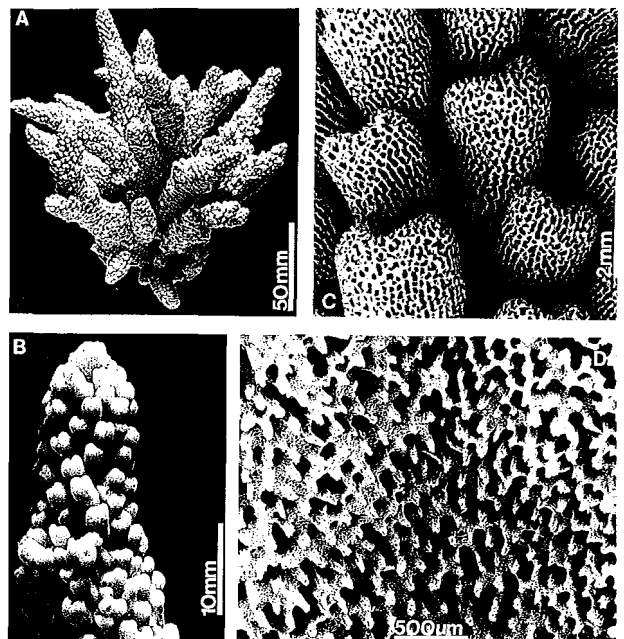


Fig. 16. *Acropora (Acropora) formosa*, "sturdy form", G45787: (A) portion of colony; (B) portion of branch; G45786: (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

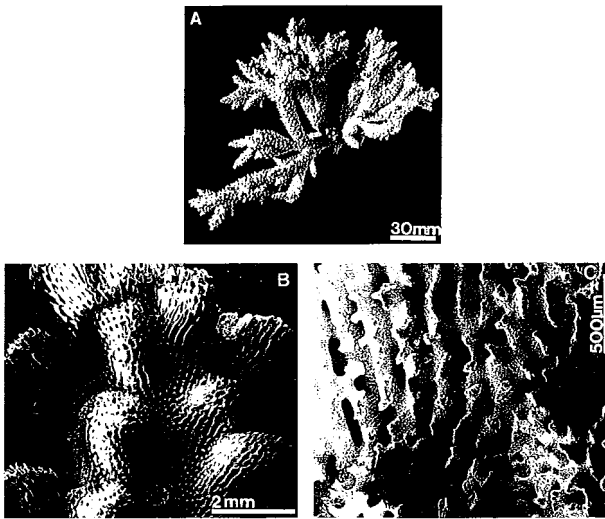


Fig. 17. *Acropora (Acropora) formosa*, "elseyi form", G45778: (A) portion of colony; (B) electron micrograph showing radial corallites; (C) electron micrograph showing coenosteum between radial corallites.

pora nobilis (Dana, 1846) by Veron and Wallace (1984, p. 214). It is returned to its former status (as used in Wallace 1978, p. 280) following re-examination of the type material of *A. nobilis* in the USNM. Both syntypes of *A. nobilis*, USNM 427 and 85752, are *A. robusta* group, but not of this species (This situation has been clarified by lectotypification in Wallace 1996). The holotype of *A. vanderhorsti*, USNM 68205, has also been re-examined and we confirm that species to be a junior synonym.

Many of the colonies from Taiwan do not always have the distinctive dimidiate openings to the radial corallites that are usual in this species: instead, most long radials have oblique openings, so that the colonies may be easily confused with *A. formosa*. This characteristic is also seen in *A. intermedia* from Indonesian waters (Wallace and Wolstenholme 1998). The specimen G47617 is only tentatively included with *A. intermedia* as it has very scale-like radial corallites with only occasional immersed corallites.

***Acropora (Acropora) listeri* (Brook, 1893)**
(Figs. 14, 59)

Madrepora listeri Brook, 1893: p. 53, pl. 30, figs. C, D.

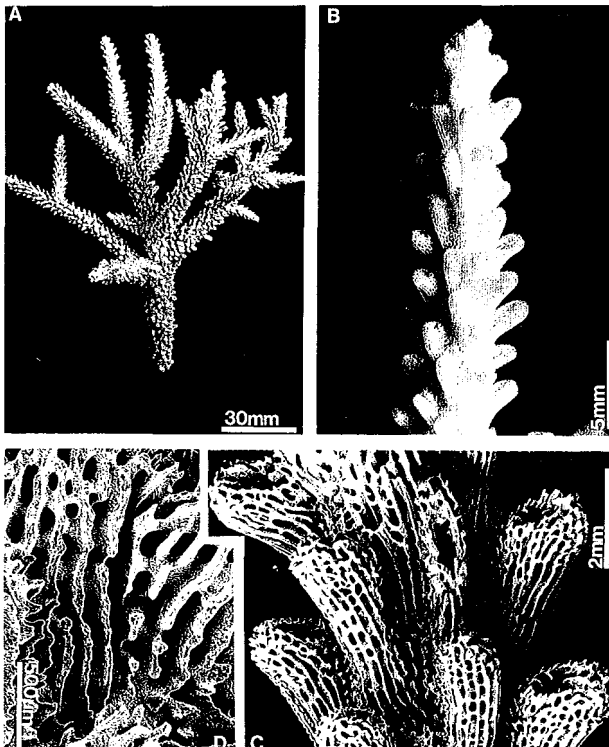


Fig. 18. *Acropora (Acropora) acuminata*, G45834: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

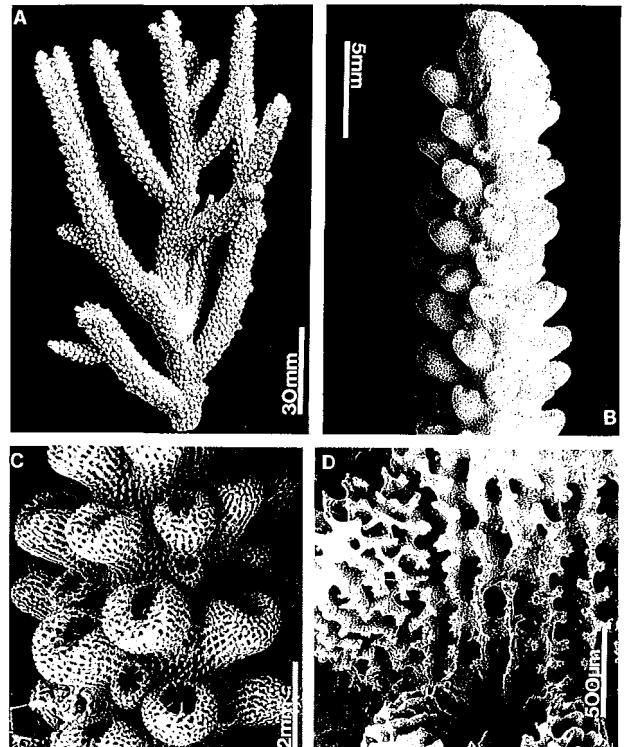


Fig. 19. *Acropora (Acropora) valenciennesi*, G45903: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

Specimens: MTQ: G47595, Lutao, Chaikochiao; G35493, Nanwan; G35494, Nanwan, Hsiangchiaowan; TUIO: C7178, Lutao, Chaikochiao.

Diagnosis: Laboratory: Branches irregular in size and may have incipient branchlets developed along them; axial corallites outer diameter 2.5–4.0 mm, inner diameter 0.8–1.0 mm; radial corallites dimorphic: long tubular radial corallites with dimidiate or oblique openings, primary septa to 2/3 R, secondary septa to 1/4 R; between these are immersed corallites in which septa are hardly visible; coenosteum strongly costate on radial corallite walls, reticulate between corallites. **Field:** Colonies irregular subarborescent to corymbose; colony up to 0.5 m in diameter; known colors cream or brown; found on reef edges.

Remarks: There is some possibility that this species may be a synonym of *A. polystoma* (Brook 1891) (see Veron and Wallace 1984).

The *Acropora formosa* group

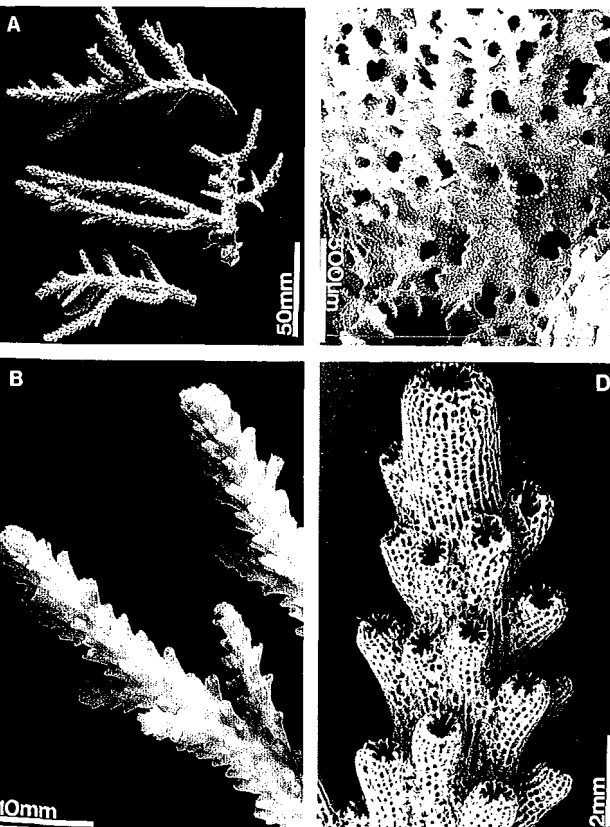


Fig. 20. *Acropora (Acropora) microphthalmalma*, G43855: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing axial and radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

Open arborescent branching mode (no other distinctive features: this is probably not a monophyletic group).

Acropora (Acropora) formosa (Dana, 1846)

(Figs. 15, 16, 17, 60, 61, 62)

Madrepora formosa Dana, 1846: p. 473, pl. 38, fig. 4, pl. 31, figs. 2a, b.

Madrepora arbuscula Dana, 1846: p. 474, pl. 40, fig. 2.

Madrepora virgata Dana, 1846: p. 471, pl. 39, fig. 1.

Madrepora stellulata Verrill, 1902: p. 238, pl. 36C, fig. 3, pl. 36F, fig. 10.

Specimens: MTQ: G45789, G45840, G43844, G43850, G43852, G43856, Nanwan, Tiaoshi; G45774 -6, Penghu; G45897, Penghu, Chinwan; G45904, G47607 Penghu, Fenguei; "sturdy": G45786 -7, G45846 Penghu; "elseyi-like": G45778 -84, Penghu; G47614 -6, Taiwan; TUIO: C7179 -82, Nanwan, Tiaoshi; C7183 -6 Penghu; C7187 -9 Penghu, Chinwan.

Diagnosis: Laboratory: Arborescent branch-

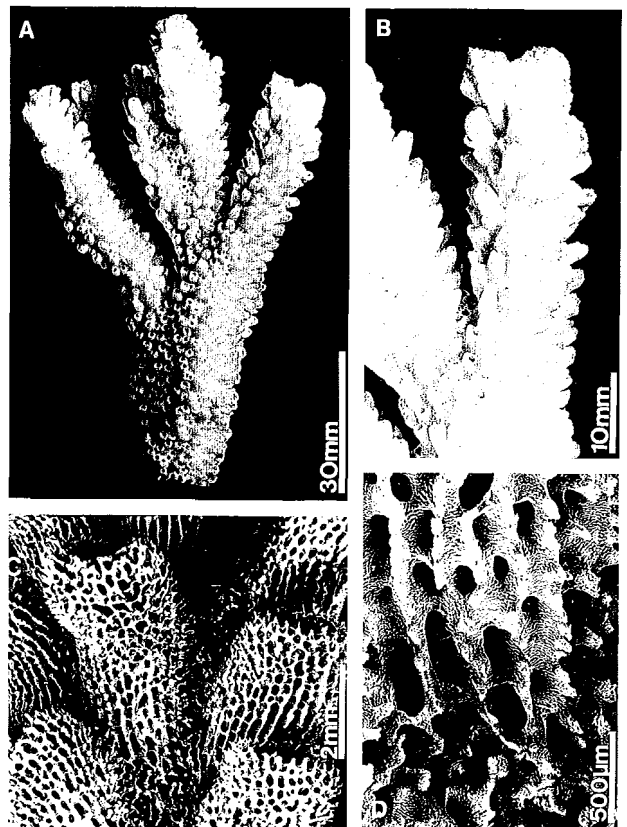


Fig. 21. *Acropora (Acropora) austera*, G35497: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

ing; axial corallites outer diameter 1.5-3.0 mm, inner diameter 0.6-1.2 mm, primary septa to 1/3 R, secondary septal cycle incomplete; radial corallites crowded on branches, evenly sized, tubular with small round to oval openings, primary septa to 2/3 R, secondary septa to 1/3 R; coenosteum costate or neatly arranged simple spinules on radial corallites, intercorallite areas similar, or reticulate with scattered simple spinules. **Field:** Arborescent thickets with slender to moderately thick branches; radial corallites evenly sized, tubular and close together; known color brown or cream, sometimes with blue tips; found intertidally and subtidally in most reef habitats.

Remarks: This species is very common on the shallow reefs of the Penghu Islands, where there is such variability in characters, particularly length and frequency of branching, that adjacent colonies may look like separate species. Two common variations are regarded as sufficiently different to require further investigation of the species composition of the Penghu *A. formosa* assemblages. Three specimens collected at Penghu are much sturdier than normal *A. formosa*, with thickened radial corallites (Fig. 16). These have branches up to 15 mm diameter, and the radial corallites are appressed with slightly dimidiate

openings. The coenosteum both on and between radial corallites is a dense arrangement of slightly elaborated spinules throughout. When these specimens were collected (9 May 1993), they were densely packed with bright red eggs. Other colonies

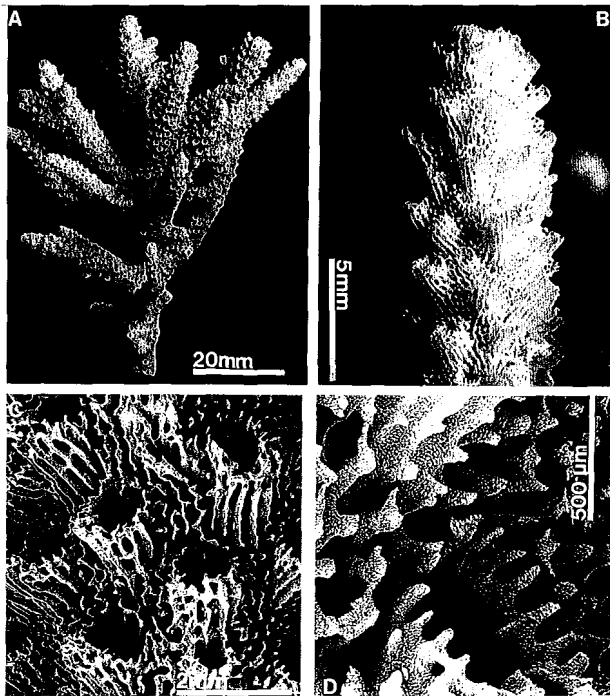


Fig. 22. *Acropora (Acropora) pulchra*, G45785: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

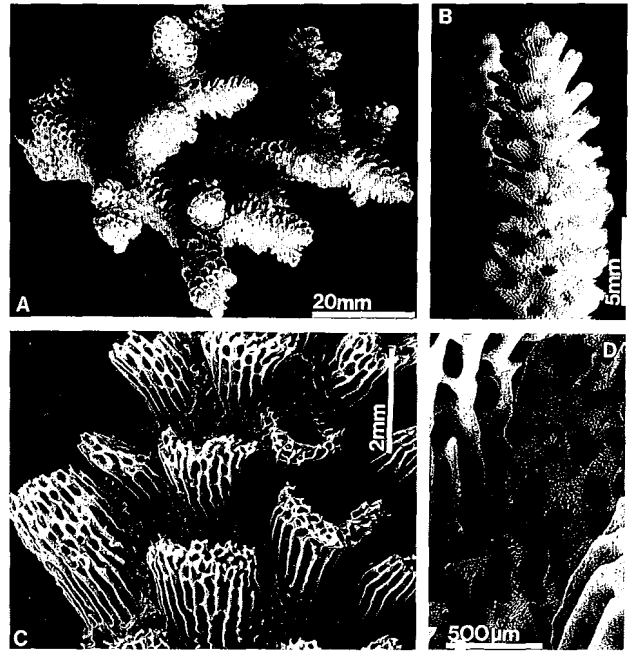


Fig. 23. *Acropora (Acropora) millepora*, G45838: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

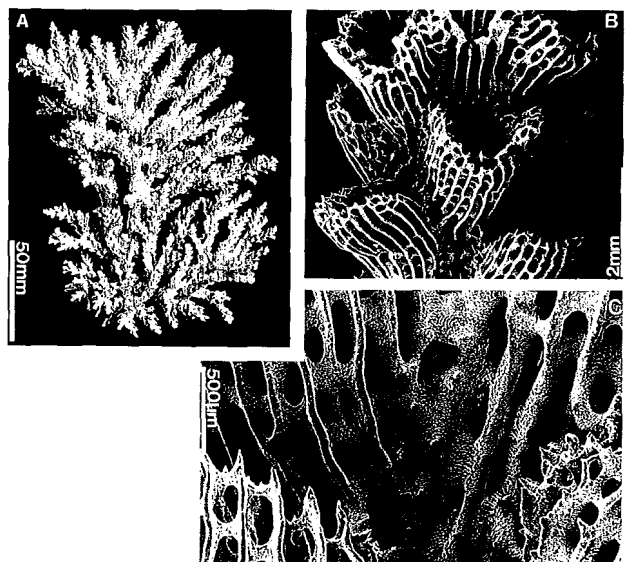


Fig. 24. *Acropora (Acropora) tenuis*, G43841: (A) portion of colony; (B) electron micrograph showing radial corallites; (C) electron micrograph showing coenosteum between radial corallites.

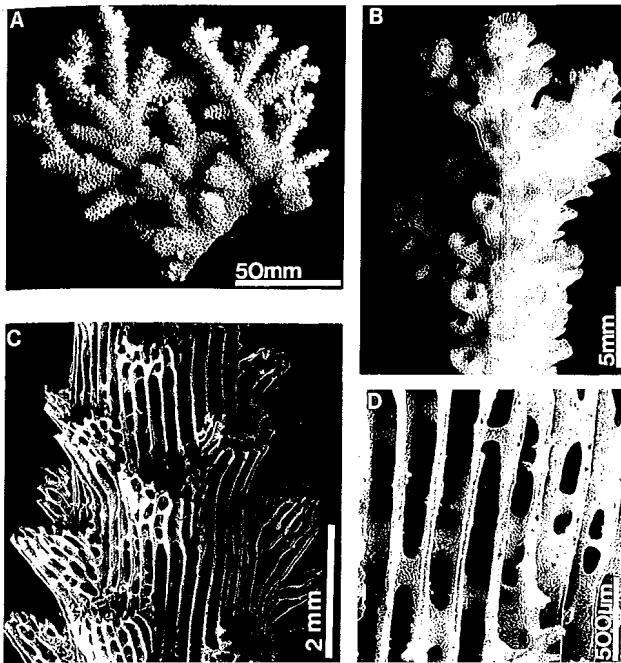


Fig. 25. *Acropora (Acropora) donei*, G45822: (A) portion of colony; (B) portion of branch; G43839: (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

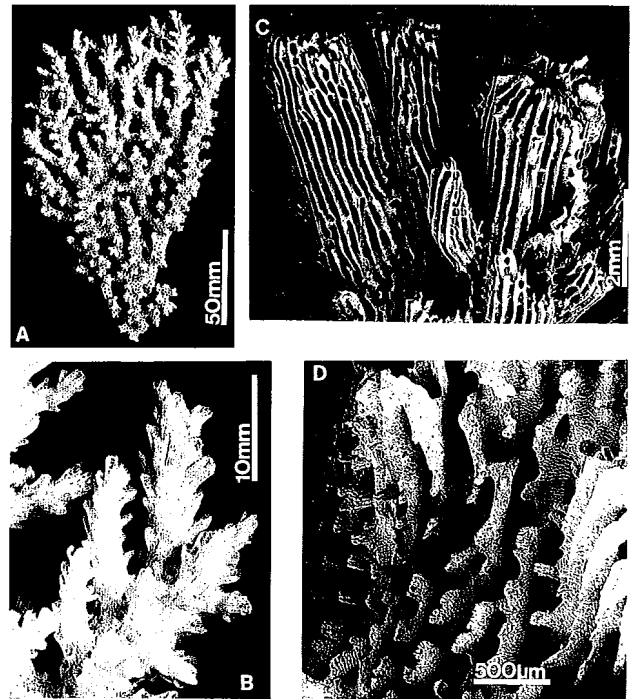


Fig. 27. *Acropora (Acropora) cytherea*, G43848: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing axial and radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

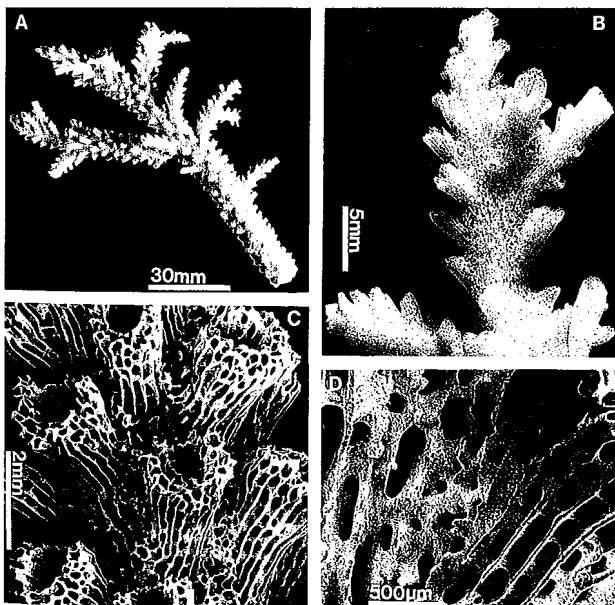


Fig. 26. *Acropora (Acropora) yongei*, G47586: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

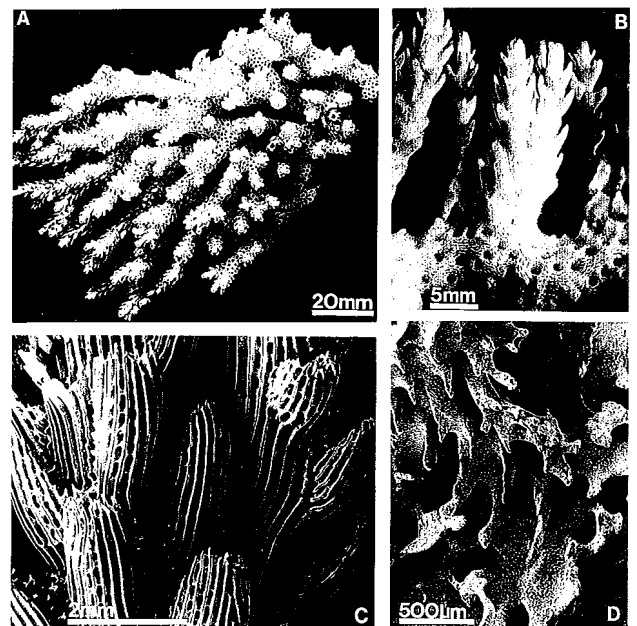


Fig. 28. *Acropora (Acropora) microclados*, G43854: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

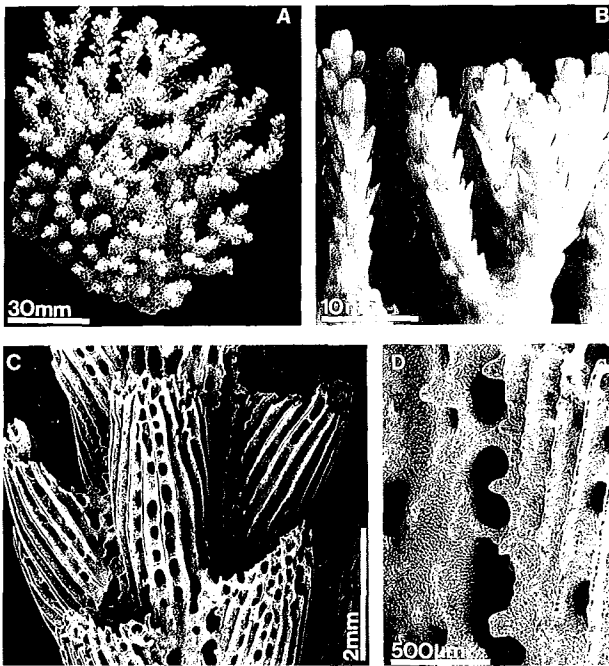


Fig. 29. *Acropora (Acropora) hyacinthus*, G43843: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

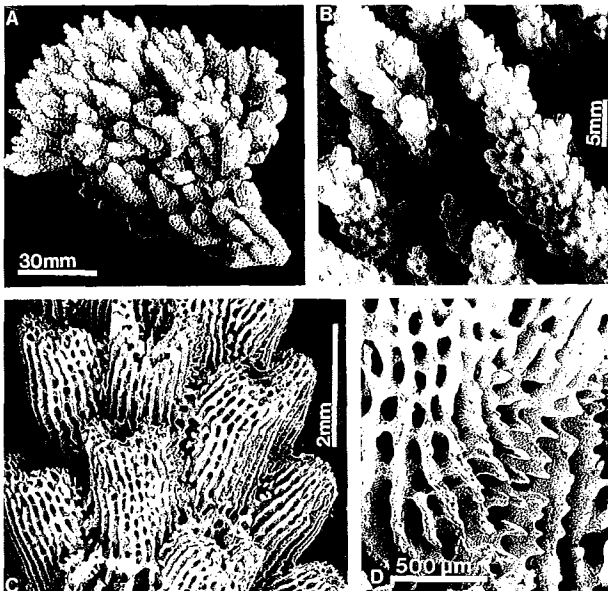


Fig. 30. *Acropora (Acropora) hyacinthus*, "sturdy form", G45800: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

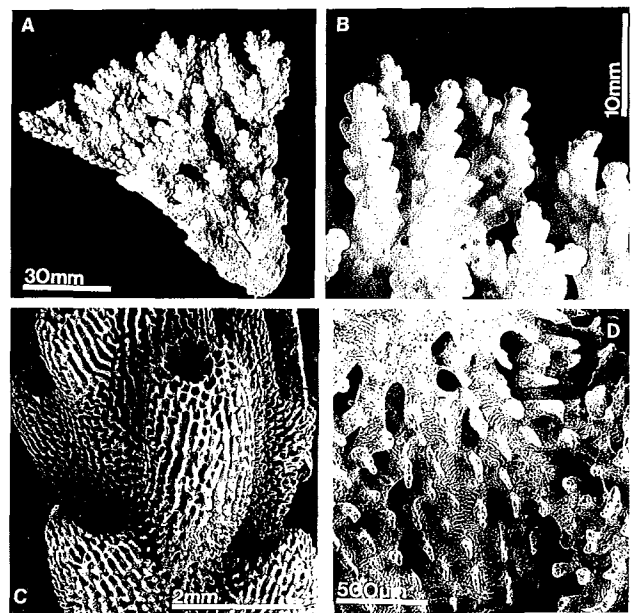


Fig. 31. *Acropora (Acropora) latistella*, G45924: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

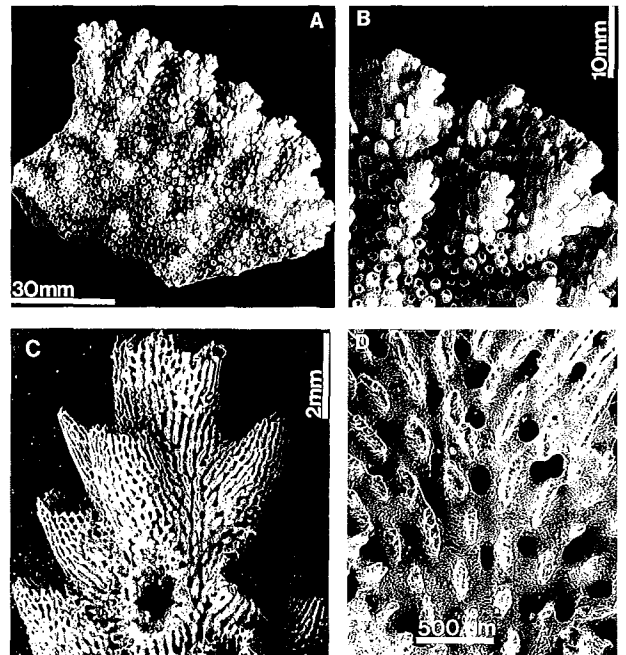


Fig. 32. *Acropora (Acropora) latistella*, "anastomosed", G45928: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

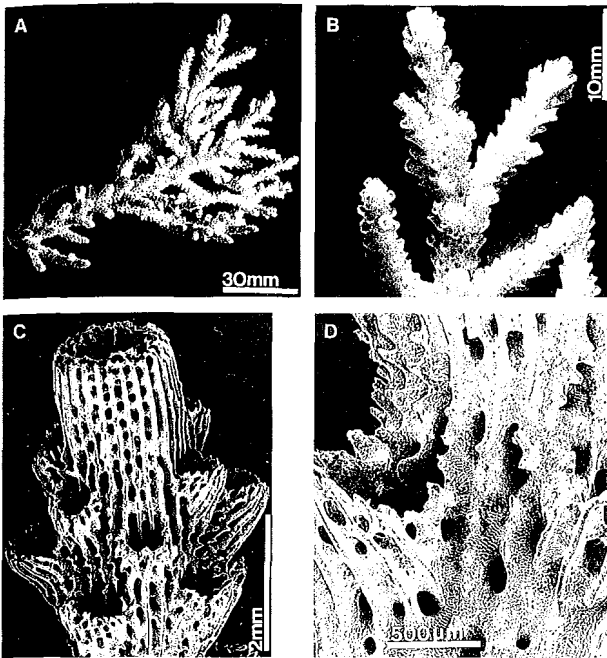


Fig. 33. *Acropora (Acropora) subulata*, G45896: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing axial and radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

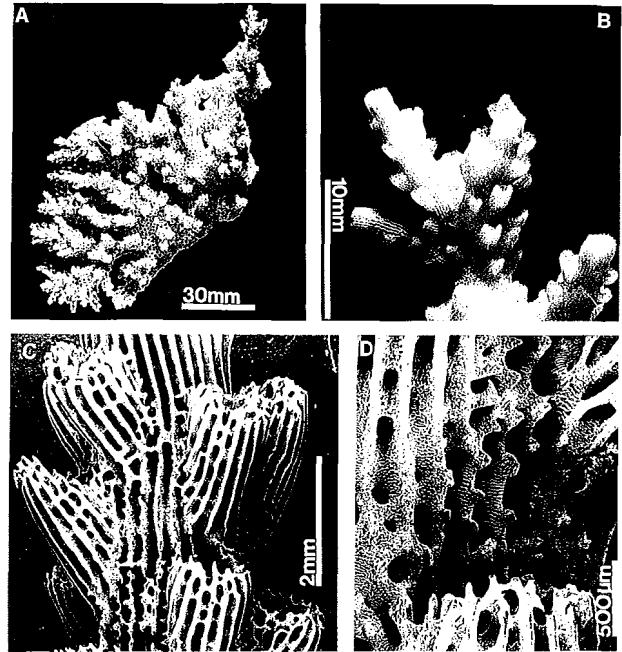


Fig. 35. *Acropora (Acropora) aculeus*, G47588: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

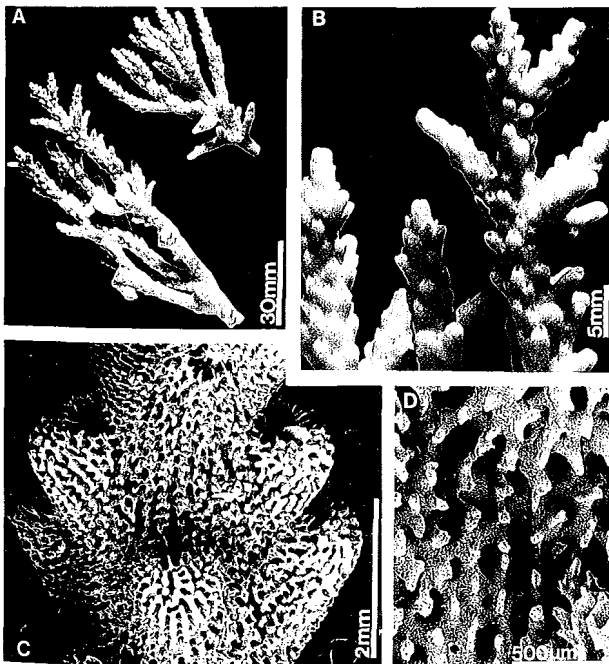


Fig. 34. *Acropora (Acropora) nana*, G45829: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

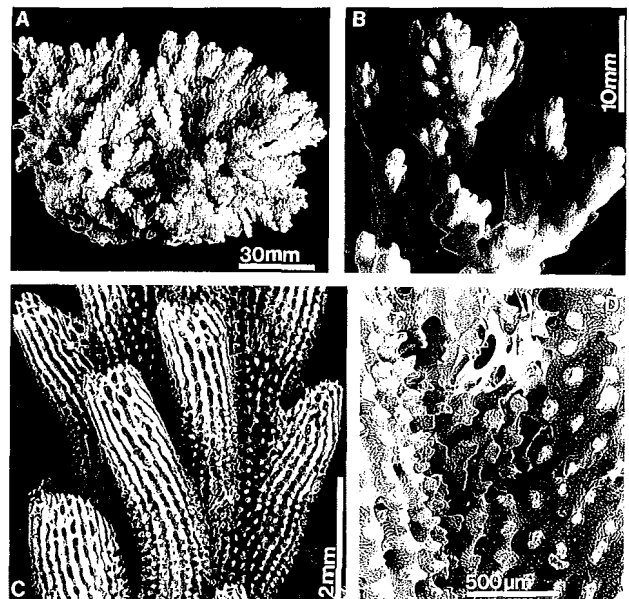


Fig. 36. *Acropora (Acropora) azurea*, G35495: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

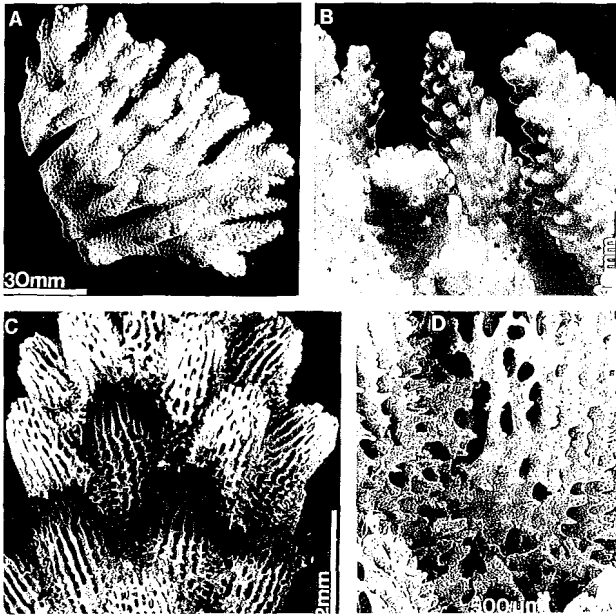


Fig. 37. *Acropora (Acropora) nasuta*, G35499: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

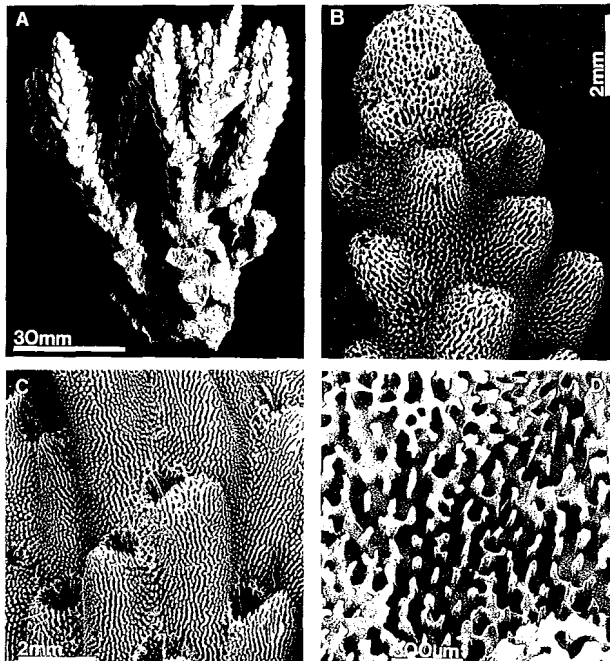


Fig. 38. *Acropora (Acropora) valida*, G45801: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

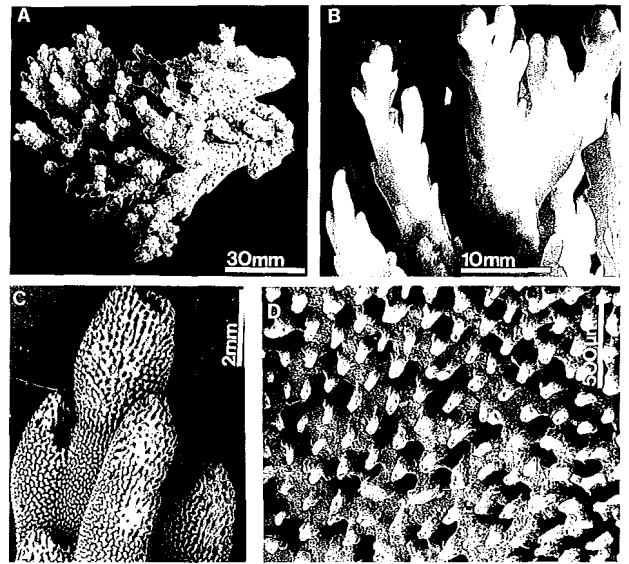


Fig. 39. *Acropora (Acropora) valida*, G46531: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing axial and radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

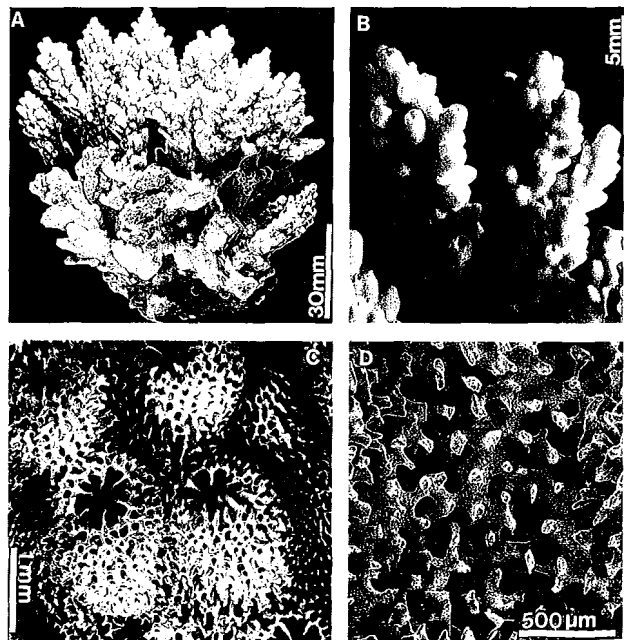


Fig. 40. *Acropora (Acropora) secale*, G45813: (A) portion of colony; (B) portion of branches; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

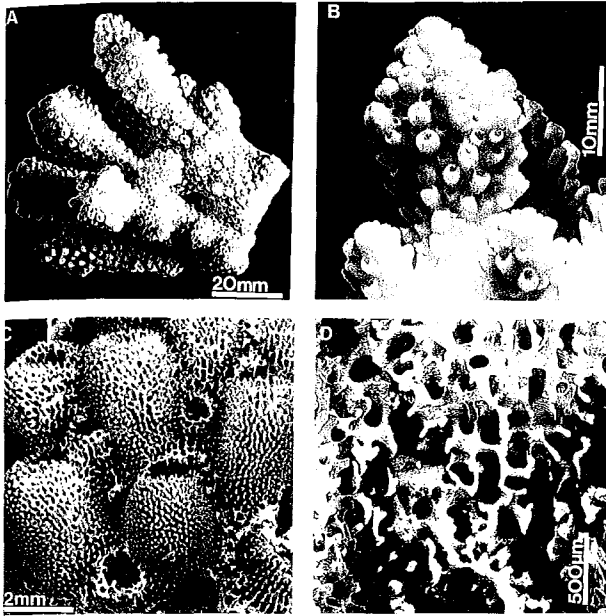


Fig. 41. *Acropora (Acropora) lutkeni*, G43853: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

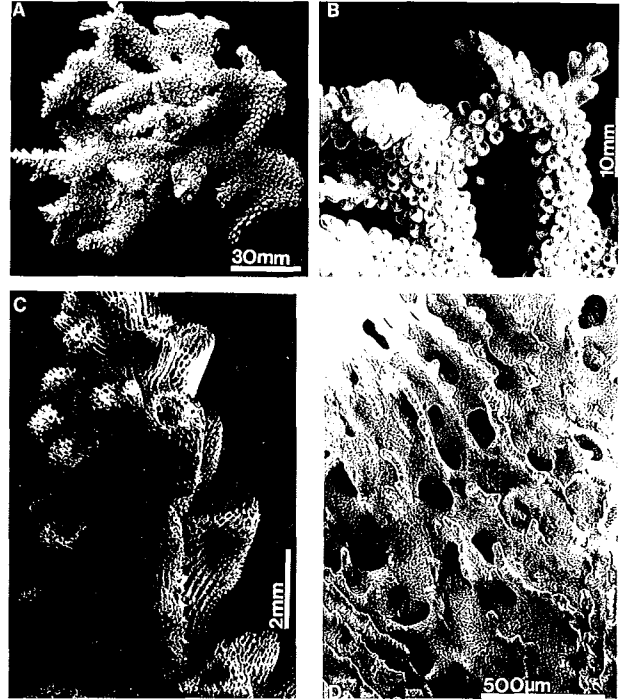


Fig. 43. *Acropora (Acropora) solitaryensis*, G45835: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

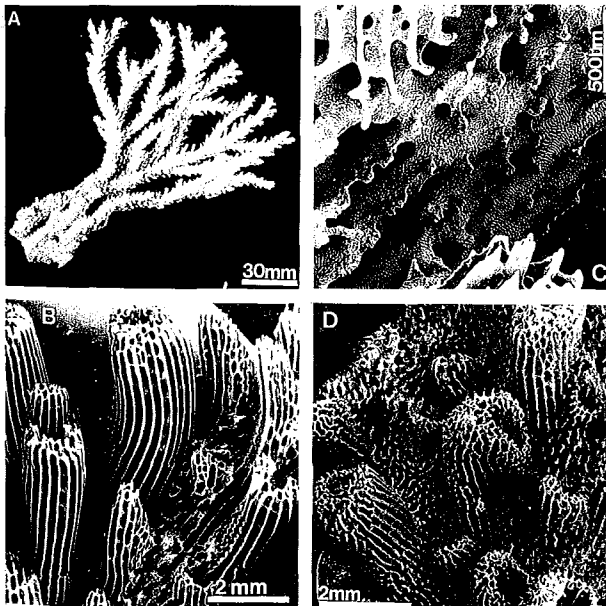


Fig. 42. *Acropora (Acropora) clathrata*, G43847: (A) portion of colony; (B) electron micrograph showing radial corallites; (C) electron micrograph showing coenosteum between radial corallites; (D) "sturdy form" G47575: electron micrograph showing radial corallites.

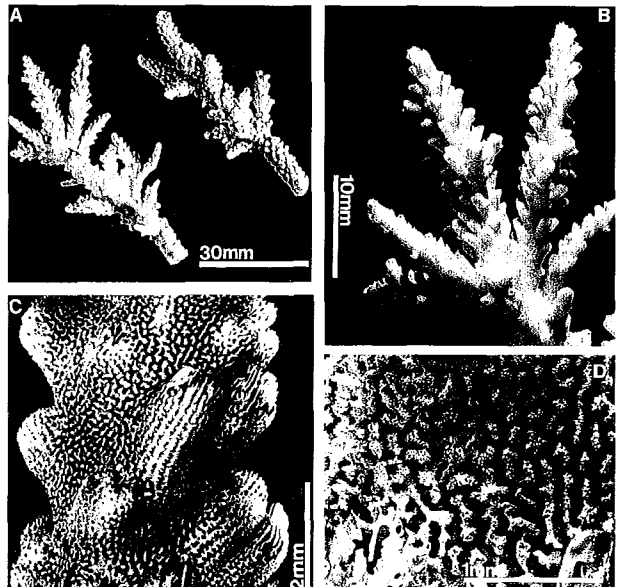


Fig. 44. *Acropora (Acropora) elseyi*, G45833: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

occurring on the shallow reef floor at the Penghu Islands had proliferous branching, leading to an almost hispidose appearance of the branches: these looked superficially like *A. elseyi* on the reef (Figs. 17, 61, 62). These forms should be further investigated, as they may be separate species.

***Acropora (Acropora) acuminata* (Verrill, 1864)**
(Figs. 18, 63)

Madrepora acuminata Verrill, 1864: p. 40.

Madrepora diffusa Verrill, 1864: p. 41.

Madrepora nigra Brook, 1892: p. 459; 1893: p. 45, pl. 27, fig. C.

Specimens: MTQ: G43849, G45834, G45842, Nanwan, Tiaoshi; G47582, Lutao, Haisenping; G47590, Lutao, Chaikochiao; G47601, Lutao, Nan-liao; TUIO: C7190, C7191, Nanwan, Tiaoshi; C7192-4, Lutao.

Diagnosis: Laboratory: Branches widely separated and arching upwards, maximum diameter 10 mm; axial corallites outer diameter 1.6 to 2.9 mm, inner diameter 0.6-1.0mm, primary septa to 2/3 R, secondary septa to 1/3 R; radial corallites mostly not touching on branch, tubular with oval to nariform openings; some radial corallites longer than average, primary septa to 1/2 R, secondary septa to 1/4 R; coenosteum costate on radial corallites, with spi-

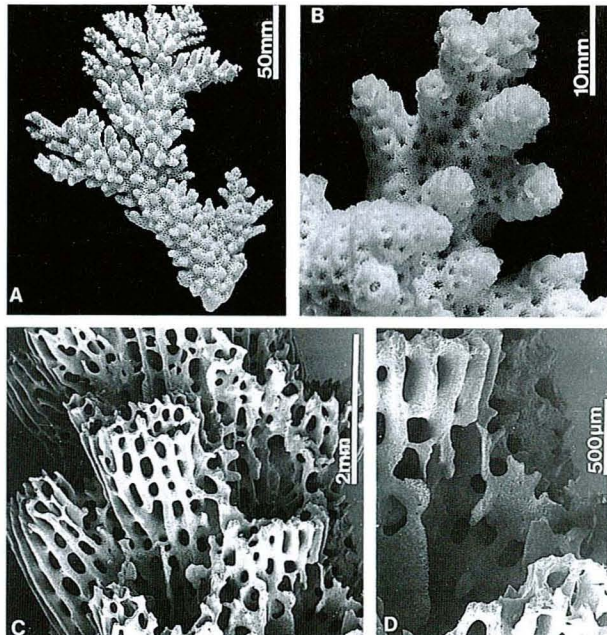


Fig. 45. *Acropora (Acropora) florida*, G43845: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

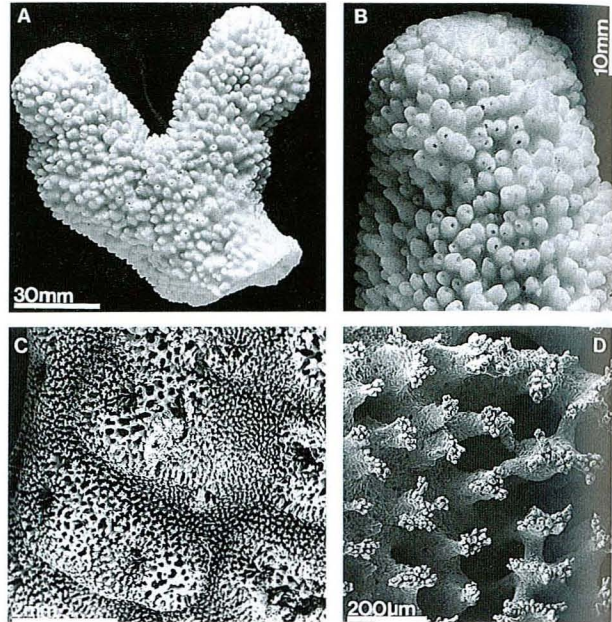


Fig. 46. *Acropora (Acropora) palifera*, G45938: (A) portion of colony; (B) portion of branch; G45935: (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

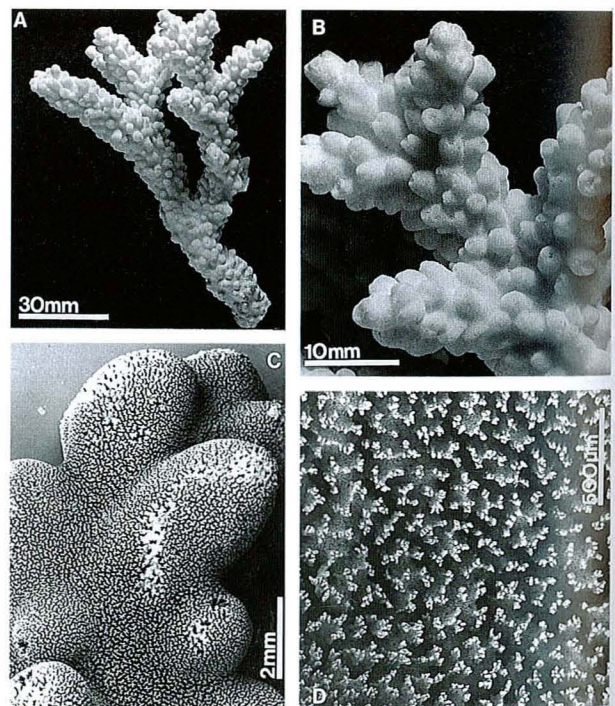


Fig. 47. *Acropora (Acropora) breuggemanni*, G35498: (A) portion of colony; (B) portion of branch; (C) electron micrograph showing radial corallites; (D) electron micrograph showing coenosteum between radial corallites.

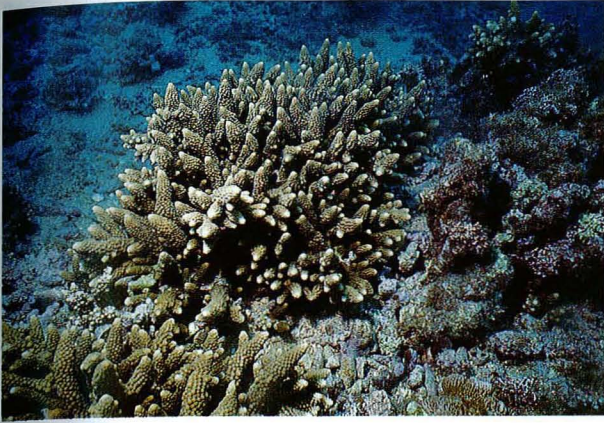


Fig. 48. *Acropora (Acropora) humilis*, Penghu Is.



Fig. 51. *Acropora (Acropora) samoensis*, Tiaoshi, Nanwan.



Fig. 49. *Acropora (Acropora) gemmifera*, Lutao.



Fig. 52. *Acropora (Acropora) digitifera*, Penghu Is.

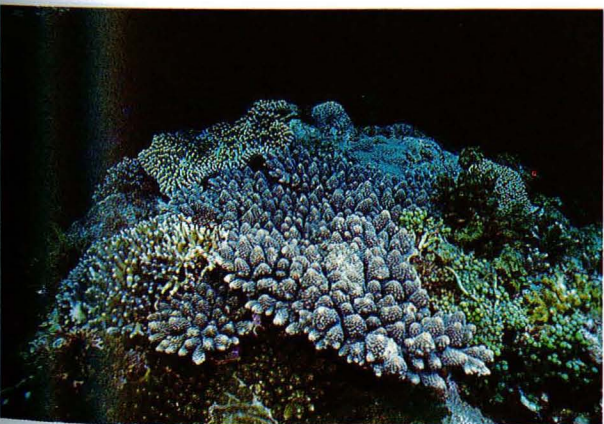


Fig. 50. *Acropora (Acropora) gemmifera*, Nanwan.

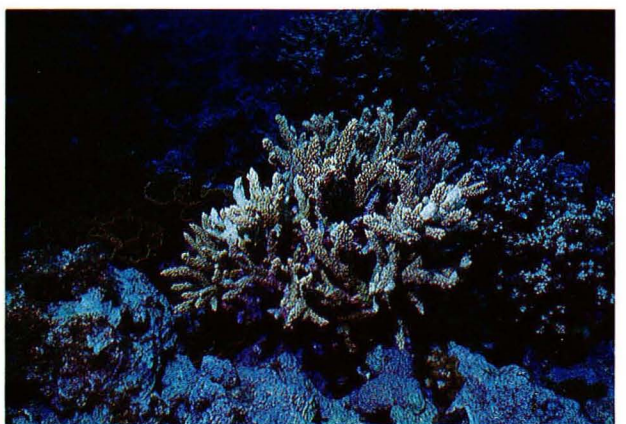


Fig. 53. *Acropora (Acropora) digitifera*, Penghu Is.

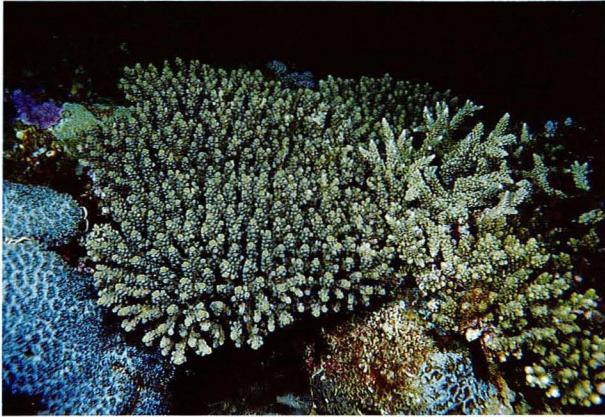


Fig. 54. *Acropora (Acropora) verweyi*, G43851, Tiaoshi, Nanwan.

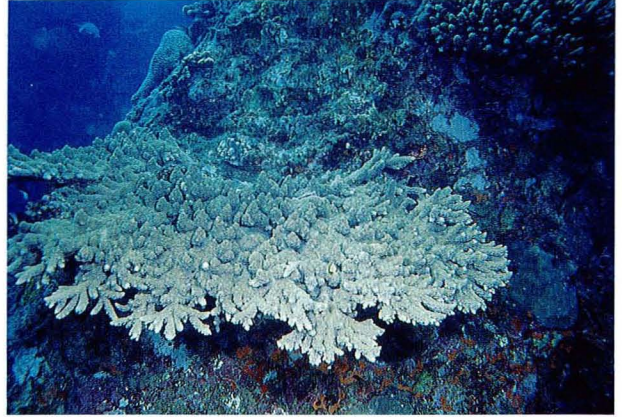


Fig. 57. *Acropora (Acropora) danai*, G45810, Nanwan.



Fig. 55. *Acropora (Acropora) glauca*, Penghu Is.



Fig. 58. *Acropora (Acropora) intermedia*, Nanwan.



Fig. 56. *Acropora (Acropora) robusta*, Nanwan.

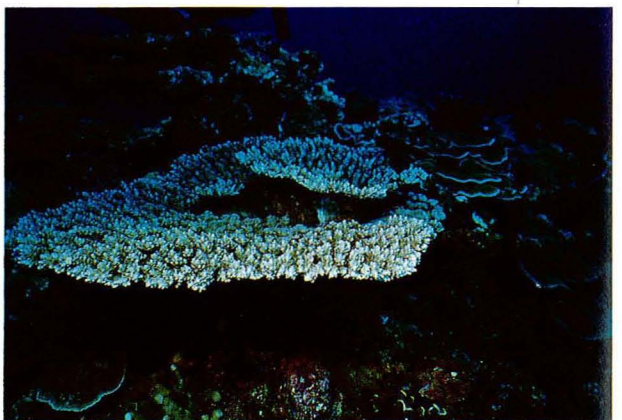


Fig. 59. *Acropora (Acropora) listeri*, Lutao.

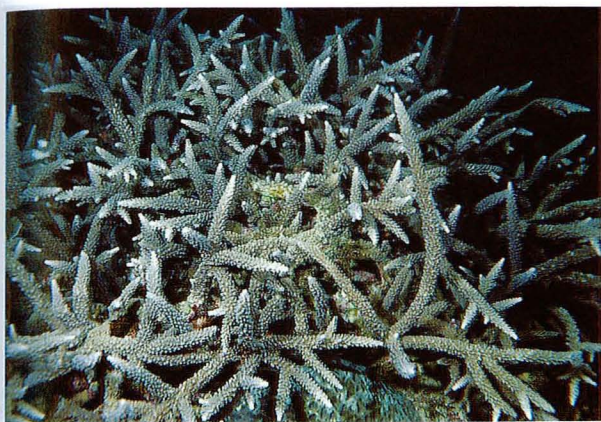


Fig. 60. *Acropora (Acropora) formosa*, Tiaoshi, Nanwan.



Fig. 63. *Acropora (Acropora) acuminata*, G47582, Nanwan.

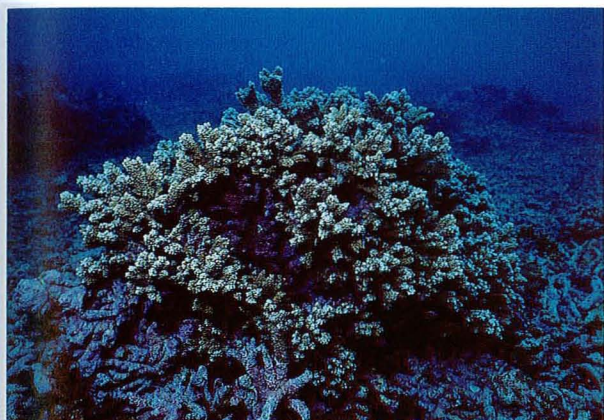


Fig. 61. *Acropora (Acropora) formosa*, "sturdy form", Penghu Is.

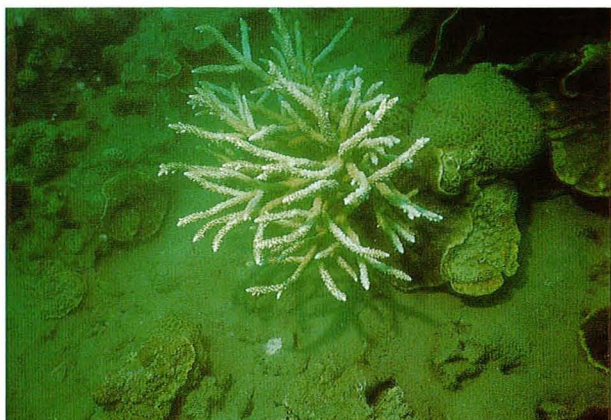


Fig. 64. *Acropora (Acropora) valenciennesi*, G45903, Penghu Is.



Fig. 62. *Acropora (Acropora) formosa*, "elseyi form", Penghu Is.



Fig. 65. *Acropora (Acropora) microphthalma*, G45828, Nanwan.



Fig. 66. *Acropora (Acropora) austera*, G47597, Chaikochiao, Lutaotao.

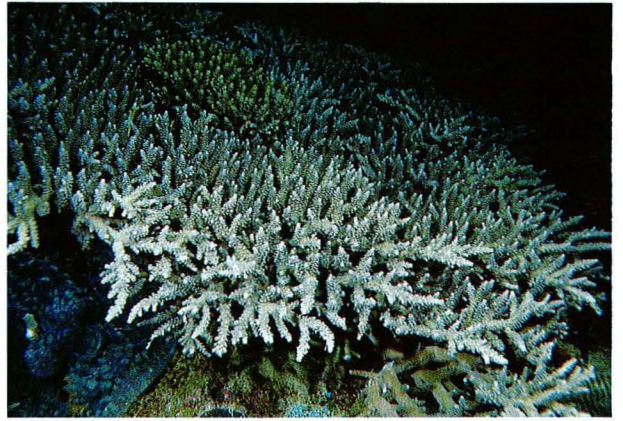


Fig. 69. *Acropora (Acropora) donei*, Tiaoshi, Nanwan.

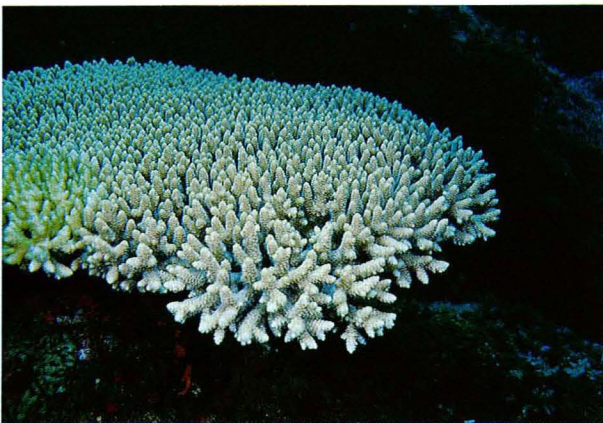


Fig. 67. *Acropora (Acropora) millepora*, G45838, Nanwan.



Fig. 70. *Acropora (Acropora) yongei*, Nanliao, Lutaotao.

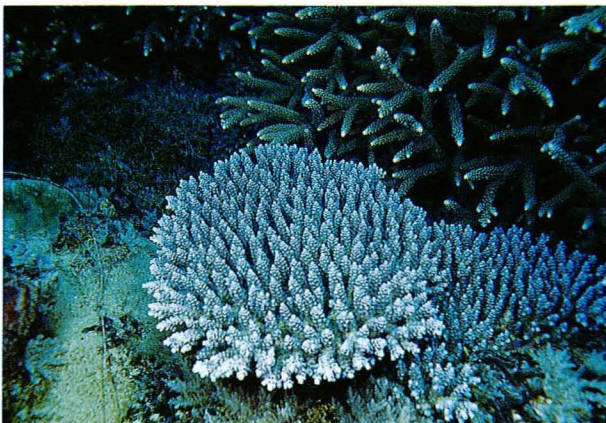


Fig. 68. *Acropora (Acropora) tenuis*, G45839, Nanwan.

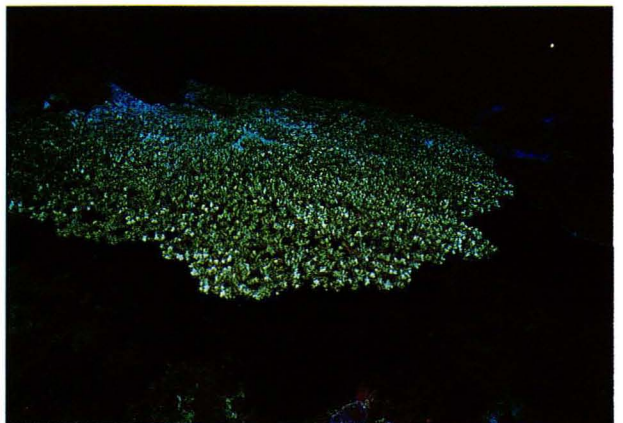


Fig. 71. *Acropora (Acropora) cytherea*, Lutaotao.

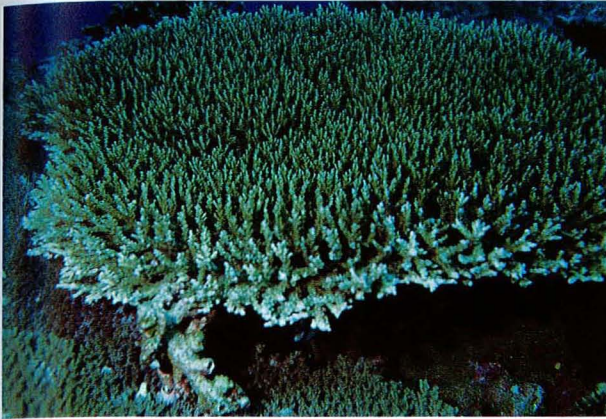


Fig. 72. *Acropora (Acropora) microclados*, Tiaoshi, Nanwan.

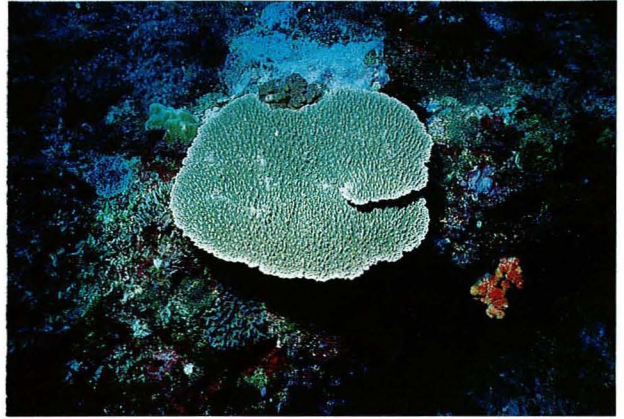


Fig. 75. *Acropora (Acropora) latistella*, "fused form", Nanwan.



Fig. 73. *Acropora (Acropora) hyacinthus*, Nanwan.

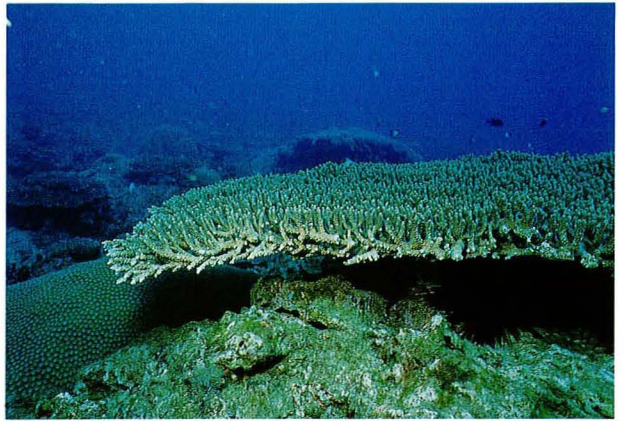


Fig. 76. *Acropora (Acropora) subulata*, Tiaoshi, Nanwan.

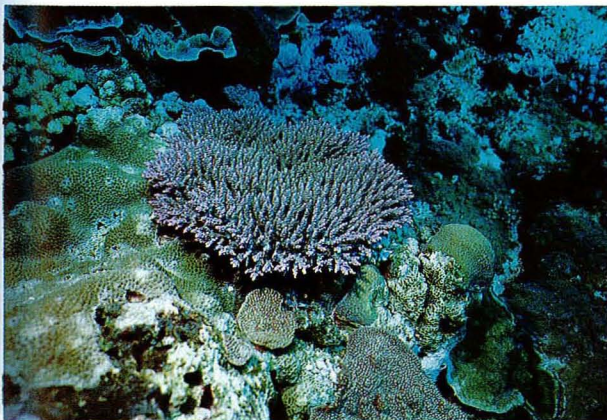


Fig. 74. *Acropora (Acropora) latistella*, Lutao.

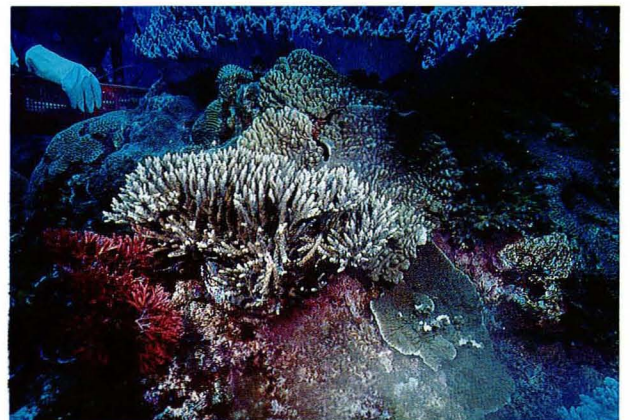


Fig. 77. *Acropora (Acropora) nana*, Nanwan.

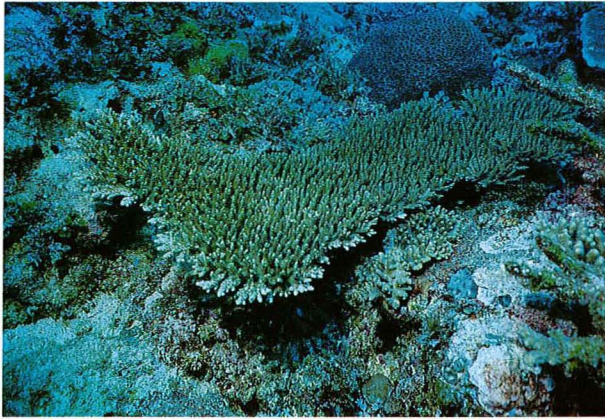


Fig. 78. *Acropora (Acropora) aculeus*, G47587, Haisenping, Lutaotao.

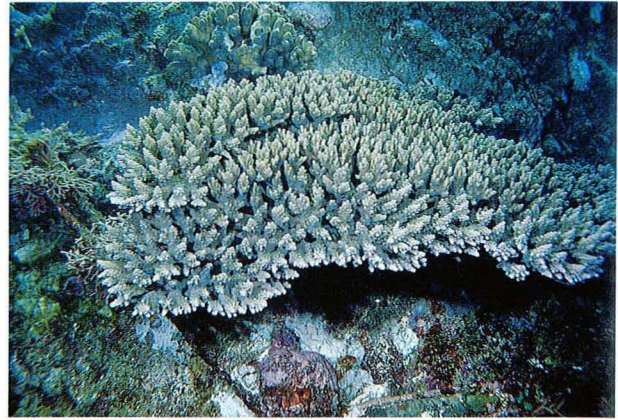


Fig. 81. *Acropora (Acropora) valida*, Nanwan.



Fig. 79. *Acropora (Acropora) azurea*, Tiaoshi, Nanwan.



Fig. 82. *Acropora (Acropora) secale*, Penghu Is.



Fig. 80. *Acropora (Acropora) nasuta*, Haisenping, Lutaotao.



Fig. 83. *Acropora (Acropora) lutkeni*, G43853, Tiaoshi, Nanwan.

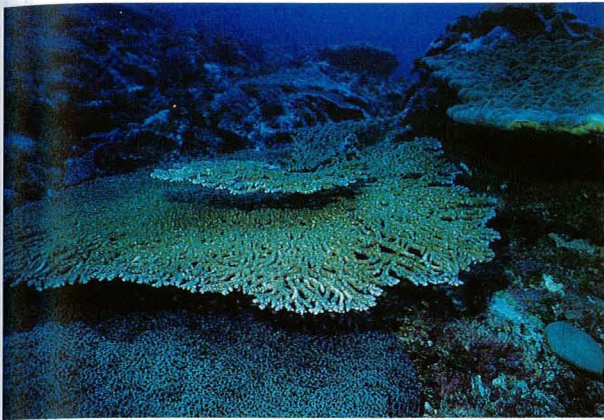


Fig. 84. *Acropora (Acropora) clathrata*, G47576, Luato.



Fig. 87. *Acropora (Acropora) elseyi*, Tiaoshi, Nanwan.



Fig. 85. *Acropora (Acropora) divaricata*, Chinwan, Penghu Is.



Fig. 88. *Acropora (Acropora) florida*, Tiaoshi, Nanwan.

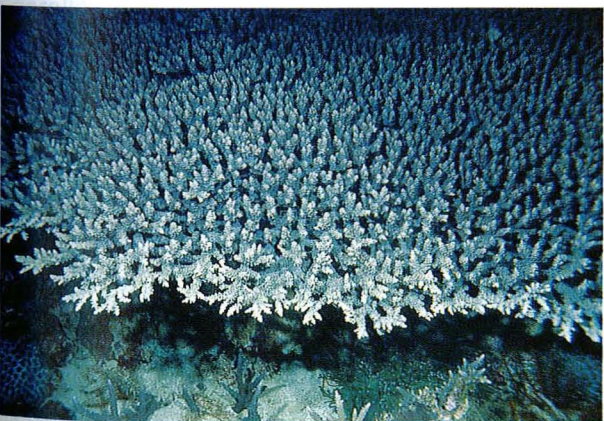


Fig. 86. *Acropora (Acropora) solitaryensis*, G45835, Tiaoshi, Nanwan.



Fig. 89. *Acropora (Acropora) palifera*, Nanwan.

nules on costae; reticulate with occasional simple spinules between radial corallites. **Field:** Small arborescent table; branches appear prickly because of occasional protruding radial corallites; known colors brown or blue; found subtidally on reef slopes.

Remarks: As noted by Wells (1954), specimens of this species tend to blacken on exposure to air.

Acropora (Acropora) valenciennesi
(Edwards and Haime, 1860)
(Figs. 19, 64)

Madrepora valenciennesi Edwards and Haime, 1860: p. 137.
Acropora splendida Nemenzo, 1967: p. 51, pl. 17, fig. 2.

Specimens: MTQ: G45903, Penghu, Fenguei; TUIO: C7195, Penghu, Fenguei.

Diagnosis: Laboratory: Branches widely separated, arching upwards; axial corallites outer diameter 2.0-3.5 mm, inner diameter 0.8-1.5 mm, primary septa to 1/3 R, secondary septa to 1/4 R; radial corallites evenly sized and distributed, tubular with oval to nariform openings, directive septa obvious, other primary septa to 1/3 R, secondary septa absent to all present to 1/4 R; coenosteum open reticulate on and between radial corallites: almost no spinules. **Field:** Large open arborescent table; known colors brown, brown with blue tips, or green with paler tips; found on reef slopes and subtidal reef tops.

Remarks: This does not seem to be a common species in Taiwan. The color plate (Fig. 64) shows a colony which has not developed its full table shape.

The *Acropora horrida* group

Colonies of all species have phenotypically plastic growth forms, ranging from open arborescent through hispidose to irregular caespitose (sometimes within a single colony); radial corallites simple tubular with round openings.

Acropora (Acropora) microphthalmalma
(Verrill, 1864)
(Figs. 20, 65)

Madrepora microphthalmalma Verrill, 1869: p. 83.

Specimens: MTQ: G45893 -4, Penghu, Chinwan; G45902, Penghu, Fenguei; G43855, G45827 -8, G46430 -1, Nanwan, Tiaoshi; G47619, Nanwan; TUIO: C7196 -8, Nanwan, Tiaoshi; C7199, C7200 -1, Penghu, Chinwan.

Diagnosis: Laboratory: Branching arborescent, with slender branches, up to 15 mm diameter; axial corallites outer diameter 1.8-2.3 mm, inner diameter 0.6-1.0 mm, primary septa to 3/4 R, second-

ary septa absent or some present to 1/4 R; radial corallites tubular with round to oblique openings, crowded on branches, primary septa to 2/3 R, secondary absent or just visible; coenosteum densely arranged simple spinules on and between radial corallites. **Field:** Fine-branching dense arborescent thickets; known colors cream or white, occasionally pale blue; found in subtidal habitats.

Remarks: This is a common species throughout the western Pacific and South China Sea. It can sometimes be confused with *A. formosa*, which differs by having sturdier branches.

***Acropora (Acropora) austera* (Dana, 1846)**
(Figs. 21, 66)

Madrepora austera Dana, 1846: p. 478.
Acropora multiramosa Nemenzo, 1967: p. 73, pl. 24, figs. 1, 2.

Specimens: MTQ: G35497, Nanwan-A; G45788, G45806, Tiaoshi; G45944, Lutao, Nanliao; G47583 -4, Lutao, Haisenping; G47597 -8, Lutao, Chaikochiao; TUIO: C7202 -3, Nanwan, Tiaoshi; C7104 -8, Lutao.

Diagnosis: Laboratory: Irregular branching; axial corallites outer diameter 2.4-3.8 mm, inner diameter 1.0-1.5 mm, primary septa to 2/3 R, secondary septa to 1/2 R; radial corallites rounded tubular, with round to square calices, primary septa to 1/3 R, directive septa may be larger, secondary cycle absent to incomplete; coenosteum dense reticulate with scattered elaborate spinules throughout, sometimes slightly costate on radial corallites. **Field:** Hispidose to arborescent, sometimes forming large thickets several meters across; corallites large and obvious, with obvious calices; known colors pale brown; sometimes with yellow radial corallites and purple axial corallites, or lavender; found in subtidal habitats.

Remarks: This is a common species on the southeastern reefs of Taiwan.

The *Acropora aspera* group

All species possess labellate radial corallites, the upper part of the corallite wall being absent and the lower part being developed into a flaring lip; coenosteum dimorphic, being costate on radial corallites and reticulate in intercorallite areas.

***Acropora (Acropora) pulchra* (Brook, 1891)**
(Fig. 22)

Madrepora pulchra Brook, 1891: p. 452; 1893: p. 44, pl. 28, figs. A, B, C.

Specimens: MTQ: G45785, Penghu; G47618, Taiwan; TUIO: C7209, Penghu.

Diagnosis: **Laboratory**: Open to compact arborescent branching, branches up to 12 mm diameter and terete; axial corallites outer diameter 2.0-3.5 mm, inner diameter 0.6-1.2 mm, primary septa to 2/3 R, secondary cycle incomplete, to 1/4 R; radial corallites a mixture of large and small, larger corallites labellate with "pointed" lip, smaller corallites submersed with a reduced lip, primary septa to 2/3 R, secondary septa incomplete, to 1/4 R; coenosteum costate on radial corallites, open reticulate with scattered simple spinules in intercorallite areas. **Field**: Open arborescent, thicket-like colonies, may appear corymbose when occurring at low tide mark; radial corallites scattered and not very obvious; known colors brown, brown with blue tips; occurs intertidally in reef flat and shallow habitats.

Remarks: This species is usually the shallowest-occurring of *Acropora*, and it may be found with rubble or algae within a few meters of the shore. A closely related species of this group, *A. aspera*, was not encountered in the collection from Taiwan.

Acropora (Acropora) millepora (Ehrenberg, 1834)

(Figs. 23, 67)

Heteropora millepora Ehrenberg, 1834: p. 109.

Madrepora spathulata Brook, 1891: p. 469; 1893: p. 121, pl. 32, fig. B.

Madrepora squamosa Brook, 1892: p. 463; 1893: p. 120, pl. 20, fig. B.

Acropora singularis Nemenzo, 1967: p. 91, pl. 26, fig. 5.

Acropora librata Nemenzo, 1967: p. 121, pl. 34, figs. 1, 2.

Specimens: MTQ: G45838, Nanwan, Tiaoshi; TUIO: C7210, Nanwan, Tiaoshi.

Diagnosis: **Laboratory**: Corymbose branching, with terete branches up to 10 mm diameter; axial corallites outer diameter 2.4-3.9 mm, inner diameter 0.9-1.6 mm, primary septa to 1/2 R, secondary septa to 1/4 R; radial corallites equally sized labellate, with flaring lips, primary septa to 2/3 R, secondary septa to 1/4 R; coenosteum costate on radial corallites, reticulate with scattered spinules in intercorallite areas. **Field**: Corymbose colonies from a central to peripheral attachment; radial corallites very evenly distributed and sized, appearing scale-like; known colors green with orange branch tips, orange-brown, pink, or blue; found on reef flat or shallow subtidal areas.

Remarks: As noted by Wallace and Willis (1994), the synonymy given above is probably too broad, encompassing "thick-branched" and "thin-branched" morphs which do not interbreed. The

specimens recorded in Taiwan correspond with the "thin-branched" morph, which is identified with *A. millepora* sensu stricto.

The *Acropora selago* group

Radial corallites have a "cochleariform" shape: inner wall is short and weakly developed, outer wall forms a flaring lip.

Acropora (Acropora) tenuis (Dana, 1846)

(Figs. 24, 68)

Madrepora tenuis Dana, 1846: p. 451.

Madrepora macrostoma Brook, 1891: 464; 1893: p. 105, pl. 19, fig. B.

Madrepora bifaria Brook, 1892: p. 453; 1893: p. 110, pl. 30, fig. A.

Madrepora kenti Brook, 1892: p. 458; 1893: p. 110, pl. 11, fig. B.

Acropora plana Nemenzo, 1967: p. 93, pl. 27, fig. 3.

Specimens: MTQ: G43841, G45839, Nanwan, Tiaoshi; G45941, Lutao, Nanliao; TUIO: C7211 -2, Nanwan, Tiaoshi; C7213, Lutao.

Diagnosis: **Laboratory**: Corymbose branching with terete branches up to 10 mm in diameter; axial corallites outer diameter 2.4-3.4 mm, inner diameter 0.8-1.2 mm, primary and secondary septa to 1/3 R; radial corallites evenly arranged and close together on branches, cochleariform, the lip rounded and flaring broadly; primary septa to 2/3 R, secondary septa to 1/4 R; coenosteum costate or rows of simple spinules on radial corallites, reticulate with scattered simple spinules in intercorallite areas. **Field**: Corymbose to caespito-corymbose colonies with narrow branches, radial corallites evenly sized with obvious, flaring lips; known colors pale cream, pale brown, or blue; found in shallow subtidal locations.

Remarks: This species can sometimes be confused in the field with *A. latistella*, from which it can be distinguished by its large, even, flaring-lipped cochleariform corallites, and by the fact that its colonies are usually pale cream or brown (the blue color is unusual).

Acropora (Acropora) donei Veron and Wallace, 1984

(Figs. 25, 69)

Acropora donei Veron and Wallace, 1984: p. 287, figs. 698, 702, 708.

Specimens: MTQ: G43839 -40, G45821 -4, Nanwan, Tiaoshi; G45942, G45945, Lutao, Nanliao; G47591, Lutao, Chaikochiao; TUIO: C7214 -7 Nanwan, Tiaoshi; C7218 -20 Lutao.

Diagnosis: **Laboratory**: Open corymbose

branching, the branches widely spaced and up to 5 mm in diameter; axial corallites outer diameter 2.5-4.2 mm, inner diameter 1.0-1.4 mm, primary septa to 2/3 R, secondary septa to 1/3 (sometimes 2/3 R); radial corallites scattered, cochleariform but with lip reduced, primary septa to 1/2 R, secondary septa to 1/3 R; coenosteum costate or lines of simple spinules on radial corallites, reticulate with scattered simple spinules in intercorallite areas. **Field:** Large arborescent tables or side-attached plates up to 3 m in diameter; known colors cream, gray, or white, sometimes white with bright blue branch tips; occurs subtidally.

Remarks: This species is common throughout the South China Sea.

***Acropora (Acropora) yongei* Veron and Wallace, 1984**
(Figs. 26, 70)

Acropora yongei Veron and Wallace, 1984: p. 294, figs. 719, 723.

Specimens: MTQ: G47586, Lutao, Haisenping; TUIO: C7221, Lutao.

Diagnosis: Laboratory: Arborescent branching, the branches up to 15 mm in diameter; axial corallites outer diameter 2.2-3.5 mm, inner diameter 0.8-1.2 mm, primary septa to 2/3 R, secondary septa to 1/3 R; radial corallites primary septa to 1/2 R, sometimes to R, secondary septa to 1/2 R, sometimes incomplete; coenosteum costate or lines of simple spinules on radial corallites, reticulate with scattered simple spinules in intercorallite areas. **Field:** Colonies open arborescent, sometimes forming thickets, sometimes small patches; known colors pale brown, yellow-brown, pink-brown, or cream, sometimes with polyps colored differently; occurs subtidally.

Remarks: This species, recorded as *A. haimei* (Edwards and Haime, 1860) by Wallace (1978), may be a junior synonym of that species (see Wallace et al. 1991).

The *Acropora hyacinthus* group

Colony table- or plate-shaped, with main branching horizontal and short vertical branchlets given off evenly throughout the table; radial corallites labelate; coenosteum dimorphic.

***Acropora (Acropora) cytherea* (Dana, 1846)**
(Figs. 27, 71)

Madrepora cytherea Dana, 1846: p. 441, pl. 32, figs. 3a, 3b.
Madrepora efflorescens Dana, 1846: p. 441, pl. 33, fig. 6.

Madrepora arcuata Brook, 1892: p. 452; 1893: p. 102, pl. 12.
Madrepora armata Brook, 1892: p. 461; 1893: p. 68, pl. 4, figs. A, B.
Madrepora reticulata Brook, 1892: p. 461; 1893: p. 68, pl. 4, figs. A, B.
Acropora cytherea Verrill, 1902: p. 253, pl. 36, fig. 7, pl. 36A, fig. 7, pl. 36F, fig. 1.

Specimens: MTQ: G43848, Nanwan, Tiaoshi; G45943, G45946, Lutao, Nanliao; G47609, Lutao, Haisenping; TUIO: C7222, Nanwan, Tiaoshi; C7223-4 Lutao, Haisenping.

Diagnosis: Laboratory: Tabular branching: from anastomosing, horizontal branches, groups of vertical branchlets up to 15 mm long and 2 mm in diameter are given off; axial corallites outer diameter 1.3-2.5 mm, inner diameter 0.7-1.0 mm, primary septa to 2/3 R, secondary septa absent to incomplete; radial corallites with elongate upwardly pointing lips, septa absent to a few primaries just visible; coenosteum costate on radial corallites, reticulate with scattered laterally-flattened spinules in intercorallite areas, coenosteum may also bear calcite deposits, giving the cleaned skeleton a yellowed appearance. **Field:** Forms large flat tables with low vertical branchlets and fine, crumbly structure; known colors pale brown, less commonly pink-, yellow- green- or blue-brown, or brown-gray; occurs subtidally on reef slopes and submerged reefs.

Remarks: This species can be confused with *A. hyacinthus*, from which it can be distinguished in the field by its crumbly structure, and by the grouping of its branchlets into 2s and 3s; in the laboratory, it is separated by its scattered radial corallites with elongate lips.

Acropora (Acropora) microclados
(Ehrenberg, 1846)
(Figs. 28, 72)

Heteropora microclados Ehrenberg, 1834: p. 109.
Madrepora assimilis Brook, 1892: p. 452; 1893: p. 85, pl. 20, fig. A.

Specimens: MTQ: G43854, Nanwan, Tiaoshi; TUIO: C7225, Nanwan, Tiaoshi.

Diagnosis: Laboratory: Tabular or corymbose branching, with branches up to 8 mm in length and 5 mm in diameter; axial corallites outer diameter 1.3-1.8 mm, inner diameter 0.7-0.9 mm, primary septa to 1/2 R, secondary septa incomplete, to 1/4 R; many radial corallites are nariform or tubular with nariform openings rather than labelate, primary septa to 1/3 R, secondary septa absent or some present to 1/4 R; coenosteum costate on radial corallites, reticulate with scattered simple spinules or lines of spinules in intercorallite areas. **Field:** Colonies thick

plates: difficult to identify in the field; known colors pale pink-brown; probably a reef-edge species.

Remarks: This species is difficult to identify in the field, often being confused with *A. cerealis* or slender branching forms of *A. nasuta*.

***Acropora (Acropora) hyacinthus* (Dana, 1846)**
(Figs. 29, 30, 73)

Madrepora hyacinthus Dana, 1846: p. 444, pl. 32, fig. 2.

Madrepora patella Studer, 1878: p. 526, pl. 1, fig. 1.

Madrepora conferta Queich, 1886: p. 164, pl. 10, fig. 3.

Madrepora pectinata Brook, 1892: p. 460; 1893: p. 95, pl. 27, figs. D, E.

Madrepora recumbens Brook, 1892: p. 461; 1893: p. 106, pl. 27, fig. F.

Madrepora sinensis Brook, 1893: p. 114, pl. 33, fig. C.

Specimens: MTQ: G45798 -800, G45812, Penghu; G35496, Nanwan; G43842 -3, G46533, Nanwan, Tiaoshi; G47581, Lutao, Haisenping; G47600, Lutao, Nanliao; TUIO: C7226 -7, Nanwan, Tiaoshi; C7228 -9, Lutao.

Diagnosis: Laboratory: Tabular branching: from anastomosing, horizontal branches, vertical branchlets up to 15 mm long and 2 mm in diameter are given off; axial corallites outer diameter 1.4-2.0 mm, 0.5-1.1 mm, primary septa to 3/4 R, secondary septa absent or some present to 1/4 R; radial corallites crowded on branchlets, labellate with flaring lip and arranged in neat rosette around axial corallite, primary septa to 1/2 R, secondary septa to 1/4 R; coenosteum costate on radial corallites, reticulate with scattered laterally-flattened spinules in intercorallite areas. **Field:** Colonies are large tables or plates with a flat top on which the short, regular, rosette-like branchlets can be seen; known colors brown, brown with blue or pink edges, or blue; occurs intertidally on reef flats and subtidally on upper reef slopes and submerged reefs.

Remarks: Included with this species are some specimens from Penghu with a caespitose-corymbose form and longer than usual branchlets. These specimens, like the unusual *A. formosa* specimens referred to above, indicate unusual environmental conditions and/or differentiation events in the Taiwan Strait.

The *Acropora latistella* group

Colonies are corymbose with slender branches (around 5 mm in diameter). Radial corallites are appressed tubular with round openings.

***Acropora (Acropora) latistella* (Brook, 1892)**
(Figs. 31, 32, 74, 75)

Madrepora latistella Brook, 1892: p. 459; 1893: p. 112, pl. 9, fig. B.

Madrepora patula Brook, 1892: p. 460; 1893: p. 111, pl. 9, fig. E.

Acropora loricata Nemenzo, 1967: p. 113, pl. 32, figs. 1, 2.

Acropora imperfecta Nemenzo, 1971: p. 153, pl. 4, fig. 3.

Specimens: MTQ: G35541 Kenting National Park; G45906 -12, Maoao; G45923 -5, Shenao; G47610, Lutao, Haisenping; anastomosed form: G45928, G45929, Shenao; TUIO: C7230 -6, Maoao; C7237 -9, Shenao; C7240, Lutao.

Diagnosis: Laboratory: Corymbose branching, with compactly arranged terete branches up to 40 mm in length and 5 mm in diameter, forming thick plates with a side attachment; axial corallites outer diameter 2.0-3.0 mm, inner diameter 0.6-0.9 mm, primary septa to 3/4 R, secondary septa to 1/2 R; radial corallites as a group with well developed septa, primary septa to 1/2 R, secondary to 1/4 R; coenosteum lines of spinules both on radial corallites and in intercorallite areas. **Field:** Corymbose colonies with slender branches; known colors brown, yellow, yellow-gray, blue, or blue-brown; occurs subtidally on outer reef flats, reef slopes and submerged reefs.

Remarks: This hardy coral is common on Taiwan's reefs. In situations of strong current, the branches of the table become fully anastomosed, so that the colony forms a solid plate (Figs. 32, 75).

***Acropora (Acropora) subulata* (Dana, 1846)**
(Figs. 33, 76)

Madrepora subulata Dana, 1846: p. 448, pl. 32, fig. 3.

Madrepora frondosa Brook, 1893: p. 114, pl. 34, fig. E.

Specimens: MTQ: G45896, Penghu, Chinwan; G46530, Penghu.

Diagnosis: Laboratory: Tabular branching: branchlets of up to 4 mm diameter and 40 mm in length extending vertically from horizontal branches; axial corallites outer diameter 1.4-1.9 mm, inner diameter 0.8-1.2 mm, primary septa to 3/4 R, secondary septa to 1/2 R; radial corallites scattered labellate or tubular with oblique calice, primary septa to 1/3 R, secondary septa to 1/4 R; coenosteum costate on radial corallites, costate or reticulate between. **Field:** Large tables with regular and well-spaced upright branches which break easily; known color brown; found subtidally on submerged reef tops and gentle slopes.

Remarks: In the field this species is sometimes confused with *A. hyacinthus* and *A. cytherea*, as the size of the tables may be similar; however, the branches of this species are longer and more widely spaced than those of the other 2 species.

***Acropora (Acropora) nana* (Studer, 1878)**
(Figs. 34, 77)

Madrepora nana Studer, 1878: p. 533, pl. 2, fig. 6.

Specimens: MTQ: G45825 -6, G45829, Nanwan, Tiaoshi; TUIO: C7241 -4, Nanwan, Tiaoshi.

Diagnosis: Laboratory: Branches 4-10 mm diameter and up to 18 mm in length, arising vertically from a solid base or short stalk; axial corallites outer diameter 1.8-2.0 mm, inner diameter 0.9-1.0 mm, primary septa to R, secondary septa to 3/4 R; radial corallites regular in size, regularly arranged and just touching, appressed tubular with round to oval openings and outer wall extended upwards, sometimes giving a nariform appearance; primary septa to 1/2 R, secondary septa to 1/4 R; coenosteum dense reticulate with simple spinules or lines of simple spinules throughout. **Field:** Small rounded corymbose colonies (maximum colony diameter around 15 cm), with slender branches; known colors brown, blue, or purple; found at reef edge and subtidally around the top of the reef slope.

Remarks: This is a common species in Nanwan Bay, Kenting National Park. It is restricted to the Pacific Ocean, South China Sea, and northern and eastern parts of the Indo-Australian arc.

***Acropora (Acropora) aculeus* (Dana, 1846)**
(Figs. 35, 78)

Madrepora aculeus Dana, 1846: p. 450, pl. 32, fig. 6.

Specimens: MTQ: G45895, Penghu, Chinwan; G45914, Maoao; G45927, Shenao; G47587 -8, Lutao, Haisenping; G47589, Lutao, Chaikochiao; TUIO: C7245, Penghu, Chinwan; C7246, Maoao; C7247 -9, Lutao.

Diagnosis: Laboratory: Branching corymbose, short slender branchlets up to 4 mm diameter and 50 mm length, arising from a horizontal plate or table; axial corallites outer diameter 1.6-2.4 mm, inner diameter 0.8-1.0 mm, primary septa to 2/3 R, secondary septa absent or some present to 1/3 R; radial corallites regularly sized and arranged on branches, not touching, appressed tubular with round openings; primary septa to 1/2 R, secondary septa absent to just visible; coenosteum dense reticulate with simple spinules or lines of simple spinules throughout. **Field:** Flattened, corymbose colonies to about 40 cm diameter, with very slender vertical branchlets; known colors bright blue, bright yellow-green, brown, or blue-gray; occurs subtidally on reef slopes.

Remarks: This species co-occurs with *A. latistella*. Sometimes the 2 species can only be distin-

guished in the laboratory.

***Acropora (Acropora) azurea* Veron and Wallace, 1984**
(Figs. 36, 79)

Acropora azurea Veron and Wallace, 1984: p. 332, figs. 819, 821.

Specimens: MTQ: G35495, Nanwan.

Diagnosis: Laboratory: Caespitose branching, branches up to 80 mm long and 5 mm in diameter, mainly vertical from a solid base; axial corallites outer diameter 1.5-1.8 mm, inner diameter 0.6-0.8 mm, primary septa to 3/4 R, secondary septa absent or a few just visible; radial corallites primary septa to 2/3 R, secondary septa absent to some present to 1/4 R; coenosteum dense reticulate with simple spinules or lines of simple spinules throughout. **Field:** Small rounded colonies with slender branches up to 5.5 mm in diameter, known color bright blue; found intertidally or just subtidally on reef edge.

Remarks: This species is very similar to *A. nana*, and may be a synonym. This is the 1st record of this species outside the Great Barrier Reef.

The *Acropora nasuta* group

All species have corymbose colonies with branches around 8-10 mm diameter; radial corallites mostly nariform or appressed tubular with nariform openings.

***Acropora (Acropora) nasuta* (Dana, 1846)**
(Figs. 37, 80)

Madrepora nasuta Dana, 1846: p. 453, pl. 34, fig. 2.

Madrepora cymbicyathus Brook, 1893: p. 86.

Acropora nasuta Verrill, 1902: p. 257.

Specimens: MTQ: G35499 Nanwan; G45844 Nanwan, Tiaoshi.

Diagnosis: Laboratory: Corymbose branching, branches up to 12 mm in diameter arising from a central to side attachment; axial corallites outer diameter 2.0-3.0 mm, inner diameter 0.6-1.1 mm, primary septa to 3/4 R, secondary septa to 1/4 R; radial corallites evenly arranged nariform along branches, forming a neat rosette pattern when viewed from the branch tip, primary septa to 2/3 R, secondary septa to 1/4 R; coenosteum densely costate or lines of laterally flattened spinules on radial corallites, reticulate with scattered spinules in intercorallite areas. **Field:** Corymbose colonies, usually with a short thick stalk; known colors pale brown with blue tips, blue, purple, or green; found subtidally on reef edge, reef slope and submerged reefs.

Remarks: The closely related species *A. cerealis* is not included in the collection, but could be expected to be found on Taiwan's reefs, as it is found commonly throughout the Indo-Pacific (Veron and Wallace 1984, Veron 1993). The latter species has more elongate radial corallite openings and more slender branches than *A. nasuta*, giving a spiky appearance to the colony in the field. *A. cerealis* is always a pale brown or cream in color.

***Acropora (Acropora) valida* (Dana, 1846)**

(Figs. 38, 39, 81)

Madrepora valida Dana, 1846: p. 461, pl. 35, fig. 1.

Acropora dissimilis Verrill, 1902.

Specimens: MTQ: G35542, G45804, G45819 -20, Nanwan, Tiaoshi; G45801, Penghu; G45815, Penghu; G45898 -901, Chinwan; G45917 -22, G47604 -5, Maoao; G45930 -2, Shenao; G45939, Lutao, Nanliao; G47416 Keelung; G47577 -8, Lutao, Haisenping; G47594, Lutao, Chaikochiao; TUIO: C7250 -2, Nanwan, Tiaoshi; C7253 -7, Penghu; C7258 -61, Maoao; C7262 -3, Shenao; C7264 -6, Lutao.

Diagnosis: Laboratory: Corymbose to caespitocorymbose branches, 7-20 mm diameter; axial corallites outer diameter 1.6-2.8 mm, inner diameter 0.7-0.9 mm, primary septa to 1/2 R, secondary septa to 1/3 R; radial corallites similar sizes or a mixture of sizes, crowded on branch, appressed tubular or tubo-nariform, with rounded to slightly elongate openings, primary septa to 2/3 R, secondary septa to 1/4 R; coenosteum reticulate with densely and evenly arranged spinules throughout. **Field:** Small rounded corymbose to caespitocorymbose colonies or thick tables; known colors purple with yellow corallite tips or purple, brown, or green; found on outer reef flat, reef edge, and subtidally on upper reef slope and submerged reefs.

Remarks: The purple and yellow color combination is also seen in some colonies of *A. secale*, so that the 2 species are sometimes difficult to distinguish in the field. *A. valida* has more slender branches and lacks the prominent tubular radial corallites of *A. secale*.

***Acropora (Acropora) secale* (Studer, 1878)**

(Figs. 40, 82)

Madrepora secale Studer, 1878: p. 530.

Madrepora concinna Brook, 1891: p. 460; 1893: p. 165, pl. 17.

Madrepora diversa Brook, 1891: p. 461; 1893: p. 424, pl. 117, figs. 3-6.

Acropora otteri Crossland, 1952: p. 229, pl. 43, figs. 1, 2, pl. 44, figs. 1, 2.

Specimens: MTQ: G45813, G45818, Penghu.

Diagnosis: Laboratory: Corymbose or caespitocorymbose branching, branches 7-20 mm in diameter and 20-70 mm long; axial corallites outer diameter 2.4-3.3 mm, inner diameter 0.7-1.2 mm, primary septa to 3/4 R, secondary septa to 1/3 R; radial corallites a mixture of long tubular with round to nariform openings and shorter nariform, just touching and with the 2 types often arranged in separate rows along the branches, primary septa to 1/3 R, secondary septa absent or some present to 1/4 R; coenosteum a dense arrangement of spinules on radial corallites, reticulate with evenly distributed spinules in intercorallite areas. **Field:** Colonies corymbose or caespitocorymbose, side attached or with a central stalk; mixture of long tubular and short nariform corallites obvious; known colors purple with yellow corallite tips, brown, brown with blue branch tips, or green; found subtidally on reef flat, edge and upper slope.

Remarks: See notes for *A. valida* regarding field separation of the 2 species.

***Acropora (Acropora) lutkeni* Crossland, 1952**

(Figs. 41, 83)

Acropora lutkeni Crossland, 1952: p. 229, pl. 41, fig. 1, pl. 46, fig. 2.

Specimens: MTQ: G43853, Nanwan, Tiaoshi; G45937, G47596, Lutao, Chaikochiao; G47579, Lutao, Haisenping; TUIO: C7267, Nanwan, Tiaoshi; C7268 -70, Lutao.

Diagnosis: Laboratory: Irregular branching, with sturdy branches up to 45 mm in diameter, arising from a central to side-attached base but ending at different heights, sometimes corymbose; axial corallites outer diameter 2.6-4.3 mm, inner diameter 0.7-1.2 mm, primary septa to 2/3 R, secondary septa to 1/3 R; radial corallites in mixed sizes up to 5 mm long, touching or just separated on branches, tubular with mostly rounded or slightly nariform openings, primary septa to 1/3 R, secondary septa to 1/2 R; coenosteum a dense arrangement of laterally flattened spinules on radial corallites, reticulate with flaky spinules in intercorallite areas. **Field:** Corymbose to irregular caespitose colonies with sturdy branches in which can be seen the mixture of corallite lengths; known colors brown, purple, or blue; found on reef edge or subtidally on upper slopes and submerged reefs.

Remarks: Because of the irregular mode of growth, the appearance of colonies is variable, which makes *A. lutkeni* a difficult species to identify in the field. Corymbose colonies can be confused

with *A. secale*.

The *Acropora divaricata* group

Radial corallites open nariform with thickened outer walls; branches anastomosing; coenosteum reticulate with forked or simple spinules throughout.

Acropora (Acropora) clathrata (Brook, 1891)

(Figs. 42, 84)

Madrepora clathrata Brook, 1891: p. 459; 1893: p. 49, pl. 5, pl. 6, figs. A, B.

Madrepora complanata Brook, 1891: p. 459; 1893: p. 70, pl. 8, fig. C.

Madrepora orbicularis Brook, 1892: p. 460; 1893: p. 37, pl. 2.

Madrepora vasiformis Brook, 1893: p. 37, pl. 26, fig. A.

Specimens: MTQ: G43847, Nanwan, Tiaoshi; G45940, Lutao, Nanliao; G47575 -6, Lutao, Haisenping; G47593, Lutao, Chaikochiao; TUIO: C7271, Nanwan, Tiaoshi; C7272 -5, Lutao.

Diagnosis: Laboratory: Tabulate, branching beyond the stalk entirely horizontal or almost so, branches anastomosed and flattened, diameter 6-10 mm; axial corallites outer diameter 1.6-3.0 mm, inner diameter 0.5-0.9 mm, primary septa to 1/3 R, secondary septa absent or a few just visible as points; radial corallites evenly sized or of mixed sizes, closely arranged on branches, nariform or appressed tubo-nariform, sometimes with rostrate developments in the form of single or double extensions to the outer corallite wall, primary septa absent or a few just visible as points, secondary septa absent; coenosteum costate or lines of densely arranged laterally flattened or forked spinules on radial corallites, reticulate with scattered spinules in intercorallite areas. **Field:** Large tables or side-attached plates with a very flat surface; known colors brown, blue, lavender, or green; found subtidally on reef tops, slopes, and walls, to about 15 m depth.

Remarks: This species is very distinctive and not readily confused with any other; branch thickness varies from very sturdy to quite delicate, the table top can be heavily anastomosed or open, and radial corallites vary from evenly sized and shaped to very irregular.

Acropora (Acropora) divaricata (Dana, 1846)

(Fig. 85)

Madrepora divaricata Dana, 1846: p. 477, pl. 41, fig. 2, 2a.

Madrepora tenuispicata Studer, 1880: - Singapore.

Madrepora scabrosa Quelch, 1886: -Fiji.

Specimens: MTQ: G45805, Nanwan, Tiaoshi; G47608, Penghu, Fenguei; TUIO: C7276, Penghu,

Fenguei.

Diagnosis: Laboratory: Branching open caespitocorymbose with branches up to 15 mm diameter curving and anastomosing to form a network within the colony; axial corallites outer diameter 1.8-3.0 mm, inner diameter 0.7-1.1 mm, primary septa to 1/2 R, secondary septa to 1/4 R; radial corallites evenly sized and spaced on branches, just touching, nariform, with large, open calices; distal radial corallites are tubo-nariform and towards the base of branches they may be appressed tubular; sometimes walls extended outwards by a rostrate development, primary septa to 1/2 R, secondary septa to 1/4 R; coenosteum reticulate with dense arrangement of rows of laterally flattened or forked spinules on radial corallites, reticulate with spinules less densely arranged in intercorallite areas. **Field:** Colonies have a distinctive divergent branching pattern within a bracket or rounded arborescent table; known colors brown or greenish brown, usually with blue branch tips; found subtidally on reef slopes.

Remarks: The few specimens of this species recorded in Taiwan may actually be juveniles of *Acropora solitaryensis* (see below). For illustrations of this species see Veron and Wallace (1984).

Acropora (Acropora) solitaryensis Veron and Wallace, 1984

(Figs. 43, 86)

Acropora solitaryensis Veron and Wallace, 1984: p. 371, figs. 916, 922, 928.

Specimens: MTQ: G45830 -2, G45835 -7, G46532, Nanwan, Tiaoshi; G47585, Lutao, Haisenping; G47602, Shenao; G47603, Maoao; TUIO: C7277 -83, Nanwan, Tiaoshi; C7284, Lutao; C7285, Shenao; C7286, Maoao.

Diagnosis: Laboratory: Anastomosing branches with curved secondary branches rising from them; axial corallites outer diameter 1.6-3.4 mm, inner diameter 0.5-1.1 mm, primary septa to 1/2 R, secondary septa to 1/4 R; radial corallites evenly sized and arranged, large appressed tubular with nariform openings, primary septa to 1/3 R, secondary septa to 1/4 R; coenosteum reticulate with dense arrangement of rows of laterally flattened or forked spinules on radial corallites, reticulate with spinules less densely arranged in intercorallite areas. **Field:** Occurs as stalked tables up to 3 m in diameter with widely spaced and anastomosing branchlets and large, obvious, radial corallites; known colors brown or greenish brown, usually with blue edge to table; found subtidally on reef slopes and submerged reefs.

Remarks: This species looks like a flattened version of *A. divaricata*, with lower branches so much anastomosed that they sometimes form a solid plate. Although it is a very common species in Taiwan as well as Indonesia and the South China Sea, it is rare on the Great Barrier Reef and was described from latitudes south of the Great Barrier Reef (Veron and Wallace 1984).

The *Acropora echinata* group

Species with hispidose ("bottlebrush") branching form due to the presence of evenly distributed secondary branchlets, each consisting of an axial corallite with a few radial corallites developed along it; radial corallites tubular or tubular appressed; coenosteum costate or with lines of elaborated spinules throughout.

Acropora (Acropora) elseyi (Brook, 1892) (Figs. 44, 87)

Madrepora elseyi Brook, 1892: p. 456; 1893: p. 172, pl. 11, figs. E, F.

Madrepora exilis Brook, 1892: p. 457; 1893: p. 172, pl. 10, figs. C, D.

Specimens: MTQ: G45777, Penghu; G45833, Nanwan, Tiaoshi; TUIO: C7287, Nanwan, Tiaoshi.

Diagnosis: Laboratory: Hispidose branching pattern, branchlets of irregular length; axial corallites outer diameter 1.6-3.2 mm, inner diameter 0.5-1.0 mm, primary septa to 2/3 R, secondary septa only a few present, to 1/4 R; radial corallites appressed tubular with oblique openings and slightly thickened outer wall, primary septa present to 1/3 R, secondary septa absent to a few just visible; coenosteum both on and between radials is a dense arrangement of elaborate spinules. **Field:** Colonies have irregular hispidose shape ranging from compact "bottlebrush" branches to shrubby and arborescent forms; known colors white, brown with white branch tips, brown, or bright yellow; found at low tide and shallow subtidal habitats.

Remarks: The 2 specimens identified as this species in Taiwan are somewhat in doubt, as they are small. At the Penghu Islands, the large assemblages of variable *Acropora formosa* may also contain some colonies of *A. elseyi*.

The *Acropora florida* group

The 2 species in this group both have sturdy hispidose branches and large rounded appressed corallites.

Acropora (Acropora) florida (Dana, 1846) (Figs. 45, 88)

Madrepora florida Dana, 1846: p. 466, pl. 37, fig. 1.

Madrepora graviga Dana, 1846: p. 470.

Madrepora ornata Brook, 1891: p. 464.

Madrepora affinis Brook, 1893: p. 60, pl. 28, fig. F.

Specimens: MTQ: G43845, Nanwan, Tiaoshi; G45913, Maoao; G45926, Shenao; G45933 -4, Lutao, Haisenping; TUIO: C7288, Nanwan, Tiaoshi; C7289, Shenao; C7290, Maoao; C7291 -2, Lutao.

Diagnosis: Laboratory: Branches hispidose with evenly distributed short secondary branches; axial corallites outer diameter 2.0-3.0 mm, inner diameter 0.8-1.4 mm, primary septa up to 2/3 R, secondary septa to 1/2 R; radial corallites evenly sized and distributed, with rounded lower wall, approaching a lipped shape, primary septa to 1/2 R, secondary septa to 1/4 R; coenosteum costate on radial corallites, reticulate in intercorallite areas. **Field:** Colonies have sturdy upright or horizontal hispidose branches (mostly horizontal in Taiwan colonies); known colors greenish or pinkish brown, yellow or brown; found subtidally on reef tops and slopes.

Remarks: This is a very broadly distributed species. On Taiwan reefs, colonies usually occur as tables with the separate branching units still being recognized. The secondary branches are only developed on the upper surface.

Acropora (Acropora) sarmentosa (Brook, 1892)

Madrepora sarmentosa Brook, 1892: p. 462; 1893: p. 127, pl. 22.

Acropora vermiculata Nemenzo, 1967: p. 108, pl. 31, fig. 4.

Specimens: MTQ: G47613, Nanwan.

Diagnosis: Laboratory: Branching hispidose, branchlets more strongly developed on upper surface; axial corallites outer diameter 3.0-4.0 mm, inner diameter 1.0-2.0 mm, primary septa to 3/4 R, secondary septa to 1/2 R; radial corallites evenly sized and arranged, touching, rounded tubular, primary septa to 2/3 R, secondary septa to 1/4 R; coenosteum a dense reticulum with evenly distributed laterally flattened or slightly elaborated spinules throughout. **Field:** Colonies usually have 1 or 2 thick, hispidose branching units which extend horizontally; large, rounded corallites can be seen in the field; known colors pinkish or greenish brown; found subtidally on reef tops and slopes.

Remarks: This species appears to be uncommon in Taiwan and the specimen examined shows a more open arrangement of secondary branches than that described in Wallace (1978) or Veron and Wallace (1984).

Subgenus *Isopora*

Species in this subgenus have a tendency for multiple axial corallites or no axial corallites, leading to thickened, wedge-shaped (cuneiform) branches or no branches at all. Coenosteum consists of a dense arrangement of horizontally elongated, elaborated spinules both on and between corallites.

Acropora (Isopora) palifera (Lamarck, 1816) (Figs. 46, 89)

Astrea palifera Lamarck, 1816: p. 262.

Madrepora labrosa Dana, 1846: p. 486, pl. 43, fig. 3.

Acropora prominens Nemenzo, 1967: p. 139, pl. 15, fig. 2.

Specimens: MTQ: G45935, Lutao, Haisenping; G45938, Lutao, Nanliao; TUIO: C7293 -4, Lutao.

Diagnosis: Laboratory: Branches are thick, cuneiform, with many axial corallites; axial corallites outer diameter 2.8 to 4.2 mm, inner diameter 0.7 to 1.4 mm, primary septa up to R, secondary septa up to 1/3 R; radial corallites large, 1.0 to 5.0 mm long, appressed tubular with distinct dimidiate openings; primary septa up to R, secondary septa up to 1/3 R; coenosteum a dense arrangement of horizontally elongated, elaborated spinules both on and between radial corallites. **Field:** Colonies have thick branches with multiple axial corallites opening along the tip of the branch; large radial corallites obvious, sometimes dimidiate openings can be seen; known colors brown or green; found on deeper parts of reef flat, reef slopes and subtidally, sometimes occurs in an encrusting form on the reef edge.

Remarks: This is the most common isoporan species, occurring throughout the Indian and Pacific Oceans as well as the central Indo-Pacific. In Taiwan, it is rare in southern Taiwan and more abundant in the offshore Pacific Ocean islands.

Acropora (Isopora) brueggemanni (Brook, 1893) (Fig. 47)

Madrepora brueggemanni Brook, 1893: p. 145, pl. 24, p. 35, fig. E.

Acropora meridiana Nemenzo, 1971: p. 146, pl. 1, fig. 3.

Specimen: G35498 Nanwan.

Diagnosis: Laboratory: Arborescent branches have 1 or 2 axial corallites (sometimes more) with outer diameter 2.9-4.5 mm, inner diameter 1.0-1.6 mm; primary septa present up to 3/4 R, secondaries up to 1/3 R; radial corallites conical or tubular appressed with round openings; coenosteum a dense arrangement of horizontally elongated, elaborated spinules both on and between corallites. **Field:** Ar-

borescent branching, branches thick and radial corallites obvious; known colors brown, pale green, or white; found on subtidal reef flats, reef edge, or upper slope.

Remarks: This species is distributed throughout the central part of the Indo-Pacific, including the northern part of the Great Barrier Reef, but not in other parts of the Pacific, where it is replaced by another isoporan species, *A. cuneata*.

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臺灣之石珊瑚 (IV)：軸孔珊瑚屬之分類整理

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本文報導臺灣產軸孔珊瑚屬的分類整理，經由野外採集和標本鑑定，總共記錄了產自臺灣附近海域的四十種軸孔珊瑚，並對各種做簡明的描述和圖示。這四十種軸孔珊瑚分別是：*Acropora humilis* (趾形軸孔珊瑚)、*A. gemmifera* (芽枝軸孔珊瑚)、*A. samoensis* (三毛亞軸孔珊瑚)、*A. digitifera* (指形軸孔珊瑚)、*A. verweyi* (小叢軸孔珊瑚)、*A. glauca* (板葉軸孔珊瑚)、*A. robusta* (強壯軸孔珊瑚)、*A. danai* (達氏軸孔珊瑚)、*A. intermedia* (中間軸孔珊瑚)、*A. listeri* (列枝軸孔珊瑚)、*A. formosa* (美麗軸孔珊瑚)、*A. acuminata* (繁枝軸孔珊瑚)、*A. valenciennesi* (華倫軸孔珊瑚)、*A. microphthalma* (小葉軸孔珊瑚)、*A. austera* (簡單軸孔珊瑚)、*A. pulchra* (叉枝軸孔珊瑚)、*A. millepora* (多孔軸孔珊瑚)、*A. tenuis* (柔枝軸孔珊瑚)、*A. donei* (童氏軸孔珊瑚)、*A. yongei* (楊氏軸孔珊瑚)、*A. cytheria* (輻板軸孔珊瑚)、*A. microclados* (灌叢軸孔珊瑚)、*A. hyacinthus* (桌形軸孔珊瑚)、*A. latistella* (盤枝軸孔珊瑚)、*A. subulata* (淺盤軸孔珊瑚)、*A. nana* (細枝軸孔珊瑚)、*A. aculeus* (尖銳軸孔珊瑚)、*A. azurea* (天藍軸孔珊瑚)、*A. nasuta* (鼻形軸孔珊瑚)、*A. valida* (變異軸孔珊瑚)、*A. secale* (穗枝軸孔珊瑚)、*A. lutkeni* (粗短軸孔珊瑚)、*A. clathrata* (方格軸孔珊瑚)、*A. divaricata* (兩叉軸孔珊瑚)、*A. solitaryensis* (單獨軸孔珊瑚)、*A. elseyi* (旁枝軸孔珊瑚)、*A. florida* (佛州軸孔珊瑚)、*A. sarmentosa* (短小軸孔珊瑚)、*A. palifera* (籬枝軸孔珊瑚)、*A. brueggemanni* (鈍枝軸孔珊瑚)。基本上，臺灣海域的軸孔珊瑚相是太平洋或印度太平洋軸孔珊瑚相的一部分，臺灣產的所有四十種軸孔珊瑚都出現於澳洲的太平洋岸，其中有二種 (*A. verweyi* 及 *A. azurea*) 未曾在印度太平洋中部(印尼)海域發現，而 *A. verweyi* 也在西印度洋出現。台灣海峽澎湖海域的優勢種 *A. formosa* 具有數個複雜形態的族群，其種的分化和分界值得進一步研究。臺灣海域的軸孔珊瑚相與澳洲大堡礁緯度相似的 *Capricorn* 島群(四十九種)比較，顯示兩地的種類組成相似性高達 89%；但是臺灣海域軸孔珊瑚的總種數比鄰近地區，如日本海域(七十四種)、菲律賓海域(六十七種)、印尼海域(八十九種)、南中國海(五十一種)都較少，這些差異可能是由於調查頻度和種類認定的標準不同所致；此外，臺灣海域的珊瑚礁面積較小、棲地型態較少，也可能是導致軸孔珊瑚種數較少的原因。

關鍵詞：軸孔珊瑚，石珊瑚，分類，臺灣。

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