

## Cnidaria Anthozoa: Deep-water azooxanthellate Scleractinia from Vanuatu, and Wallis and Futuna Islands

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### ABSTRACT

A total of 134 Recent species of azooxanthellate Scleractinia are reported from the Vanuatu (116 species) and Wallis and Futuna (83 species) Archipelagos, all but one being new records for this region of the tropical central Pacific. The newly reported specimens originate primarily from the MUSORSTOM 7 and 8 expeditions, including approximately 4400 specimens from 227 stations, most of these stations from deeper than 100 m. Sixteen new species and one new subspecies are described, and two new combinations are proposed: *Asterosmilia gigas* and *Javania fusca*. Tables of comparison are provided for the Indo-Pacific species of *Fungiacyathus* (*Fungiacyathus*); the Recent *Trochocyathus* (*Aplocyathus*); all species of *Aulocyathus*; all species of spined *Deltocyathus*; and the Recent species and subspecies of *Anthemiphyllia*. To facilitate comparisons of species among these taxa, three additional species having distributions other than the Vanuatu/Wallis and Futuna region are described as new: *Deltocyathus corrugatus*, *Anthemiphyllia multidentata*, and *A. macrolobata*.

The distribution and bathymetric ranges of the 134 species known from the Vanuatu/Wallis and Futuna region are tabulated. Within the tropical central Pacific these corals show a strong affinity with those from the ridges and islands north of New Zealand (56 species) and a lesser relationship with the Hawaiian Island fauna (24 species). Other regions in the central Pacific are too poorly known for comparison. Beyond the tropical central Pacific, the Vanuatu/Wallis and Futuna fauna is part of the larger Indo-Polynesian province, sharing 95 (71%) of its species with the tropical western Pacific and 62 species (46%) with the Indian Ocean. Only seven species are found in common with the tropical eastern Pacific and 11 with the Atlantic Ocean. Finally, 43 species from the Vanuatu/Wallis and Futuna Archipelagos are also known from temperate Japan (exclusive of the Ryukyu Islands) and 32 from temperate New Zealand and southern Australia.

Examples of commensal/parasitic relationships are reported to occur with petraroid ascithoracican crustaceans (2 coral hosts) and acrothoracican cirripede crustaceans (8 hosts). The shells of the gastropod *Xenophora* ("carrier shells") were found to be effective collectors of deep-water corals; a total of 19 coral species were found incorporated into the shells, including three species that were found only on these shells and another five species that were otherwise very rarely collected by conventional means.

## RÉSUMÉ

**Cnidaria Anthozoa : Scléractiniaux d'eau profonde sans zooxanthelles du Vanuatu et des îles Wallis et Futuna.**

Cent-trente-quatre espèces récentes de Scléractiniaux sans zooxanthelles sont recensées dans l'archipel du Vanuatu (116 espèces) et aux îles Wallis et Futuna (83 espèces). À une exception près, il s'agit de signalisations nouvelles pour cette région du Pacifique central tropical. Le matériel étudié provient essentiellement des campagnes MUSORSTOM 7 et 8 et comprend environ 4400 spécimens provenant de 227 stations, le plus souvent à plus de 100 m de profondeur. Seize espèces nouvelles (*Fungiacyathus sandoi*, *Anthemiphyllia spinifera*, *Caryophyllia abrupta*, *Oxysmilia corrugata*, *O. epithecata*, *Trochocyathus efateensis*, *T. patelliformis*, *Polycyathus octuplus*, *Deltocyathus crassiseptum*, *D. cameratus*, *Conotrochus asymmetros*, *Lochmaeotrochus gardineri*, *Cryptotrochus brevivalis*, *Flabellum arcuatile*, *Truncatoflabellum vigintifarium*, et *Javania exserta*) et une sous-espèce nouvelle (*Anthemiphyllia patera costata*) sont décrites et 2 combinaisons nouvelles sont proposées (*Asterosmilai gigas* et *Javania fusca*). Des tableaux de comparaison sont fournis pour les espèces indo-pacifiques de *Fungiacyathus* (*Fungiacyathus*), les espèces récentes de *Trochocyathus* (*Aplocyathus*), toutes les espèces d'*Aulocyathus*, toutes les espèces de *Deltocyathus* à épines et les espèces et sous-espèces d'*Anthemiphyllia*. Afin de faciliter les comparaisons, trois espèces nouvelles d'origine autre que MUSORSTOM 7 et 8 (*Deltocyathus corrugatus*, *Anthemiphyllia multidentata*, et *A. macrolobata*) sont incluses dans les tableaux.

Les répartitions géographique et bathymétrique des 134 espèces connues du Vanuatu et de Wallis et Futuna sont rassemblées dans un tableau. À l'intérieur du Pacifique central tropical, la faune étudiée ici a une forte affinité avec celle des rides et îles se trouvant au nord de la Nouvelle-Zélande (56 espèces) et une affinité moindre avec la faune des îles Hawaii (24 espèces). Les autres régions du Pacifique central sont trop peu connues pour être comparées. Au vu de leur faune, la région du Vanuatu et celle de Wallis et Futuna font partie de la large province biogéographique indo-polynésienne. Elles ont en commun 95 espèces (71%) avec le Pacifique occidental tropical et 62 (46%) avec l'océan Indien. Seules sept espèces sont connues aussi dans le Pacifique oriental tropical et onze dans l'Atlantique. Par ailleurs, si l'on compare cette faune à celles de quelques régions tempérées du Pacifique, on relève que 43 des 134 espèces recensées au Vanuatu et aux îles Wallis et Futuna sont connues aussi au Japon et 32 en Nouvelle-Zélande et dans l'Australie du Sud.

Les relations commensales ou parasites observées concernent les crustacés ascothoraciques Petrarciidae (deux espèces hôtes) et les crustacés cirripèdes acrothoraciques (huit espèces hôtes). Des coraux de profondeur sont souvent incorporés dans les coquilles des gastéropodes *Xenophora*. Dix-neuf espèces de coraux ont ainsi été trouvées sur ces coquilles "porteuses"; dont trois n'ont pas été récoltées autrement et cinq n'ont été que très rarement récoltées par les engins de capture conventionnels.

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## INTRODUCTION

The azooxanthellate corals of Vanuatu, Wallis, and Futuna Archipelagos are representative of the tropical central Pacific, which, in turn, is very closely tied to that of the Indo-West Pacific fauna. For the purpose of this study, the tropical central Pacific is defined as those islands east of the Philippines, Indonesia, New Guinea, and Australia, and extending to the Tuamotu Archipelago in the east, the Hawaiian Islands to the north, and the Kermadec Islands to the south. Although this vast region was and is still not comprehensively sampled, the intensive MUSORSTOM collections provide a good basis for the deep-water coral fauna for this province, and provide zoogeographic data for one of the last poorly-known deep-water coral faunas. It should be noted that, whereas Table 1 lists all papers pertaining to azooxanthellates in the central tropical Pacific, the MUSORSTOM collections made very few collections shallower than 200 m or deeper than 1500 m, which reduces the number of species reported herein.

## LIST OF ABBREVIATIONS

### MUSEUMS:

<b>MNHN</b>	Muséum National d'Histoire Naturelle, Paris.
<b>MoNZ</b>	Museum of New Zealand Te Papa Tonga-rewa, Wellington (formerly the National Museum of New Zealand: <b>NMNZ</b> ).
<b>NHM</b>	The Natural History Museum, London (formerly the British Museum (Natural History): <b>BMNH</b> ).
<b>NMV</b>	National Museum Victoria, Melbourne.
<b>NMNH</b>	National Museum of Natural History, Smithsonian, Washington, D. C.
<b>NZOI</b>	New Zealand Oceanographic Institute, Wellington.
<b>USNM</b>	United States National Museum, now the National Museum of Natural History, Smithsonian, Washington, D.C.
<b>YPM</b>	Yale Peabody Museum, New Haven.
<b>ZMB</b>	Zoologisches Museum, Berlin.

### EXPEDITIONS AND VESSELS:

Throughout the paper, the names of vessels are given in italics and quotation marks.

<b>BANZARE</b>	British, Australian, New Zealand Antarctic Research Expedition, 1929-1931.
<b>CANCAP III</b>	<i>"Tydeman"</i> , Madeira-Mauritania Expedition 1978. Initiated by the Nationaal Natuurhistorisch Museum (Leiden). Named for <b>Canaries</b> and <b>Cape Verde</b> Islands.
<b>HURL</b>	Hawaiian Underseas Research Laboratory.
<b>KARUBAR</b>	French-Indonesian expedition (1991) that collected in the southeastern Banda Sea. Named for the <b>Kai</b> , <b>Aru</b> , and <b>Tanimbar</b> Islands.
<b>MUSORSTOM</b>	Cruises organized jointly by the Muséum National d'Histoire Naturelle and the Institut Français de Recherche Scientifique pour le Développement en Coopération (formerly: Office de la Recherche Scientifique et Technique d'Outre-Mer, = <b>ORSTOM</b> ).
<b>USGS</b>	United States Geological Survey.

### MORPHOLOGICAL TERMS:

<b>CD</b>	Calicular diameter.
<b>GCD</b>	Greater calicular diameter.
<b>GCD:LCD</b>	Ratio of greater calicular diameter to lesser calicular diameter.

- PD** Pedicel diameter.  
**PD:GCD** Ratio of pedicel diameter to greater calicular diameter of a solitary corallum.  
**S<sub>x</sub>, C<sub>x</sub>, P<sub>x</sub>** Septa, costae, or pali (respectively) of cycle designated by numerical subscript.  
**S<sub>x</sub> > S<sub>y</sub>** In the context of a septal formula, septa of cycle x more wide than septa of cycle y.

### COMBINED LIST OF STATIONS AND OF SPECIES OBTAINED PER STATION

This list provides the data for all stations mentioned in this report. Vessels and expeditions are listed alphabetically, whereas listing of species per station follows the order of the text. If the specimen was collected as a result of being cemented to a *Xenophora* gastropod shell, the species name is followed by an X in brackets.

#### BANZARE

Stn 115. — 24.03.1931, 41°03'S, 148°42'E, 128 m, northeastern Tasmania: *Anthemiphyllia multidentata*.

#### CANCAP

Stn 3.053. — 20.10.1978, 32°25'N, 16°57'W, 2850-3010 m, south of Madeira: *Truncatoflabellum stabile*.

#### HURL

Stn 83-202. — 16.10.1983, 16°41'12"N, 169°24'18"W, 183 m, Johnston Atoll: *Madracis kauaiensis*.

Stn P5-063. — 23.05.1988, 20°35.8'N, 156°03.5'W, 1020 m, Alenuihaha, Hawaiian Is: *Trochocyathus (Trochocyathus) patelliformis*.

#### KARUBAR, "Baruna Jaya I"

Stn 5. — 22.10.1991, 5°46'39"S, 132°20'04"E, 285-323 m, Kai Is: *Trochocyathus (Trochocyathus) vasiformis*.

Stn 18. — 24.10.1991, 5°17'49"S, 133°01'51"E, 205-212 m, Kai Is: *Anthemiphyllia spinifera*.

Stn 44. — 29.10.1991, 7°52'27"S, 132°48'24"E, 291-295 m, Tanimbar Is: *Javania exserta*.

Stn 49. — 29.10.1991, 7°59'51"S, 132°58'50"E, 206-209 m, Tanimbar Is: *Javania exserta*.

Stn 86. — 04.11.1991, 9°23'59"S, 131°14'29"E, 222-226 m, Tanimbar Is: *Javania exserta*.

#### KIMBLA

Stn K7/73-37. — 23.11.1973, 39°02.0'S, 148°36.5'E, 256 m, northeastern Tasmania: *Anthemiphyllia multidentata*.

#### MUSORSTOM 1, "Vauban"

Stn 65. — 27.03.1976, 14°00.0'N, 120°19.2'E, 194-202 m, SW Luzon, Philippines: *Javania exserta*.

#### MUSORSTOM 3, "Coriolis"

Stn 87. — 31.05.1985, 14°00.6'N, 120°19.6'E, 191-197 m, SW Luzon, Philippines: *Aulocyathus juvenescens*.

#### MUSORSTOM 7, "Alis"

Stn 494. — 10.05.1992, 14°18.9'S, 178°03.0'W, 100-110 m, Futuna: *Polycyathus octuplus*, *Heterocyathus* cf. *sulcatus*, *Heteropsammia cochlea*

Stn 495. — 10.05.1992, 14°19.2'S, 178°04.3'W, 180-210 m, Futuna: *Heterocyathus* cf. *sulcatus*, *Conotrochus asymmetros*, *Truncatoflabellum phoenix*, *Heteropsammia cochlea*.

- Stn 496. — 10.05.1992, 14°19.6'S, 178°04.3'W, 250-330 m, Futuna: *Madracis kauaiensis*, *Caryophyllia* (*Acanthocyathus*) *grayi*, *Oxysmilia epithecata*, *Trochocyathus* (*Trochocyathus*) *philippinensis*, *Polycyathus octuplus*, *Heterocyathus* cf. *sulcatus*, *Conotrochus asymmetros*, *Thalamophyllia tenuescens*, *Balanophyllia desmophyllioides*, *Heteropsammia cochlea*.
- Stn 499. — 10.05.1992, 14°19.6'S, 178°04.6'W, 290-395 m, Futuna: *Madracis kauaiensis*, *Madrepora porcellana*, *Caryophyllia* (*Acanthocyathus*) *grayi*, *Trochocyathus* (*Trochocyathus*) *maculatus*, *Polycyathus octuplus*, *Thalamophyllia tenuescens*, *Dactyloctrochus cervicornis*, *Truncatoflabellum vanuatu*, *Javania exserta*, *Endopachys grayi*.
- Stn 500. — 11.05.1992, 14°19.5'S, 178°04.1'W, 350-394 m, Futuna: *Madracis kauaiensis*, *Madrepora porcellana*, *Balanophyllia desmophyllioides*.
- Stn 501. — 11.05.1992, 14°19.8'S, 178°06.1'W, 500-530 m, Futuna: *Truncatoflabellum angustum*, *Enallopsammia rostrata*.
- Stn 502. — 11.05.1992, 14°19.8'S, 178°06.5'W, 516-535 m, Futuna: *Madracis kauaiensis*, *Madrepora oculata* forma *tenuis*, *M. porcellana*, *Caryophyllia* (*Caryophyllia*) *lamellifera*, *Crispatotrochus rubescens*, *Truncatoflabellum angustum*, *Balanophyllia desmophyllioides*.
- Stn 504. — 11.05.1992, 14°19.6'S, 178°04.5'W, 300-390 m, Futuna: *Madracis kauaiensis*, *Caryophyllia* (*Caryophyllia*) *hawaiiensis*, *Trochocyathus* (*Trochocyathus*) *maculatus*, *Polycyathus octuplus*, *Conotrochus asymmetros*, *Thalamophyllia tenuescens*, *Dactyloctrochus cervicornis*, *Guynia annulata*, *Flabellum* (*Flabellum*) *pavoninum*, *Endopachys grayi*, *Heteropsammia cochlea*.
- Stn 505. — 11.05.1992, 14°19.5'S, 178°04.3'W, 245-400 m, Futuna: *Trochocyathus* (*Trochocyathus*) *maculatus*, *Truncatoflabellum vanuatu*.
- Stn 506. — 11.05.1992, 14°19.8'S, 178°05.0'W, 400 m, Futuna: *Dendrophyllia alcocki*.
- Stn 507. — 11.05.1992, 14°19.6'S, 178°06.7'W, 419-425 m, Futuna: *Madracis kauaiensis*, *Madrepora oculata* forma *formosa*, *Crispatotrochus rubescens*, *Oxysmilia epithecata*, *Endopachys grayi*.
- Stn 508. — 11.05.1992, 14°19.5'S, 178°04.5'W, 245-400 m, Futuna: *Madracis kauaiensis*, *Madrepora porcellana*, *Trochocyathus* (*Trochocyathus*) *maculatus*.
- Stn 509. — 12.05.1992, 14°14.8'S, 178°11.5'W, 200-240 m, Futuna: *Madracis kauaiensis*, *Madrepora porcellana*, *Oxysmilia epithecata*, *Trochocyathus* (*Trochocyathus*) *maculatus*, *Polycyathus octuplus*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Heterocyathus* cf. *sulcatus*, *Conotrochus asymmetros*, *Thalamophyllia tenuescens*, *Rhizosmilia robusta*, *Idiotrochus kikutii*, *Truncatoflabellum phoenix*, *T. vanuatu*, *Balanophyllia desmophyllioides*, *Heteropsammia cochlea*.
- Stn 510. — 12.05.1992, 14°14.5'S, 178°11.5'W, 280-370 m, Futuna: *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Heterocyathus* cf. *sulcatus*, *Asterosmilia gigas*.
- Stn 511. — 12.05.1992, 14°14.0'S, 178°11.5'W, 400-450 m, Futuna: *Anthemiphyllia dentata*, *Crispatotrochus rubescens*, *C. rugosus*, *Oxysmilia epithecata*, *Tethocyathus virgatus*, *Bourneotrochus stellulatus*, *Deltocyathus crassiseptum*, *Deltocyathus stella*, *Conotrochus funiculocolumna*, *C. brunneus*, *Rhizotrochus flabelliformis*.
- Stn 512. — 12.05.1992, 14°13.5'S, 178°10.3'W, 210-245 m, Futuna: *Madrepora porcellana*, *Anthemiphyllia spinifera*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Heterocyathus* cf. *sulcatus*, *Conotrochus asymmetros*, *Thalamophyllia tenuescens*, *Dactyloctrochus cervicornis*, *Deltocyathoides orientalis*, *Idiotrochus kikutii*, *Truncatoflabellum phoenix*, *Balanophyllia desmophyllioides*, *Heteropsammia cochlea*.
- Stn 513. — 12.05.1992, 14°13.5'S, 178°10.8'W, 260-300 m, Futuna: *Madrepora minutiseptum*, *M. porcellana*, *Anthemiphyllia spinifera*, *Polycyathus octuplus*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Heterocyathus* cf. *sulcatus*, *Conotrochus brunneus*, *C. asymmetros*, *Thalamophyllia tenuescens*, *Dactyloctrochus cervicornis*, *Idiotrochus kikutii*, *Guynia annulata*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum phoenix*, *Javania exserta*.
- Stn 514. — 12.05.1992, 14°13.3'S, 178°10.7'W, 349-355 m, Futuna: *Madrepora porcellana*, *Anthemiphyllia spinifera*, *Oxysmilia epithecata*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *D. heteroclitus*, *Heterocyathus* cf. *sulcatus*, *Thalamophyllia tenuescens*, *Dactyloctrochus cervicornis*, *Truncatoflabellum phoenix*, *Javania exserta*, *Dendrophyllia alcocki*.

- Stn 515. — 12.05.1992, 14°13.5'S, 178°10.3'W, 224-252 m, Futuna: *Madracis kauaiensis*, *Madrepora minutiseptum*, *M. porcellana*, *Dactylotrachus cervicomis*, *Asterosmilia gigas*.
- Stn 516. — 12.05.1992, 14°13.5'S, 178°11.6'W, 441-550 m, Futuna: *Polycyathus octuplus*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Heterocyathus cf. sulcatus*, *Conotrochus asymmetros*, *Flabellum (Flabellum) pavoninum*, *Truncatoflabellum phoenix*, *Endopachys grayi*, *Heteropsammia cochlea*.
- Stn 517. — 12.05.1992, 14°13.4'S, 178°10.4'W, 233-235 m, Futuna: *Madrepora minutiseptum*.
- Stn 520. — 13.05.1992, 14°10.6'S, 176°16.7'W, 920-930 m, Wallis: *Deltocyathus cameratus*, *Javania lamprotichum* (or station 521), *Enallopsammia rostrata*.
- Stn 521. — 13.05.1992, 14°11.0'S, 176°17.3'W, 890-915 m, Wallis: *Javania lamprotichum* (or station 520).
- Stn 522. — 13.05.1992, 13°10.7'S, 176°15.0'W, 650-765 m, Wallis: *Fungiacyathus (Fungiacyathus) pusillus pacificus*, *Anthemiphyllia dentata*, *A. patera costata*, *Caryophyllia (Caryophyllia) abrupta*, *Trochocyathus (Trochocyathus) vasiformis*, *Tethocyathus virgatus*, *Deltocyathus suluensis*, *D. taiwanicus*, *Conotrochus funiculumna*, *Enallopsammia rostrata*.
- Stn 523. — 13.05.1992, 13°12.0'S, 176°15.6'W, 455-515 m, Wallis: *Fungiacyathus (Fungiacyathus) sandoi*, *Stephanophyllia complicata*, *Caryophyllia (Caryophyllia) abrupta*, *Crispatotrochus rubescens*, *C. rugosus*, *Oxysmilia epithecata*, *Trochocyathus (Aplocyathus) hastatus*, *Deltocyathus taiwanicus*, *D. crassiseptum*, *D. stella*, *Conotrochus funiculumna*, *Asterosmilia gigas*, *Deltocyathoides orientalis*, *Flabellum (Flabellum) pavoninum*, *Truncatoflabellum mortenseni*, *Javania exserta*.
- Stn 524. — 13.05.1992, 13°11.8'S, 176°15.6'W, 300 m, Wallis: *Caryophyllia (Caryophyllia) abrupta*, *Trochocyathus (Trochocyathus) maculatus*, *Rhizosmilia robusta*, *Flabellum (Flabellum) arcuatile*, *Truncatoflabellum vanuatu*, *Balanophyllia desmophyllioides*.
- Stn 525. — 13.05.1992, 13°10.6'S, 176°14.7'W, 500-600 m, Wallis: *Anthemiphyllia dentata*, *Caryophyllia (Caryophyllia) marmorea*, *Deltocyathus taiwanicus*, *Conotrochus funiculumna*, *C. brunneus*, *Javania fusca*.
- Stn 527. — 14.05.1992, 13°24.1'S, 176°14.6'W, 540-560 m, Wallis: *Trochocyathus (Trochocyathus) vasiformis*.
- Stn 529. — 16.05.1992, 12°31.4'S, 176°39.6'W, 500 m, Waterwitch Bank: *Deltocyathus suluensis*, *D. taiwanicus*, *D. crassiseptum*.
- Stn 530. — 16.05.1992, 12°32.7'S, 176°39.3'W, 580-600 m, Waterwitch Bank: *Anthemiphyllia dentata*, *A. patera costata*, *A. spinifera*, *Caryophyllia (Caryophyllia) rugosa*, *C. (C.) abrupta*, *Deltocyathus suluensis*, *D. cameratus*, *Conotrochus brunneus*, *Lophelia pertusa*, *Flabellum (Flabellum) arcuatile*, *Javania fusca*, *Enallopsammia rostrata*.
- Stn 532. — 16.05.1992, 12°28.9'S, 176°41.0'W, 516-530 m, Waterwitch Bank: *Deltocyathus suluensis*, *Conotrochus funiculumna*, *Flabellum (Ulocyathus) deludens*.
- Stn 534. — 16.05.1992, 12°23.3'S, 176°42.0'W, 440-500 m, Waterwitch Bank: *Fungiacyathus (Fungiacyathus) pusillus pacificus*, *Fungiacyathus (Bathyactis) margaretae*, *Anthemiphyllia dentata*, *Caryophyllia (Caryophyllia) abrupta*, *C. (C.) marmorea*, *Deltocyathus suluensis*, *Flabellum (Flabellum) arcuatile*.
- Stn 535. — 16.05.1992, 12°29.6'S, 176°41.3'W, 340-470 m, Waterwitch Bank: *Fungiacyathus (Fungiacyathus) pusillus pacificus*, *Fungiacyathus (Bathyactis) margaretae*, *Stephanophyllia complicata*, *Anthemiphyllia dentata*, *A. patera costata*, *Caryophyllia (Caryophyllia) abrupta*, *Trochocyathus (Trochocyathus) vasiformis*, *Deltocyathus suluensis*, *D. taiwanicus*, *Conotrochus funiculumna*, *Asterosmilia gigas*, *Flabellum (Flabellum) arcuatile*.
- Stn 537. — 16.05.1992, 12°30.0'S, 176°41.0'W, 325-400 m, Waterwitch Bank: *Anthemiphyllia dentata*, *A. spinifera*, *Caryophyllia (Caryophyllia) abrupta*, *Deltocyathus taiwanicus*, *D. crassiseptum*, *D. cameratus*, *D. stella*, *Conotrochus funiculumna*, *Asterosmilia gigas*, *Javania exserta*.
- Stn 538. — 16.05.1992, 12°30.8'S, 176°40.3'W, 275-295 m, Waterwitch Bank: *Fungiacyathus (Fungiacyathus) sandoi*, *Anthemiphyllia dentata*, *Caryophyllia (Caryophyllia) hawaiiensis*, *Flabellum (Flabellum) pavoninum*, *Truncatoflabellum phoenix*, *Javania exserta*, *Balanophyllia desmophyllioides*.
- Stn 539. — 17.05.1992, 12°27.3'S, 177°27.3'W, 700 m, Combe Bank: *Trochocyathus (Trochocyathus) discus*, *Lochmaeotrochus gardineri*.

- Stn 540. — 17.05.1992, 12°26.7'S, 177°28.4'W, 600 m, Combe Bank: *Fungiacyathus (Fungiacyathus) pusillus pacificus*, *F. (F.) sandoi*, *Fungiacyathus (Bathyactis) margaretae*, *Stephanophyllia complicata*, *Anthemiphyllia dentata*, *A. patera costata*, *Caryophyllia (Caryophyllia) crosnieri*, *Deltocyathus suluensis*, *D. taiwanicus*, *Conotrochus funiculumna*, *Javania fusca*.
- Stn 541. — 17.05.1992, 12°26.7'S, 177°28.0'W, 500-505 m, Combe Bank: *Fungiacyathus (Fungiacyathus) sandoi*, *Fungiacyathus (Bathyactis) margaretae*, *Anthemiphyllia spinifera*, *Deltocyathus suluensis*, *D. taiwanicus*, *D. cameratus*, *D. stella*, *Conotrochus funiculumna*.
- Stn 542. — 17.05.1992, 12°26.4'S, 177°28.2'W, 370 m, Combe Bank: *Fungiacyathus (Fungiacyathus) sandoi*, *Stephanophyllia neglecta*, *Anthemiphyllia dentata*, *A. patera costata*, *A. spinifera*, *Crispatotrochus rugosus*, *Deltocyathus taiwanicus*, *D. cameratus*, *Conotrochus funiculumna*, *Flabellum (Flabellum) arcuatile*.
- Stn 546. — 17.05.1992, 12°26.9'S, 177°29.1'W, 550-552 m, Combe Bank: *Fungiacyathus (Bathyactis) margaretae*, *Anthemiphyllia dentata*, *A. patera costata*, *Caryophyllia (Caryophyllia) abrupta*, *Trochocyathus (Trochocyathus) maculatus*, *Deltocyathus suluensis*, *D. taiwanicus*, *D. cameratus*, *Conotrochus brunneus*, *Flabellum (Flabellum) arcuatile*.
- Stn 548. — 17.05.1992, 12°23.3'S, 177°24.4'W, 700-740 m, Combe Bank: *Lochmaetrochus gardineri*.
- Stn 551. — 18.05.1992, 12°15.3'S, 177°28.1'W, 791-795 m, Combe Bank: *Fungiacyathus (Fungiacyathus) stephanus*, *Madrepora oculata forma tenuis*, *Flabellum (Ulocyathus) apertum apertum*.
- Stn 552. — 18.05.1992, 12°15.7'S, 177°27.8'W, 786-800 m, Combe Bank: *Fungiacyathus (Fungiacyathus) stephanus*, *Madrepora oculata forma tenuis*, *Caryophyllia (Caryophyllia) scobinosa*, *Deltocyathus cameratus*, *Flabellum (Ulocyathus) apertum apertum*.
- Stn 555. — 19.05.1992, 11°47.5'S, 178°19.2'W, 540-542 m, Tuscarora Bank: *Anthemiphyllia dentata*, *Trochocyathus (Aplocyathus) hastatus*, *Deltocyathus taiwanicus*, *D. cameratus*, *Conotrochus funiculumna*.
- Stn 556. — 19.05.1992, 11°48.7'S, 178°18.0'W, 440 m, Tuscarora Bank: *Stephanophyllia neglecta*, *Caryophyllia (Caryophyllia) quadragenaria*, *Oxysmilia epithecata*, *Bourneotrochus stellulatus*, *Deltocyathus taiwanicus*, *D. stella*, *Heterocyathus cf. sulcatus*, *Conotrochus funiculumna*.
- Stn 557. — 19.05.1992, 11°48.1'S, 178°18.2'W, 600-608 m, Tuscarora Bank: *Stephanophyllia complicata*, *Caryophyllia (Caryophyllia) abrupta*, *Deltocyathus suluensis*, *D. taiwanicus*, *D. cameratus*, *Conotrochus funiculumna*, *Lochmaetrochus gardineri*.
- Stn 560. — 19.05.1992, 11°47.0'S, 178°20.0'W, 697-702 m, Tuscarora Bank: *Deltocyathus taiwanicus*, *D. cameratus*, *Conotrochus funiculumna*, *Lochmaetrochus gardineri*.
- Stn 564. — 20.05.1992, 11°46.1'S, 178°27.4'W, 1015-1020 m, Tuscarora Bank: *Fungiacyathus (Bathyactis) margaretae*, *Caryophyllia (Caryophyllia) ambrosia*, *Stephanocyathus (Stephanocyathus) regius*, *Aulocyathus recidivus*, *Flabellum (Ulocyathus) apertum apertum*.
- Stn 565. — 20.05.1992, 11°47.4'S, 178°25.3'W, 900 m, Tuscarora Bank: *Fungiacyathus (Fungiacyathus) stephanus*, *Fungiacyathus (Bathyactis) margaretae*, *Caryophyllia (Caryophyllia) scobinosa*, *C. (C.) ambrosia*, *Stephanocyathus (Stephanocyathus) regius*, *Flabellum (Ulocyathus) apertum apertum*.
- Stn 567. — 20.05.1992, 11°47.0'S, 178°27.3'W, 1010-1020 m, Tuscarora Bank: *Stephanocyathus (Stephanocyathus) regius*, *Deltocyathus cameratus*, *Aulocyathus recidivus*, *Flabellum (Ulocyathus) apertum apertum*.
- Stn 569. — 21.05.1992, 12°30.0'S, 176°51.2'W, 300-305 m, Waterwitch Bank: *Fungiacyathus (Fungiacyathus) sandoi*, *Anthemiphyllia dentata*, *A. spinifera*, *Caryophyllia (Caryophyllia) abrupta*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *D. ornatus*, *D. cameratus*, *Guynia annulata*, *Flabellum (Flabellum) pavoninum*, *Javania exserta*.
- Stn 570. — 21.05.1992, 12°30.9'S, 176°51.4'W, 420-439 m, Waterwitch Bank: *Fungiacyathus (Fungiacyathus) pusillus pacificus*, *Anthemiphyllia dentata*, *Caryophyllia (Caryophyllia) abrupta*, *Deltocyathus crassiseptum*, *Heterocyathus cf. sulcatus*, *Conotrochus funiculumna*.
- Stn 571. — 21.05.1992, 12°31.3'S, 176°51.7'W, 502-508 m, Waterwitch Bank: *Caryophyllia (Caryophyllia) abrupta*, *Conotrochus funiculumna*.

- Stn 572. — 21.05.1992, 12°31.8'S, 176°52.2'W, 500-560 m, Waterwitch Bank: *Fungiacyathus (Fungiacyathus) pusillus pacificus*, *Anthemiphyllia dentata*, *Caryophyllia (Caryophyllia) crosnieri*, *Vaughanella concinna*, *Lophelia pertusa*.
- Stn 574. — 21.05.1992, 12°30.9'S, 176°52.3'W, 105-410 m, Waterwitch Bank: *Enallopsammia rostrata*.
- Stn 575. — 21.05.1992, 12°30.9'S, 176°52.3'W, 425 m, Waterwitch Bank: *Fungiacyathus (Fungiacyathus) pusillus pacificus*, *Anthemiphyllia patera costata*, *Deltocyathus suluensis*.
- Stn 578. — 22.05.1992, 13°08.2'S, 176°15.6'W, 640-730 m, North of Wallis: *Anthemiphyllia patera costata*, *Deltocyathus suluensis*, *D. cameratus*, *Flabellum (Flabellum) arcuatile*, *Javania fusca*.
- Stn 581. — 22.05.1992, 13°09.9'S, 176°13.9'W, 461-550 m, North of Wallis: *Fungiacyathus (Fungiacyathus) pusillus pacificus*, *Caryophyllia (Caryophyllia) crosnieri*.
- Stn 584. — 22.05.1992, 13°11.2'S, 176°14.3'W, 360-400 m, North of Wallis: *Crispatotrochus rugosus*, *Dactylotrachus cervicornis*.
- Stn 585. — 22.05.1992, 13°10.2'S, 176°12.6'W, 415-475 m, North of Wallis: *Madrepora oculata* forma *formosa*, *Anthemiphyllia dentata*, *Caryophyllia (Caryophyllia) marnorea*, *Crispatotrochus rubescens*, *Bourneotrochus stellulatus*, *Stephanocyathus (Acinocyathus) spiniger*, *Deltocyathus taiwanicus*, *D. crassiseptum*, *D. stella*, *Conotrochus funiculumna*, *Truncatoflabellum mortenseni*.
- Stn 586. — 22.05.1992, 13°10.7'S, 176°13.1'W, 510-600 m, North of Wallis: *Madrepora oculata* forma *formosa*, *Anthemiphyllia dentata*, *A. patera costata*, *A. spinifera*, *Caryophyllia (Caryophyllia) abrupta*, *Trochocyathus (Aplocyathus) hastatus*, *Bourneotrochus stellulatus*, *Deltocyathus crassiseptum*, *Conotrochus brunneus*, *C. asymmetros*, *Asterosmilia gigas*.
- Stn 589. — 23.05.1992, 12°16.2'S, 174°41.4'W, 400 m, Field Bank: *Fungiacyathus (Fungiacyathus) sandoi*, *Anthemiphyllia dentata*, *A. spinifera*, *Caryophyllia (Caryophyllia) lamellifera*, *Crispatotrochus rugosus*, *Deltocyathus taiwanicus*, *D. cameratus*, *Dactylotrachus cervicornis*, *Flabellum (Flabellum) arcuatile*, *Balanophyllia desmophyllioides*.
- Stn 590. — 23.05.1992, 12°31.4'S, 174°18.7'W, 400 m, Field Bank: *Fungiacyathus (Fungiacyathus) sandoi*, *Anthemiphyllia dentata*, *A. patera costata*, *Deltocyathus suluensis*, *D. taiwanicus*, *Conotrochus brunneus*.
- Stn 591. — 23.05.1992, 12°31.1'S, 174°19.4'W, 320 m, Field Bank: *Anthemiphyllia dentata*, *A. patera costata*, *Bourneotrochus stellulatus*, *Deltocyathus taiwanicus*, *Conotrochus brunneus*.
- Stn 592. — 24.05.1992, 12°32.4'S, 174°22.0'W, 730-775 m, Field Bank: *Javania fusca*.
- Stn 594. — 24.05.1992, 12°31.0'S, 174°19.9'W, 495-505 m, Field Bank: *Anthemiphyllia dentata*, *A. patera costata*, *Bourneotrochus stellulatus*, *Deltocyathus suluensis*, *D. taiwanicus*, *D. stella*.
- Stn 595. — 24.05.1992, 12°30.9'S, 174°18.9'W, 566-580 m, Field Bank: *Anthemiphyllia patera costata*, *Bourneotrochus stellulatus*, *Deltocyathus suluensis*.
- Stn 597. — 24.05.1992, 12°31.4'S, 174°18.6'W, 469-475 m, Field Bank: *Fungiacyathus (Fungiacyathus) sandoi*, *Letepsammia franki*, *Anthemiphyllia dentata*, *Deltocyathus taiwanicus*, *D. crassiseptum*, *D. cameratus*, *Conotrochus brunneus*.
- Stn 598. — 24.05.1992, 12°30.5'S, 174°18.4'W, 702-708 m, Field Bank: *Madrepora oculata* forma *tenuis*, *Caryophyllia (Caryophyllia) ambrosia*.
- Stn 601. — 25.05.1992, 13°18.7'S, 176°17.2'W, 350 m, SE of Wallis: *Madrepora oculata* forma *formosa*, *Truncatoflabellum mortenseni*, *Balanophyllia desmophyllioides*.
- Stn 604. — 26.05.1992, 13°21.4'S, 176°08.3'W, 415-420 m, SE of Wallis: *Caryophyllia (Caryophyllia) abrupta*, *Crispatotrochus rubescens*, *Bourneotrochus stellulatus*, *Stephanocyathus (Acinocyathus) spiniger*, *Deltocyathus crassiseptum*, *Conotrochus funiculumna*.
- Stn 605. — 26.05.1992, 13°21.3'S, 176°08.4'W, 335-340 m, SE of Wallis: *Fungiacyathus (Fungiacyathus) sandoi*, *Anthemiphyllia spinifera*, *Caryophyllia (Caryophyllia) abrupta*, *Oxysmilia epithecata*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Dactylotrachus cervicornis*, *Flabellum (Flabellum) pavoninum*, *Truncatoflabellum vanuatu*.
- Stn 606. — 26.05.1992, 13°21.4'S, 176°08.3'W, 420-430 m, SE of Wallis: *Madrepora oculata* forma *formosa*, *Caryophyllia (Caryophyllia) abrupta*, *Stephanocyathus (Acinocyathus) spiniger*.



- Stn 608. — 26.05.1992, 13°21.7'S, 176°08.5'W, 440-458 m, SE of Wallis: *Caryophyllia* (*Caryophyllia*) *abrupta*, *Bourneotrochus stellulatus*, *Deltocyathus crassiseptum*.
- Stn 609. — 26.05.1992, 13°21.5'S, 176°08.5'W, 430 m, SE of Wallis: *Madrepora oculata* forma *formosa*, *Trochocyathus* (*Trochocyathus*) *vasiformis*.
- Stn 610. — 26.05.1992, 13°21.5'S, 176°08.9'W, 286 m, SE of Wallis: *Anthemiphyllia spinifera*, *Caryophyllia* (*Caryophyllia*) *rugosa*, *Crispatotrochus rugosus*, *Oxysmilia epithecata*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Conotrochus asymmetros*, *Flabellum* (*Flabellum*) *pavoninum*.
- Stn 618. — 27.05.1992, 14°21.7'S, 178°00.5'W, 420-435 m, E + SE of Alofi: *Stephanophyllia neglecta*, *Madrepora oculata* forma *formosa*, *M. porcellana*, *Anthemiphyllia dentata*, *Trochocyathus* (*Aplocyathus*) *hastatus*, *Bourneotrochus stellulatus*, *Deltocyathus crassiseptum*, *Conotrochus funiculumna*.
- Stn 619. — 27.05.1992, 14°21.8'S, 178°00.4'W, 455 m, E + SE of Alofi: *Fungiacyathus* (*Bathyactis*) *granulosus*, *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Trochocyathus* (*Aplocyathus*) *hastatus*, *Conotrochus funiculumna*.
- Stn 620. — 28.05.1992, 12°34.4'S, 178°11.0'W, 1280 m, bank SW of Combe Bank: *Madrepora oculata* forma *formosa*, *Aulocyathus recidivus*, *Flabellum* (*Ulocyathus*) *apertum apertum*.
- Stn 621. — 28.05.1992, 12°35.0'S, 178°11.5'W, 1280-1300 m, bank SW of Combe Bank: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Madrepora oculata* forma *tenuis*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Stephanocyathus* (*Odontocyathus*) *coronatus*, *Deltocyathus rotulus*, *Flabellum* (*Ulocyathus*) *apertum apertum*.
- Stn 622. — 28.05.1992, 12°34.5'S, 178°10.9'W, 1280-1300 m, bank SW of Combe Bank: *Stephanocyathus* (*Odontocyathus*) *coronatus*, *Deltocyathus rotulus*, *Aulocyathus recidivus*.
- Stn 623. — 28.05.1992, 12°34.2'S, 178°15.1'W, 1280-1300 m, bank SW of Combe Bank: *Madrepora oculata* forma *tenuis*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Stephanocyathus* (*Odontocyathus*) *coronatus*, *Deltocyathus rotulus*, *Aulocyathus recidivus*, *Flabellum* (*Ulocyathus*) *apertum apertum*.
- Stn 625. — 29.05.1992, 11°52.4'S, 179°33.8'W, 425-430 m, Bayonnaise Bank: *Conotrochus brunneus*.
- Stn 626. — 29.05.1992, 11°53.6'S, 179°32.0'W, 597-600 m, Bayonnaise Bank: *Deltocyathus stella*.
- Stn 631. — 29.05.1992, 11°54.0'S, 179°31.6'W, 600 m, Bayonnaise Bank: *Deltocyathus suluensis*.
- Stn 635. — 30.05.1992, 13°49.0'S, 179°56.0'E, 700-715 m, SW of Rotumah Bank: *Anthemiphyllia patera costata*, *Caryophyllia* (*Caryophyllia*) *scobinosa*, *C. (C.) ambrosia*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Deltocyathus cameratus*.
- Stn 636. — 30.05.1992, 13°39.4'S, 179°55.5'E, 650-700 m, SW of Rotumah Bank: *Caryophyllia* (*Caryophyllia*) *ambrosia*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Deltocyathus cameratus*.
- Stn 637. — 30.05.1992, 13°37.2'S, 179°56.0'E, 820-830 m, SW of Rotumah Bank: *Madrepora oculata* forma *tenuis*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Desmophyllum dianthus*, *Pleotrochus zibrowii*.
- MUSORSTOM 8, "Alis"
- Stn 956. — 20.09.1994, 20°33'S, 169°35'E, 1175-1210 m, Anatom: *Fungiacyathus* (*Bathyactis*) *margaretae*, *Stephanocyathus* (*Odontocyathus*) *coronatus*, *Deltocyathus cameratus*, *Lochmaetrochus gardineri*, *Flabellum* (*Ulocyathus*) *marcus*.
- Stn 958. — 20.09.1994, 20°20'S, 169°47'E, 497-570 m, Anatom: *Stephanophyllia neglecta*, *Trochocyathus* (*Trochocyathus*) *discus*, *Deltocyathus crassiseptum*, *Cyathotrochus pileus*.
- Stn 959. — 20.09.1994, 20°20'S, 169°48'E, 436-475 m, Anatom: *Stephanophyllia complicata*, *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *diomedaeae*, *Oxysmilia epithecata*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Trochocyathus* (*Aplocyathus*) *hastatus*, *T. (A.) brevispina*, *Deltocyathus crassiseptum*, *Conotrochus brunneus*, *Cyathotrochus pileus*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Javania fusca*, *Enallopsammia rostrata*.
- Stn 961. — 21.09.1994, 20°18'S, 169°49'E, 100-110 m, Anatom: *Trochocyathus* (*T.*) *maculatus*, *T. (T.) cooperi*, *Rhizosmilia robusta*, *Heteropsammia cochlea*.
- Stn 962. — 21.09.1994, 20°19'S, 169°49'E, 370-400 m, Anatom: *Letepsammia franki*, *Madrepora porcellana*, *Caryophyllia* (*Caryophyllia*) *quadrigenaria*, *Oxysmilia epithecata*, *Flabellum* (*Flabellum*) *pavoninum*, *Javania exserta*, *Balanophyllia laysanensis*.

- Stn 963. — 21.09.1994, 20°20'S, 169°49'E, 400-440 m, Anatom: *Fungiacyathus (Fungiacyathus) stephanus*, *F. (F.) paliferus*, *Fungiacyathus (Bathyactis) margaretae*, *Stephanophyllia neglecta*, *S. complicata* [X], *Madrepora porcellana*, *Caryophyllia (Caryophyllia) abrupta* [X], *Trochocyathus (Aplocyathus) hastatus*, *T. (A.) brevispina*, *Stephanocyathus (Acinocyathus) spiniger*, *Deltocyathus magnificus*, *Bourneotrochus stellulatus* [X], *Tropidocyathus labidus* [X], *Temnotrochus kermadecensis* [X], *Flabellum (Flabellum) pavoninum*, *Flabellum (Ulocyathus) aotearoa*, *Truncatoflabellum mortenseni*, *Balanophyllia laysanensis*.
- Stn 964. — 21.09.1994, 20°19'S, 169°49'E, 360-408 m, Anatom: *Madrepora porcellana*, *Caryophyllia (Caryophyllia) octonaria*, *Trochocyathus (Aplocyathus) brevispina*, *Deltocyathus magnificus*, *D. ornatus*, *Rhizosmilia robusta*, *Flabellum (Ulocyathus) aotearoa*, *Truncatoflabellum mortenseni*, *Javania exserta*, *Balanophyllia desmophyllioides*.
- Stn 965. — 21.09.1994, 20°20'S, 169°51'E, 361-377 m, Anatom: *Stephanophyllia neglecta*, *Caryophyllia (Caryophyllia) quadragenaria*, *Flabellum (Flabellum) pavoninum*, *Truncatoflabellum dens*, *Javania fusca*, *Balanophyllia laysanensis*.
- Stn 967. — 21.09.1994, 20°19'S, 169°53'E, 295-334 m, Anatom: *Fungiacyathus (Fungiacyathus) paliferus*, *Anthemiphyllia dentata*, *Caryophyllia (Caryophyllia) rugosa*, *C. (C.) quadragenaria*, *Deltocyathus stella*, *D. ornatus*, *Truncatoguyonia irregularis*, *Truncatoflabellum mortenseni*, *Endopachys grayi*, *Heteropsammia cochlea*.
- Stn 968. — 21.09.1994, 20°18'S, 169°53'E, 199-214 m, Anatom: *Madrepora porcellana*.
- Stn 969. — 21.09.1994, 20°19'S, 169°53'E, 252-280 m, Anatom: *Fungiacyathus (Fungiacyathus) paliferus*, *Stephanophyllia neglecta*, *Madrepora porcellana*, *Anthemiphyllia dentata*, *Caryophyllia (Caryophyllia) hawaiiensis*, *C. (C.) octonaria*, *Trochocyathus (Trochocyathus) philippinensis*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Heterocyathus cf. sulcatus*, *Truncatoflabellum mortenseni*, *Balanophyllia desmophyllioides*, *Endopachys grayi*, *Heteropsammia cochlea*.
- Stn 970. — 21.09.1994, 20°18'S, 169°53'E, 252-310 m, Anatom: *Truncatoflabellum mortenseni*, *Balanophyllia rediviva*.
- Stn 971. — 21.09.1994, 20°19'S, 169°53'E, 250-315 m, Anatom: *Rhizosmilia robusta*, *Flabellum (Flabellum) pavoninum*, *Truncatoflabellum mortenseni*, *Dendrophyllia alcocki*.
- Stn 973. — 22.09.1994, 19°21'S, 169°27'E, 460-480 m, Tanna: *Caryophyllia (Caryophyllia) crosnieri*, *Trochocyathus (Trochocyathus) vasiformis*, *Tethocyathus virgatus*, *Truncatoflabellum pusillum*.
- Stn 974. — 22.09.1994, 19°21'S, 169°28'E, 492-520 m, Tanna: *Caryophyllia (Caryophyllia) crosnieri*, *Javania lamprotichum*, *Enallopsammia rostrata*.
- Stn 975. — 22.09.1994, 19°23'S, 169°29'E, 536-566 m, Tanna: *Fungiacyathus (Fungiacyathus) stephanus*, *Caryophyllia (Caryophyllia) crosnieri*, *Deltocyathus suluensis*, *Javania lamprotichum*, *Polymyces wellsi*.
- Stn 976. — 22.09.94, 19°25'S, 169°27'E, 160-182 m, Tanna: *Madrepora porcellana*, *Caryophyllia (Caryophyllia) octonaria*, *Trochocyathus (Trochocyathus) philippinensis*, *Heterocyathus cf. sulcatus*, *Aulocyathus juvenescens*, *Flabellum (Flabellum) pavoninum*, *Endopachys grayi*, *Heteropsammia cochlea*.
- Stn 977. — 22.09.1994, 19°25'S, 169°29'E, 410-505 m, Tanna: *Fungiacyathus (Bathyactis) granulatus*, *Anthemiphyllia dentata*, *Crispatotrochus rugosus*, *Oxysmilia circularis*, *Trochocyathus (Trochocyathus) vasiformis*, *T. (T.) rhombocolumna*, *Trochocyathus (Aplocyathus) hastatus*, *Tethocyathus virgatus*, *Deltocyathus crassiseptum*, *Conotrochus brunneus*, *Flabellum (Ulocyathus) aotearoa*, *Truncatoflabellum dens*, *Balanophyllia gigas*, *Dendrophyllia alcocki*, *Enallopsammia rostrata*.
- Stn 978. — 22.09.1994, 19°23'S, 169°27'E, 408-413 m, Tanna: *Stephanophyllia neglecta*, *Trochocyathus (Trochocyathus) vasiformis*, *Tethocyathus virgatus*, *Deltocyathus crassiseptum*, *Javania exserta*, *Balanophyllia crassitheca*, *Dendrophyllia alcocki*.
- Stn 980. — 22.09.1994, 19°21'S, 169°25'E, 433-450 m, Tanna: *Fungiacyathus (Bathyactis) granulatus*, *Letepsammia franki*, *Deltocyathus magnificus*, *D. crassiseptum*, *Cyathotrochus pileus*, *Dendrophyllia alcocki*.
- Stn 982. — 23.09.1994, 19°22'S, 169°26'E, 408-410 m, Tanna: *Anthemiphyllia dentata*, *Caryophyllia (Caryophyllia) crosnieri*, *Tethocyathus virgatus*, *Javania fusca*, *Dendrophyllia alcocki*.

- Stn 983. — 23.09.1994, 19°22'S, 169°28'E, 475-480 m, Tanna: *Anthemiphyllia dentata*, *Crispatotrochus rubescens*, *Oxysmilia circularis*, *Trochocyathus (Trochocyathus) vasiformis*, *Deltocyathus crassiseptum*, *Dendrophyllia alcocki*.
- Stn 988. — 23.09.1994, 19°16'S, 169°24'E, 372-466 m, Tanna: *Madracis kauaiensis*, *Fungiacyathus (Fungiacyathus) paliferus*, *Stephanophyllia neglecta*, *Madrepora porcellana*, *Anthemiphyllia spinifera*, *Caryophyllia (Caryophyllia) rugosa*, *C. (C.) abrupta*, *Crispatotrochus rugosus*, *Labyrinthocyathus limatulus*, *Dactylotrochus cervicornis*, *Cryptotrochus brevivalus*, *Flabellum (Flabellum) pavoninum*, *Truncatoflabellum dens*, *T. pusillum*, *Javania lamprotichum*, *J. fusca*, *Balanophyllia desmophyllioides*, *Dendrophyllia alcocki*.
- Stn 990. — 24.09.1994, 18°52'S, 168°51'E, 980-990 m, Erromango: *Fungiacyathus (Fungiacyathus) stephanus*, *Stephanocyathus (Stephanocyathus) regius*.
- Stn 992. — 24.09.1994, 18°52'S, 168°55'E, 748-775 m, Erromango: *Fungiacyathus (Fungiacyathus) stephanus*, *Caryophyllia (Caryophyllia) scobinosa*, *Stephanocyathus (Stephanocyathus) regius*, *Deltocyathus cameratus*, *Lochmaetrochus gardineri*.
- Stn 996. — 24.09.1994, 18°52'S, 168°56'E, 764-786 m, Erromango: *Fungiacyathus (Fungiacyathus) stephanus*, *Stephanocyathus (Stephanocyathus) regius*, *Truncatoflabellum stabile*.
- Stn 999. — 25.09.1994, 18°49'S, 169°00'E, 80-110 m, Erromango: *Trochocyathus (Aplocyathus) brevispina*.
- Stn 1001. — 25.09.1994, 18°49'S, 168°59'E, 150-250 m, Erromango: *Caryophyllia (Acanthocyathus) grayi*.
- Stn 1002. — 25.09.1994, 18°49'S, 168°59'E, 200-300 m, Erromango: *Caryophyllia (Acanthocyathus) grayi*.
- Stn 1003. — 25.09.1994, 18°49'S, 168°59'E, 200-327 m, Erromango: *Fungiacyathus (Fungiacyathus) paliferus*, *Trochocyathus (Aplocyathus) brevispina*, *Stephanocyathus (Acinocyathus) spiniger*.
- Stn 1004. — 25.09.1994, 18°49'S, 168°59'E, 319-350 m, Erromango: *Caryophyllia (Acanthocyathus) grayi*, *Trochocyathus (Aplocyathus) brevispina*, *Stephanocyathus (Acinocyathus) spiniger*, *Heterocyathus alternatus*, *Flabellum (Flabellum) pavoninum*, *Flabellum (Ulocyathus) aotearoa*, *Truncatoflabellum vigintifarium*.
- Stn 1005. — 25.09.1994, 18°49'S, 168°59'E, 360-450 m, Erromango: *Fungiacyathus (Fungiacyathus) paliferus*, *Stephanophyllia complicata*, *Flabellum (Flabellum) pavoninum*, *Flabellum (Ulocyathus) aotearoa*, *Endopachys grayi*.
- Stn 1006. — 25.09.1994, 18°50'S, 168°57'E, 574-611 m, Erromango: *Trochocyathus (Trochocyathus) vasiformis*, *Deltocyathus vaughani*, *Conotrochus brunneus*, *Gardineria hawaiiensis*, *Enallopsammia rostrata*.
- Stn 1007. — 25.09.1994, 18°52'S, 168°56'E, 720-830 m, Erromango: *Fungiacyathus (Fungiacyathus) stephanus*, *Stephanocyathus (Stephanocyathus) regius*, *Deltocyathus cameratus*.
- Stn 1009. — 27.09.1994, 17°46'S, 168°13'E, 430-460 m, Efaté: *Caryophyllia (Caryophyllia) crosnieri*, *Balanophyllia gemma*.
- Stn 1011. — 27.09.1994, 17°50'S, 168°11'E, 547-585 m, Efaté: *Fungiacyathus (Bathyactis) margaretae*, *Trochocyathus (Trochocyathus) vasiformis*, *Deltocyathus vaughani*, *Gardineria hawaiiensis*.
- Stn 1014. — 27.09.1994, 17°54'S, 168°19'E, 495-498 m, Efaté: *Fungiacyathus (Bathyactis) margaretae*, *Anthemiphyllia spinifera*, *Caryophyllia (Caryophyllia) diomedae*, *Cryptotrochus brevivalus*, *Flabellum (Ulocyathus) hoffmeisteri*, *Javania lamprotichum*, *Gardineria hawaiiensis*, *G. paradoxa*.
- Stn 1015. — 27.09.1994, 17°54'S, 168°22'E, 375-420 m, Efaté: *Crispatotrochus rugosus*, *Trochocyathus (Trochocyathus) vasiformis*, *Tethocyathus virgatus*, *Truncatoflabellum dens*, *Balanophyllia gemma*, *Dendrophyllia alcocki*, *Enallopsammia rostrata*.
- Stn 1016. — 27.09.1994, 17°53'S, 168°28'E, 291-300 m, Efaté: *Fungiacyathus (Fungiacyathus) paliferus*, *Letepsammia franki*, *Anthemiphyllia dentata*, *Caryophyllia (Caryophyllia) abrupta*, *Conotrochus asymmetros* [X], *Tropidocyathus lessonii*, *Cyathotrochus pileus*, *Guynia annulata*, *Flabellum (Flabellum) pavoninum*, *Flabellum (Ulocyathus) aotearoa*, *Truncatoflabellum angustum*, *Truncatoflabellum pusillum* [X], *Endopachys grayi*.
- Stn 1017. — 27.09.1994, 17°53'S, 168°26'E, 294-295 m, Efaté: *Fungiacyathus (Fungiacyathus) paliferus*, *Letepsammia franki*, *Deltocyathus ornatus*, *Conocyathus asymmetros* [X], *Flabellum (Flabellum) pavoninum*, *Flabellum (Ulocyathus) aotearoa*, *Truncatoflabellum angustum*, *Endopachys grayi* [X].

- Stn 1018. — 27.09.1994, 17°53'S, 168°25'E, 300-301 m, Efaté: *Fungiacyathus (Fungiacyathus) paliferus*, *Letepsammia franki*, *Stephanophyllia complicata*, ?*Caryophyllia (C.) lamellifera*, *Crispatotrochus rugosus*, *Oxysmilia epithecata*, *Deltocyathus ornatus*, *Bourneotrochus stellulatus* [X], *Heterocyathus alternatus*, *Notocyathus conicus* [X], *Flabellum (Flabellum) pavoninum*, *Flabellum (Ulocyathus) aotearoa*, *Truncatoflabellum angustum*, *T. vigintifarium*, *Endopachys grayi*, *Dendrophyllia arbuscula*.
- Stn 1019. — 28.09.1994, 17°38'S, 168°34'E, 397-430 m, Efaté: *Stephanophyllia neglecta*, *Trochocyathus (Trochocyathus) vasiformis*, *T. (T.) efateensis*, *Trochocyathus (Aplocyathus) hastatus*, *Balanophyllia gemma*, *Dendrophyllia alcocki*.
- Stn 1020. — 28.09.1994, 17°40'S, 168°35'E, 380-391 m, Efaté: *Trochocyathus (Trochocyathus) efateensis*, *Trochocyathus (Aplocyathus) hastatus*, *T. (A.) brevispina*.
- Stn 1021. — 28.09.1994, 17°43'S, 168°37'E, 124-130 m, Efaté: *Trochocyathus (Trochocyathus) maculatus*, *T. (T.) cooperi*, *Rhizosmilia robusta*, *Javania exserta*, *Rhizotrochus typus*, *Dendrophyllia arbuscula*.
- Stn 1023. — 28.09.1994, 17°48'S, 168°49'E, 321 m, Efaté: *Letepsammia franki*, ?*Caryophyllia (C.) lamellifera*, *Oxysmilia epithecata*, *Bourneotrochus stellulatus* [X], *Temnotrochus kermadecensis* [X], *Flabellum (Ulocyathus) aotearoa*, *Dendrophyllia alcocki*.
- Stn 1024. — 28.09.1994, 17°48'S, 168°39'E, 335-370 m, Efaté: *Enallopsammia rostrata*.
- Stn 1026. — 28.09.1994, 17°50'S, 168°39'E, 437-504 m, Efaté: *Oxysmilia epithecata*, *Trochocyathus (Trochocyathus) efateensis*, *Tethocyathus virgatus*, *Tropidocyathus labidus*.
- Stn 1028. — 28.09.1994, 17°54'S, 168°40'E, 624-668 m, Efaté: *Madrepora oculata forma tenuis*, *Deltocyathus suluensis*, *Cryptotrochus brevipalus*.
- Stn 1030. — 29.09.1994, 17°51'S, 168°30'E, 180-190 m, Efaté: *Crispatotrochus rugosus*, *Oxysmilia circularis*, *O. corrugata*, *Javania exserta*, *Balanophyllia desmophyllioides*, *Dendrophyllia arbuscula*.
- Stn 1031. — 29.09.1994, 17°52'S, 168°33'E, 310 m, Efaté: *Madrepora oculata forma tenuis*, *Anthemiphyllia pacifica*.
- Stn 1034. — 29.09.1994, 17°54'S, 168°42'E, 690-750 m, Efaté: *Caryophyllia (Caryophyllia) scobinosa*, *Lochmaeotrochus gardineri*, *Cryptotrochus brevipalus*.
- Stn 1035. — 29.09.1994, 17°56'S, 168°44'E, 765-780 m, Efaté: *Caryophyllia (Caryophyllia) scobinosa*.
- Stn 1036. — 29.09.1994, 18°01'S, 168°48'E, 920-950 m, Efaté: *Fungiacyathus (Fungiacyathus) stephanus*, *Stephanocyathus (Stephanocyathus) regius*, *Deltocyathus cameratus*, *Lochmaeotrochus gardineri*, *Truncatoflabellum stabile*.
- Stn 1037. — 29.09.1994, 18°03'S, 168°54'E, 1058-1086 m, Efaté: *Flabellum (Ulocyathus) marcus*, *Truncatoflabellum stabile*.
- Stn 1042. — 30.09.1994, 16°52'S, 168°27'E, 200-260 m, Epi: *Javania exserta*.
- Stn 1043. — 30.09.1994, 16°52'S, 168°25'E, 350-372 m, Epi: *Fungiacyathus (Fungiacyathus) paliferus*, *Crispatotrochus rugosus*.
- Stn 1047. — 30.09.1994, 16°53'S, 168°10'E, 486-494 m, Epi: *Trochocyathus (Trochocyathus) maculatus*.
- Stn 1051. — 01.10.1994, 16°36'S, 167°59'E, 555-558 m, Epi: *Fungiacyathus (Bathyactis) margaretae*, *Caryophyllia (Caryophyllia) sp. cf. calveri*.
- Stn 1056. — 01.10.1994, 16°33'S, 167°55'E, 602-620 m, Epi: *Caryophyllia (Caryophyllia) sp. cf. calveri*.
- Stn 1058. — 02.10.1994, 16°12'S, 167°20'E, 319 m, Malakula: *Trochocyathus (Aplocyathus) brevispina*, *Stephanocyathus (Acinocyathus) spiniger*, *Dendrophyllia arbuscula*.
- Stn 1059. — 02.10.1994, 16°12'S, 167°20'E, 408-430 m, Malakula: *Conotrochus funiculumna*.
- Stn 1060. — 02.10.1994, 16°13'S, 167°20'E, 375-397 m, Malakula: *Trochocyathus (Trochocyathus) vasiformis*, *Conotrochus funiculumna*, *Flabellum (Ulocyathus) aotearoa*, *Truncatoflabellum dens*, *T. vigintifarium*, *Javania exserta*.
- Stn 1061. — 02.10.1994, 16°14'S, 167°20'E, 458-512 m, Malakula: *Bourneotrochus stellulatus*, *Deltocyathus crassiseptum*, *D. cameratus*.

- Stn 1065. — 02.10.1994, 16°16'S, 167°21'E, 360-419 m, Malakula: *Caryophyllia* (*Caryophyllia*) *abrupta*, *Caryophyllia* (*Acanthocyathus*) *grayi*, *Trochocyathus* (*Aplocyathus*) *brevispina*, *Conotrochus funiculumna*, *Tropidocyathus labidus*, *Flabellum* (*Flabellum*) *pavoninum*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum angustum*, *T. vigintifarium*, *T. mortenseni*, *Balanophyllia desmophyllioides*.
- Stn 1067. — 02.10.1994, 16°16'S, 167°21'E, 344-366 m, Malakula: *Caryophyllia* (*Caryophyllia*) *crosnieri*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Notocyathus conicus*, *Cryptotrochus brevipalpus*, *Gardineria hawaiiensis*.
- Stn 1068. — 02.10.1994, 16°15'S, 167°19'E, 536-619 m, Malakula: *Deltocyathus crassiseptum*, *Alatotrochus rubescens*, *Tropidocyathus labidus*.
- Stn 1069. — 04.10.1994, 15°32'S, 167°14'E, 122-125 m, SE of Espiritu Santo: *Caryophyllia* (*Acanthocyathus*) *grayi*, *Heterocyathus* cf. *sulcatus*.
- Stn 1070. — 04.10.1994, 15°36'S, 167°16'E, 184-190 m, SE of Espiritu Santo: *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Letepsanymia franki*, *Caryophyllia* (*Acanthocyathus*) *grayi*, *Trochocyathus* (*Trochocyathus*) *philippinensis*, *Aulocyathus juvenescens*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum mortenseni*.
- Stn 1071. — 04.10.1994, 15°36'S, 167°16'E, 180-191 m, SE of Espiritu Santo: *Caryophyllia* (*Acanthocyathus*) *grayi*, *Trochocyathus* (*Trochocyathus*) *philippinensis*, *Rhizosmilia robusta*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum mortenseni*, *Endopachys grayi*.
- Stn 1072. — 04.10.1994, 15°39'S, 167°19'E, 622-625 m, SE of Espiritu Santo: *Caryophyllia* (*Caryophyllia*) *octonaria*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Conotrochus funiculumna*, *Heteropsammia cochlea*.
- Stn 1074. — 04.10.1994, 15°48'S, 167°24'E, 775-798 m, SE of Espiritu Santo: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Caryophyllia* (*Caryophyllia*) *crosnieri*, *C. (C.) scobinosa*, *Stephanocyathus* (*Odontocyathus*) *weberianus*.
- Stn 1077. — 05.10.1994, 16°04'S, 167°06'E, 180-210 m, Malakula: *Madracis kauaiensis*, *Oculina virgosa*, *Madrepora porcellana*, *Caryophyllia* (*Caryophyllia*) *lamellifera*, *Trochocyathus* (*Trochocyathus*) *maculatus*, *Rhizosmilia robusta*, *Truncatoflabellum mortenseni*, *Balanophyllia rediviva*.
- Stn 1078. — 05.10.1994, 16°03'S, 167°26'E, 194-230 m, Malakula: *Rhizosmilia robusta*, *Rhizotrochus typus*.
- Stn 1080. — 05.10.1994, 15°57'S, 167°27'E, 799-850 m, Malakula: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Caryophyllia* (*Caryophyllia*) *diomedeeae*, *Stephanocyathus* (*Odontocyathus*) *weberianus*.
- Stn 1084. — 05.10.94, 15°50'S, 167°17'E, 207-280 m, Malakula: *Madrepora porcellana*, *Rhizosmilia robusta*, *Flabellum* (*Flabellum*) *pavoninum*.
- Stn 1085. — 05.10.1994, 15°48'S, 167°18'E, 155-161 m, Malakula: *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum martensii*, *Javana exserta*, *Endopachys grayi*.
- Stn 1086. — 05.10.1994, 15°36'S, 167°16'E, 182-215 m, Malakula: *Caryophyllia* (*Acanthocyathus*) *grayi*, *Trochocyathus* (*Trochocyathus*) *philippinensis*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum candeanum*, *T. martensii*, *Endopachys grayi*.
- Stn 1087. — 06.10.1994, 15°10'S, 167°14'E, 394-421 m, NE of Espiritu Santo: *Stephanocyathus* (*Acinocyathus*) *spiniger*, *Bourneotrochus stellulatus* [X], *Conotrochus funiculumna*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum angustum*.
- Stn 1088. — 06.10.1994, 15°09'S, 167°15'E, 425-455 m, NE of Espiritu Santo: *Madrepora oculata* forma *formosa*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Trochocyathus* (*Trochocyathus*) *discus*, *Conotrochus funiculumna*, *Desmophyllum dianthus*, *Peponocyathus folliculus*.
- Stn 1089. — 06.10.1994, 15°08'S, 167°17'E, 494-516 m, NE of Espiritu Santo: *Madrepora porcellana*, *Trochocyathus* (*Trochocyathus*) *discus*, *Conotrochus brunneus*, *Desmophyllum dianthus*.
- Stn 1090. — 06.10.1994, 15°08'S, 167°17'E, 470-502 m, NE of Espiritu Santo: *Trochocyathus* (*Trochocyathus*) *discus*, *Conotrochus brunneus*.
- Stn 1091. — 06.10.1994, 15°10'S, 167°13'E, 344-350 m, NE of Espiritu Santo: *Stephanophyllia complicata* [X], *Caryophyllia* (*Caryophyllia*) *abrupta* [X], *Conotrochus funiculumna*, *Flabellum* (*Flabellum*) *pavoninum* [X], *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum angustum*.

- Stn 1092. — 06.10.1994, 15°10'S, 167°12'E, 314-321 m, NE of Espiritu Santo: *Stephanocyathus* (*Acinocyathus*) *spiniger*, *Conotrochus brunneus* [X].
- Stn 1094. — 06.10.1994, 15°08'S, 167°11'E, 312-314 m, NE of Espiritu Santo: *Caryophyllia* (*Caryophyllia*) *abrupta*, *Deltocyathus ornatus*, *Heterocyathus* cf. *sulcatus*, *Truncatoflabellum pusillum*, *T. vigintifarium*.
- Stn 1095. — 06.10.1994, 15°07'S, 167°11'E, 304-320 m, NE of Espiritu Santo: *Caryophyllia* (*Caryophyllia*) *rugosa*, ?*C. (C.) lamellifera*, *Crispatotrochus rugosus*, *Tethocyathus virgatus*, *Dactylotrachus cervicornis*, *Dendrophyllia alcocki*.
- Stn 1097. — 07.10.1994, 15°05'S, 167°10'E, 281-288 m, NE of Espiritu Santo: *Stephanophyllia complicata* [X], *Caryophyllia* (*Caryophyllia*) *rugosa*, *Oxysmilia epithecata*, *Bourneotrochus stellulatus* [X], *Deltocyathus stella* [X], *Heterocyathus* cf. *sulcatus*, *Conotrochus asymmetros* [X], *Guyonia annulata* [X], *Truncatoflabellum pusillum*, *T. vigintifarium*, *Javania fusca*.
- Stn 1098. — 07.10.1994, 15°04'S, 167°10'E, 277-285 m, NE of Espiritu Santo: *Truncatoflabellum pusillum*, *T. vigintifarium*, *Balanophyllia desmophyllioides*.
- Stn 1102. — 07.10.1994, 15°03'S, 167°08'E, 208-210 m, NE of Espiritu Santo: *Oculina virgosa*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum mortenseni*.
- Stn 1103. — 07.10.1994, 15°03'S, 167°07'E, 163-165 m, NE of Espiritu Santo: *Caryophyllia* (*Acanthocyathus*) *grayi*, *Trochocyathus* (*Trochocyathus*) *semperi*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum mortenseni*.
- Stn 1106. — 07.10.1994, 15°05'S, 167°11'E, 305-314 m, NE of Espiritu Santo: *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Caryophyllia* (*Caryophyllia*) *quadragenaria*, *Crispatotrochus rugosus*, *Bourneotrochus stellulatus* [X], *Deltocyathus stella*, *D. heteroclitus* [X], *Truncatoflabellum vigintifarium*, *T. pusillum* [X], *Javania fusca*.
- Stn 1107. — 07.10.1994, 15°05'S, 167°15'E, 397-402 m, NE of Espiritu Santo: *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Conotrochus funiculumna*.
- Stn 1108. — 07.10.1994, 15°04'S, 167°15'E, 405-419 m, NE of Espiritu Santo: *Caryophyllia* (*Caryophyllia*) *crosnieri*, *Tethocyathus virgatus*, *Dendrophyllia alcocki*.
- Stn 1109. — 08.10.1994, 14°52'S, 167°18'E, 1550-1620 m, N of Espiritu Santo: *Stephanocyathus* (*Stephanocyathus*) *regius*.
- Stn 1110. — 08.10.1994, 14°49'S, 167°15'E, 1360 m, N of Espiritu Santo: *Stephanocyathus* (*Stephanocyathus*) *regius*.
- Stn 1111. — 08.10.1994, 14°51'S, 167°14'E, 1210-1250 m, N of Espiritu Santo: *Trochocyathus* (*Trochocyathus*) *patelliformis*.
- Stn 1113. — 08.10.1994, 14°52'S, 167°06'E, 700-736 m, N of Espiritu Santo: *Stephanophyllia complicata*, *Conotrochus funiculumna*, *Pleotrochus zibrowii*, *Cryptotrochus brevipalus*, *Truncatoflabellum vigintifarium*.
- Stn 1114. — 08.10.1994, 14°52'S, 167°03'E, 647 m, N of Espiritu Santo: *Pleotrochus venustus*, *Javania fusca*.
- Stn 1125. — 10.10.1994, 15°57'S, 166°38'E, 1160-1220 m, Guyot Bougainville: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Stephanocyathus* (*Odontocyathus*) *coronatus*, *Deltocyathus rotulus*, *Truncatoflabellum stabile*.
- Stn 1127. — 10.10.1994, 15°58'S, 166°37'E, 1052-1058 m, Guyot Bougainville: *Stephanocyathus* (*Stephanocyathus*) *regius*, *Deltocyathus rotulus*, *Truncatoflabellum stabile*.
- Stn 1128. — 10.10.1994, 16°02'S, 166°38'E, 778-811 m, Guyot Bougainville: *Fungiacyathus* (*Fungiacyathus*) *pusillus pacificus*, *Caryophyllia* (*Caryophyllia*) *diomedea*, *Desmophyllum dianthus*, *Javania fusca*.
- Stn 1129. — 10.10.1994, 16°00'S, 166°39'E, 1014-1050 m, Guyot Bougainville: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Deltocyathus rotulus*, *Flabellum* (*Ulocyathus*) *marcus*.
- Stn 1131. — 11.10.1994, 15°38'S, 167°03'E, 140-175 m, S of Espiritu Santo: *Rhizotrochus typus*.
- Stn 1132. — 11.10.1994, 15°38'S, 167°02'E, 161-182 m, S of Espiritu Santo: *Flabellum* (*Flabellum*) *pavoninum*.

Stn 1134. — 11.10.1994, 15°39'S, 167°02'E, 230-287 m, S of Espiritu Santo: *Letepsammia franki*, *Caryophyllia* (*Caryophyllia*) *octonaria*, *Caryophyllia* (*Acanthocyathus*) *grayi*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum mortenseni*, *Balanophyllia rediviva*, *Endopachys grayi*.

Stn 1135. — 11.10.1994, 15°40'S, 167°02'E, 282-375 m, S of Espiritu Santo: *Flabellum* (*Flabellum*) *pavoninum* [X], *Truncatoflabellum angustum* [X].

## NIMBUS

Stn 12. — ?.07.1968, 26°32'S, 153°45'E, depth unknown, Queensland: *Anthemiphyllia multidentata*.

Stn 55. — 1968, 26°27'S, 153°50'E, 270-272 m, Queensland: *Anthemiphyllia multidentata*.

## NZOI (New Zealand Oceanographic Institute), "Tangaroa"

Stn C527. — 18.09.1960, 32°30.0'S, 179°12.0'W, 508 m, southern Kermadec Ridge: *Anthemiphyllia macrolobata*.

Stn I92. — 23.07.1975, 29°24.8'S, 168°13.2'E, 570-578 m, Norfolk I.: *Flabellum* (*Flabellum*) *arcuatile*.

Stn I97. — 25.07.1975, 32°22.9'S, 167°28.2'E, 540-544 m, southern Norfolk Ridge: *Flabellum* (*Flabellum*) *arcuatile*.

Stn I741. — 12.05.1979, 22°43.0'S, 159°16.0'E, 328 m, Lord Howe Seamount Chain: *Balanophyllia desmophyllioides*.

Stn K803. — 22.07.1974, 29°16.0'S, 177°50.3'W, 190-140 m, Raoul I., Kermadec Is: *Madracis kauaiensis*.

Stn K825. — 25.07.1974, 28°47.8'S, 177°47.8'W, 145 m, Raoul I., Kermadec Is: *Madracis kauaiensis*.

Stn K826. — 25.07.1974, 28°48.0'S, 177°48.0'W, 142 m, Raoul I., Kermadec Is: *Madracis kauaiensis*.

Stn K830. — 26.07.1974, 29°11.5'S, 177°53.0'W, 545-590 m, Raoul I., Kermadec Is: *Oxysmilia circularis*.

Stn K842. — 29.07.1974, 30°10.2'S, 178°35.9'W, 325-370 m, McCauley I., Kermadec Is: *Anthemiphyllia pacifica*.

Stn K858. — 30.07.1974, 30°34.2'S, 178°29.8'W, 465-501 m, Curtis I., Kermadec Is: *Oxysmilia circularis*.

Stn K872. — 2.08.1974, 31°20.4'S, 178°49.2'W, 280-235 m, Esperance Rock, Kermadec Is: *Anthemiphyllia pacifica*.

Stn P115. — 31.05.1977, 31°25.9'S, 159°02.2'E, Lord Howe Is: *Thalamophyllia tenuescens*.

Stn U599. — 08.02.1988, 30°43.0'S, 173°16.0'E, 640-590 m, Three Kings Ridge, New Zealand: *Flabellum* (*Flabellum*) *arcuatile*.

## "Townsend Cromwell"

Stn 81-01-14. — 02.02.1981, 23°15'48"N, 161°50'12"W, 369 m, Hawaiian Is: *Anthemiphyllia macrolobata*.

## "Toyoshio-Maru"

Stn 11. — 11.11.1995, 28°05'N, 129°47'40"E, 302 m, Ryukyu Is: *Madrepora minutisepium*.

## USGS (United States Geological Survey)

Stn 24918. — Late Pleistocene, Navaka River, Espiritu Santo: *Madrepora porcellana*.

Stn 25715. — Late Pleistocene, Kere River, Espiritu Santo: *Madrepora porcellana*, *Caryophyllia* (*Acanthocyathus*) *grayi*, *Dendrophyllia ijimai*.

Stn 25718. — Late Pleistocene, Kere River, Espiritu Santo: *Madrepora porcellana*.

Stns SM242, 129a and 129b. — Late Pleistocene, Kere River, Espiritu Santo: *Caryophyllia* (*Acanthocyathus*) *grayi*.

## HISTORICAL REVIEW

No azooxanthellate Scleractinia were previously known from the Wallis and Futuna region, and only two authors reported azooxanthellate corals from Vanuatu: *Neohelia porcellana* from Epi (MOSELEY, 1881), and 17 Late Pleistocene species from Espiritu Santo (WELLS, 1984). However, many species have been reported from other islands throughout the tropical central Pacific, which are summarized in Table 1. Although the specimens reported in this paper are primarily deep-water in habitat, it was attempted to include references to all azooxanthellate species in Table 1, regardless of depth. Only some of the more significant papers are briefly discussed below.

TABLE 1. — Summary of azooxanthellate Scleractinia previously reported from the tropical central Pacific. (S = 0-100 m, D = over 100 m, + = fossil).

Year	Author	Locality	Depth	Species reported
1831	LESSON	Hawaiian Is.	D	<i>Flabellum pavoninum</i> sp. nov.
1846	DANA	Fiji	S	3 species: <i>Tubastraea</i> and <i>Culicia</i> , including two new species.
1878	STUDER	Solomon Is. (Bougainville)	S	<i>Madracis hellana</i> , <i>Phyllangia papuensis</i> sp. nov.
1881	MOSELEY	Admiralty, Kermadec Is., Fiji, Vanuatu, Caroline, Louisiade Is.	D	6 species, including 4 new
1892	REHBERG	Fiji	D	<i>Madracis singularis</i> sp. nov.
1898	WHITELEGGE	Tuvalu (Funafuti)	SD	<i>Caryophyllia "clavus"</i>
1899a	GARDINER	Loyalty Is. (Lifou)	S	9 new species, all from Sandal Bay (73 m)
1899b	GARDINER	Tuvalu (Funafuti)	D	<i>Rhizotrochus levidensis</i>
1900	GARDINER	Loyalty Is.	S	<i>Coenopsammia willeyi</i> sp. nov.
1903	BOURNE	Funafuti (Tuvalu)	D	4 species, including 2 new
1907	VAUGHAN	Hawaiian Is.	D	32 species and 7 varieties, 27 new
1936	YABE & SUGIYAMA	Palau	D	3 species, including 2 new <i>Madracis</i>
1954	WELLS	Bikini Atoll (Marshall Is.)	SD	13 species, including a new genus, 2 new species, 1 new variety
1971	CHEVALIER	New Caledonia	S	3 species of <i>Culicia</i> and <i>Oulangia</i> , including 2 new
1973	ZIBROWIUS	Tuamotu Is.	D	<i>Enallopsammia rostrata</i>
1974	KELLER	Marcus-Necker Ridge	D	<i>Flabellum marcus</i> sp. nov.
1976	KELLER	Caroline, Marquesas, Tuamotu Is.	D	<i>Fungiacyathus fragilis fragilis</i> subsp. nov.
1977	WELLS	Tonga (Late Eocene)	+	17 species, including 13 new
1978	CHEVALIER	Marquesas	S	4 species, 3 unidentified to species
1980	CHEVALIER	Tubuai	S	2 species, both unidentified to species
1981a	KELLER	Marcus-Necker Ridge, Hermit Atoll, Dimitri Mendeleev Seamount, Hawaiian Is.	D	8 species, including 1 new
1981b	KELLER	Bonin Is., Marcus-Necker Ridge	D	<i>Caryophyllia pacifica</i> sp. nov., <i>C. scobinosa</i>
1982	KELLER	Cook, Kermadec, Hawaiian Is.	D	3 species of <i>Deltocyathus</i>
1984	CAIRNS	Hawaiian, Christmas, Line Is.	D	19 new records, including 8 new species
1984	WELLS	Vanuatu (Late Pleistocene)	+	17 species, including 3 new species
1985	ZIBROWIUS & GRYGIER	New Caledonia, Guam, Cook, Hawaiian, Santa Cruz Is.	D	6 species as hosts of ascothoracidan Crustacea



Year	Author	Locality	Depth	Species reported
1985	GRYGIER & NEWMAN	Tonga, Hawaiian Is.	D	<i>Enallopsammia rostrata</i> as host of acrothoracican cirripedes
1985	ZIBROWIUS	Chesterfield Is.	S	2 species of budd-shedding <i>Balanophyllia</i>
1985	RANDALL & MYERS	Guam	S	5 species
1989	SIEG & ZIBROWIUS	New Caledonia	D	4 unidentified species as hosts for tanaidacean
1991	MANNING	New Caledonia	D	<i>Dendrophyllia alcocki</i> as host for cryptochirid crab
1991	GRYGIER	Johnston Atoll	D	<i>Enallopsammia rostrata</i> as host of ascothoracidan Crustacea
1995	CAIRNS	Kermadec, Colville, Norfolk Ridges; Chesterfield, Cook, Tonga, Samoa Is.	DS	76 species, including 15 new species, mostly from southern border of tropical region
1995	GUERRIERO <i>et al.</i>	Loyalty Is.	D	steroids from <i>Deltocyathus magnificus</i>
1996	STOLARSKI	Loyalty Is.	D	unidentified gardinariid genus and species
1997	CAIRNS & ZIBROWIUS	Fiji, New Caledonia, Palau, Marquesas, Kermadecs Is.; Norfolk Ridge	DS	9 species, including 2 new species
1998	CAIRNS (this paper)	Vanuatu, Wallis and Futuna, Hawaiian Is., Chesterfield Is., Guam, Lord Howe Seamount Chain	D	134 species (see Historical Review), including 15 new species

The first azooxanthellate coral reported from the tropical central Pacific was *Flabellum pavoninum* Lesson, 1831 from the "Sandwich Islands" (= Hawaiian Islands), which is ironic, since it is a deep-water species that was collected before the era of deep-water dredging. The "Challenger" Expedition, which ushered in the era of deep-water biology, collected 6 species from various localities throughout the central Pacific, including one new species (*Neohelia porcellana*) from the Vanuatu archipelago (MOSELEY, 1881). The collection of the nine species reported by GARDINER (1899a) from the Loyalty Islands, all from Sandal Bay at 73 m, is significant in that many of these species are also found at greater depths, as reported herein. GARDINER's specimens were split between the British Museum and the University Museum of Zoology, Cambridge.

The Hawaiian azooxanthellate fauna is relatively well known, due to the seminal work of VAUGHAN (1907) and later additions by CAIRNS (1984), all specimens of which are deposited at the USNM. Although a northern outlier to the central Pacific region, the Hawaiian fauna includes many species found throughout the Indo-Pacific (see Distribution section), as well as some apparent endemics.

Another significant paper on corals from the central tropical Pacific was that of WELLS (1954) on the Recent corals of the Marshall Islands, in which 13 azooxanthellate species are reported from Bikini Atoll, mostly from depths shallower than 200 m. These specimens are deposited at the USNM.

KELLER (1981a) reported eight species from several exotic central Pacific bathyal localities, including the Marcus-Necker Ridge (18-23°N, 157-178°E), Hermit Atoll (1°S, 145°E), Demetri Mendeleev Seamount (5°N, 155°E), and the Hawaiian Islands. These specimens are deposited at the Institute of Oceanology, Moscow.

As the Hawaiian Islands are to the northern border of the central tropical Pacific, the ridges and islands north of New Zealand (north of 33°S) are to the southern central tropical Pacific. In his revision of the New Zealand azooxanthellate Scleractinia, CAIRNS (1995: Table 2) listed 76 species from the Kermadec and the Lord Howe Islands, and the northern Colville, Three Kings, and Norfolk ridges; additional records of 12 of these species were also reported from Chesterfield, Cook, Tonga, and Samoa Islands.

Azooxanthellate species were reported in an incidental fashion in a number of papers published after 1984 (see Table 1), often as host species for symbionts, or as a part of a larger checklist of the shallow water coral fauna

from a region. It was attempted to make Table 1 as complete as possible, but undoubtedly some references of this nature were overlooked.

As a result of this study, 116 azooxanthellate species are reported from the Vanuatu Archipelago and 83 from the Wallis and Futuna Archipelago (Table 2). Incidental records are also reported from the Kermadec Islands (3 species), Hawaiian Islands (2), Johnston Atoll (1), Lord Howe Seamount Chain (1), Guam (1), Chesterfield Island (1), and the ridges and islands north of New Zealand (1).

The following azooxanthellate coral faunas have been reviewed from regions bordering the tropical central Pacific: northern temperate Pacific (CAIRNS, 1994), eastern temperate Pacific (CAIRNS, 1994), eastern tropical Pacific (CAIRNS, 1991a), southern temperate Pacific (CAIRNS, 1982, 1995), and western tropical Pacific (CAIRNS, 1989a; CAIRNS & ZIBROWIUS, 1997).

## MATERIAL

This study was based on the examination of approximately 4400 specimens (1042 lots) collected from 227 stations. Most of the specimens were collected by the French research expedition MUSORSTOM 7 in the Wallis and Futuna archipelago in 1992 (RICHER DE FORGES & MENOUE, 1993) and MUSORSTOM 8 in the Vanuatu archipelago in 1994 (RICHER DE FORGES, FALIEUX & MENOUE, 1996).

A novel source of specimens heretofore overlooked by most are those deep-water corals that have been cemented into the shell of *Xenophora* carrier shells. Nineteen species and several more unidentified taxa were distinguished from 40 *Xenophora* shells from the MUSORSTOM 8 expedition in the Vanuatu Archipelago, some shells bearing as many as 6 different species. This source of specimens is considered promising because, despite numerous stations made by the MUSORSTOM expedition in this region, of the 19 species found on these shells, three (*Fungiacyathus variegatus*, *Peponocyathus folliculus*, and *Temnotrochus kermadecensis*) are known from this region only as *Xenophora*-collected, and another five species (*Guynia annulata*, *Tropidocyathus labidus*, *Notocyathus conicus*, *Deltocyathus heteroclitus*, and *Trochocyathus discus*) were otherwise rarely collected from this region by conventional means. The depth ranges of the *Xenophora*-collected coralla are consistent with the known depth range of the coral species, implying that bathymetric transport by the gastropod is probably negligible. Furthermore, although most coralla cemented to *Xenophora* shells are dead, some were still alive when attached and when collected.

## METHODS

Species descriptions and illustrations are provided only for those species described as new or for those for which no adequate description previously existed. Shorter diagnoses are provided for most of the remaining species for which new material is reported, with an indication as to where to find a more complete description.

Species synonymies are complete unless otherwise indicated with a reference to a more complete account; however, it was attempted to include in the synonymies all references to specimens reported from the tropical central Pacific. When possible, historical records were verified, but when material was unavailable and the published account unclear, the synonymy entry and corresponding distribution record are queried. In order to clarify what historical material was examined by the author, the following convention was employed (see MATTHEWS, 1973). The three symbols used in the synonymies, which always precede the year of publication, are:

\*, meaning this entry represents a valid species under the terms of the ICZN (1985);

v\*, meaning that the author (SDC) has examined the type of this species;

v., meaning that the author (SDC) has examined this/these nontype specimens and agrees that they belong in synonymy.

The letter "v" is Latin for *vidimus* (we have seen). The *vidimus* convention is not used for publications written by the author of the cited publication, since it is self-evident that he has seen the specimens that he has previously reported.

In the "Material Examined" sections, the number of specimens examined follows the station number, followed by the museum of deposition, and its catalog number, if any. Holotypes and paratypes are deposited primarily at the MNHN and NMNH.

In order to avoid erroneous depth ranges for species as a result of bathymetrically wide-ranging trawls, a confirmed depth range is employed in this paper, which is defined as the deepest shallow to the shallowest deep component of all trawls considered. For example, if a species was trawled at a station indicating 20-300 m and again at a station indicating 250-500 m, the confirmed depth range is 250-300 m, a depth range within which the species must occur.

Conventional photography was done by the author, in some cases the corallum dyed black with cloth dye and recoated with sublimed ammonium chloride in order to improve contrast for photography.

## DISTRIBUTION

*Inter-regional comparisons.* — The Vanuatu archipelago and Wallis and Futuna islands and adjacent seamounts lie near the centre of the large Indo-Polynesian tropical marine province as defined by BRIGGS (1974), which extends from the Persian Gulf to the Tuamotu Archipelago. The 116 azooxanthellate species listed for the Vanuatu region (Table 2) compare closely in number to the 125 listed by CAIRNS & ZIBROWIUS (1997) for the highly diverse Kai Islands, Indonesia, especially considering that the shallow and extremely deep environments of the Vanuatu region were not sampled. Indeed, 95 (71%) of the 134 species from the Vanuatu and Wallis and Futuna regions are also known in the tropical western Pacific region, this number decreasing to 62 (46%) farther west in the tropical Indian Ocean (Table 2). On the other hand, only seven species are found in common with the Vanuatu/Wallis and Futuna region and the tropical eastern Pacific: five of those being cosmopolitan; one, *Endopachys grayi*, being Indo-Pacific in distribution; and the seventh, *Polymyces wellsi*, amphi-Pacific in distribution. Ironically, the Vanuatu/Wallis and Futuna region has more species in common with the Atlantic Ocean (11) than the eastern Pacific (7)(see Table 2). Among these 11 species, 6 may be considered to be cosmopolitan; two (*Caryophyllia ambrosia* and *Truncatoflabellum stabile*) have potentially continuous distributions via the Indian Ocean; but three species (*Stephanocyathus coronatus*, *Vaughanella concinna*, and *Peponocyathus folliculus*) have apparent disjunct distributions between the central Pacific and the western or northern Atlantic.

Because deep water temperature gradients do not always exactly correspond to shallow water gradients, the zoogeographic boundaries of deep-water corals are sometimes less well-defined than for shallow-water organisms (BRIGGS, 1974; CAIRNS, 1994, 1995). Thus, it is not considered unusual that 43 species from the Vanuatu/Wallis and Futuna region are also known from the warm to cold temperate region of Japan, and 32 species extend to the temperate regions of New Zealand and southern Australia (Table 2).

*Intraregional comparisons.* — Within the tropical central Pacific, the Vanuatu/Wallis and Futuna azooxanthellates have a strong affinity (56 species, Table 2) to those species found in the tropical regions to the south, composed of the Kermadec Islands and Ridge, Colville Ridge, Norfolk Island and Ridge, and the Lord Howe Islands and Seamount Chain. These submarine ridge systems north of New Zealand form a natural conduit for the migration of corals in both directions between the New Zealand region and the Tonga Platform and the New Caledonian region. And, whereas only 9 species are listed for the New Caledonian region in Table 2, unstudied MUSORSTOM collections from this region and the Loyalty Islands suggest an extremely diverse fauna very similar to that of the Vanuatu region. The Hawaiian azooxanthellate fauna constitutes a separate province in the tropical Pacific (Briggs, 1974), having an endemic component of 48% (CAIRNS, 1984). Nonetheless, 24 species known from the Vanuatu/Wallis and Futuna region also occur off the Hawaiian Islands (Table 2). Other than the Hawaiian Islands, the ridges north of New Zealand, and the region under study, azooxanthellates are poorly known from other tropical central Pacific regions, only 17 species listed in Table 2: column 5, symbol X; see also Table 1.

TABLE 2. — Geographic distribution and bathymetric ranges of the Recent azooxanthellate scleractinian species known from the regions of Wallis &amp; Futuna and Vanuatu Archipelagos.

Key to areas: 1-7, **Tropical regions**: 1, Indian Ocean; 2, western Pacific; 3, Vanuatu region; 4, Wallis and Futuna region; 5, other central Pacific islands (H, Hawaiian Islands; NZ, ridges north of New Zealand; NC, New Caledonia, Loyalty Islands, and/or Chesterfield Islands; OI, other central Pacific islands); 6, eastern Pacific; 7, Atlantic Ocean. — 8-9, **Temperate regions**: 8, Japan (excluding Ryukyu Isl.); 9, New Zealand, Australia.

Bathymetric ranges (given in meters) only for records from Vanuatu/Wallis and Futuna region.

Symbols: + fossil occurrence.

	TROPICAL							TEMPERATE		Depth (m)
	1	2	3	4	5	6	7	8	9	
<b>POCILLOPORIDAE</b>										
<i>Madracis kauaiensis</i> Vaughan, 1907	?		x	x	H, NZ, OI					210-516
<b>FUNGIACYATHIDAE</b>										
<i>Fungiacyathus (F.) stephanus</i> (Alcock, 1893)	x	x	x	x	NZ			x	x	440-1280
<i>F. (F.) pusillus pacificus</i> Cairns, 1995				x	x	NZ			x	425-811
<i>F. (F.) sandoi</i> sp. nov.					x					295-600
<i>F. (F.) paliferus</i> (Alcock, 1902)	x	x	x					x	x	190-400(+)
<i>F. (Bathyactis) margaretae</i> Cairns, 1995				x	x	NZ				440-175
<i>F. (B.) granulatus</i> Cairns, 1989	x	x	x	x				x		433-455
<i>F. (B.) variegatus</i> Cairns, 1989	x	x	x					x		400-440(+)
<b>MICRABACIIDAE</b>										
<i>Letepsammia franki</i> Owens, 1994	x		x	x						190-475
<i>Stephanophyllia neglecta</i> Boschma, 1923			x	x	x					280-497
<i>S. complicata</i> Moseley, 1876	x	x	x	x	NZ				x	288-700(+)
<b>OCULINIDAE</b>										
<i>Oculina virgosa</i> Squires, 1958				x					x	180-210
<i>Madrepora oculata</i> Linnaeus, 1758	x	x	x	x	H, NZ		x	x	x	310-1280
<i>M. minutiseptum</i> Cairns & Zibrowius, 1997			x	x						233-260
<i>M. porcellana</i> (Moseley, 1881)			x	x	x	NC				115-516(+)
<b>ANTHEMIPHYLLIIDAE</b>										
<i>Anthemiphyllia dentata</i> (Alcock, 1902)	x	x	x	x	H, NZ					280-650
<i>A. pacifica</i> Vaughan, 1907				x	H, NZ					310
<i>A. patera costata</i> subsp. nov.					x					320-700
<i>A. spinifera</i> sp. nov.			x	x	x					245-510
<b>CARYOPHYLLIIDAE</b>										
<i>Caryophyllia (C.) hawaiiensis</i> Vaughan, 1907			x	x	x	H, NZ				252-300
<i>C. (C.) crosnieri</i> Cairns & Zibrowius, 1997	x	x	x	x	NZ				x	386-600
<i>C. (C.) rugosa</i> Moseley, 1881	x	x	x	x				x	x	314-440
<i>C. (C.) octonaria</i> Cairns & Zibrowius, 1997			x	x						182-622
<i>C. (C.) abrupta</i> sp. nov.				x	x					300-650
<i>C. (C.) marmorea</i> Cairns, 1984					x	H				475-600
<i>C. (C.) quadragenaria</i> Alcock, 1902	x	x	x	x				x	x	314-440
<i>C. sp. cf. C. (C.) calveri</i> Duncan, 1873	x	x	x	x				x	x	314-440
<i>C. (C.) diomedae</i> Marenzeller, 1904	x	x	x		NZ, OI		x	x		475-799
<i>C. (C.) lamellifera</i> Moseley, 1881	?	x	x	x	NZ					180-516
<i>C. (C.) scobinosa</i> Alcock, 1902	x	x	x	x	NZ, OI			x		715-900
<i>C. (C.) ambrosia</i> Alcock, 1898	x	x		x	NZ		x	x	x	715-1015

	TROPICAL							TEMPERATE		Depth (m)
	1	2	3	4	5	6	7	8	9	
<i>C. (Acanthocyathus) grayi</i> (H. Milne Edwards & Haimé, 1848)	x	x	x	x				x		125-160(+)
<i>Crispatotrochus rubescens</i> (Moseley, 1881)		x	x	x	H, OI			x		420-516
<i>C. rugosus</i> Cairns, 1995	x	x	x	x	NZ					190-455
<i>Labyrinthocyathus limatulus</i> (Squires, 1964)			x		NZ				x	372-466
<i>Oxysmilia circularis</i> Cairns	x		x		NZ					190-475
<i>O. corrugata</i> sp. nov.			x							180-190
<i>O. epithecata</i> sp. nov.			x	x						240-455
<i>Trochocyathus (T.) vasiformis</i> Bourne, 1903		x	x	x	OI					366-650
<i>T. (T.) rhombocolumna</i> Alcock, 1902	x	x	x		H, NZ					397-410
<i>T. (T.) philippinensis</i> Semper, 1872	x	x	x	x						182-330
<i>T. (T.) maculatus</i> Cairns, 1995		x	x	x	NZ					110-550
<i>T. (T.) efateensis</i> sp. nov.			x							391-437
<i>T. (T.) patelliformis</i> sp. nov.			x		H					1210-1250
<i>T. (T.) semperi</i> Cairns & Zibrowius, 1997		x	x							163-165
<i>T. (T.) cooperi</i> (Gardiner, 1905)	x	x	x		OI			x		101-124
<i>T. (T.) discus</i> Cairns & Zibrowius, 1997		x	x	x						455-470
<i>T. (Aplocyathus) hastatus</i> Bourne, 1903			x	x	NZ, OI					391-540
<i>T. (A.) brevispina</i> Cairns & Zibrowius, 1997		x	x							110-436
<i>Tethocyathus virgatus</i> (Alcock, 1902)		x	x	x	NZ					320-650
<i>Polycyathus octuplus</i> sp. nov.				x						110-441
<i>Bourneotrochus stellulatus</i> (Cairns, 1984)		x	x	x	H, NZ, NC, OI					240-566(+)
<i>Stephanocyathus (S.) regius</i> Cairns & Zibrowius, 1997		x	x	x	NZ					700-1550
<i>S. (Odontocyathus) coronatus</i> (Pourtalès, 1867)		x	x	x	NZ			x		1175-1300
<i>S. (O.) weberianus</i> (Alcock, 1902)		x	x		NZ			x		798-799
<i>S. (Acinocyathus) spiniger</i> (Marenzeller, 1888)	x	x	x	x	NZ			x	x	319-420(+)
<i>Vaughanella concinna</i> Gravier, 1915				x	NZ			x		500-560
<i>Deltocyathus magnificus</i> Moseley, 1876	x	x	x					x	x	408-433
<i>D. rotulus</i> (Alcock, 1902)	x	x	x	x				x		1050-1300
<i>D. suluensis</i> Alcock, 1902	x	x	x	x	NZ					400-650
<i>D. taiwanicus</i> Hu, 1987		+		x						320-697
<i>D. vauhani</i> Yabe & Eguchi, 1932		x	x					x		585-919
<i>D. crassiseptum</i> sp. nov.			x	x						413-536
<i>D. cameratus</i> sp. nov.			x	x						305-1175
<i>D. stella</i> Cairns & Zibrowius, 1997		x	x	x						240-597
<i>D. heteroclitus</i> Wells, 1984			x	x						208-355(+)
<i>D. ornatus</i> Gardiner, 1899			x	x	NC					295-360
<i>Heterocyathus</i> sp. cf. <i>H. sulcatus</i> (Verrill, 1866)	x	x	x	x						110-312
<i>H. alternatus</i> Verrill, 1865	x	x	x							301-319
<i>Conotrochus funicolumna</i> (Alcock, 1902)	x	x	x	x	H			x		350-700
<i>C. brunneus</i> (Moseley, 1881)	x	x	x	x	NZ					300-580
<i>C. asymmetros</i> sp. nov.			x	x						210-510
<i>Lochmaetrochus gardineri</i> sp. nov.			x	x						608-1175
<i>Autocyathus recidivus</i> (Dennant, 1906)	x	x		x	NZ			x	x	1020-1280
<i>A. juvenescens</i> Marenzeller, 1904	x	?	x							182-184
<i>Desmophyllum dianthus</i> (Esper, 1794)	x	x	x	x	H, NZ		x	x	x	455-830
<i>Thalamophyllia tenuescens</i> (Gardiner, 1899)	x	x		x	NZ, NC, OI					240-249

	TROPICAL							TEMPERATE		Depth (m)
	1	2	3	4	5	6	7	8	9	
<i>Lophelia pertusa</i> (Linnaeus, 1758)	x			x		x	x	x		560-580
<i>Dactylotrachus cervicornis</i> (Moseley, 1881)		x	x	x	NC, OI					245-400
<i>Rhizosmilia robusta</i> Cairns, 1993	x	x	x	x						100-360
<i>Asterosmilia gigas</i> (van der Horst, 1931)	x			x						252-510
TURBINOLIIDAE										
<i>Alatotrochus rubescens</i> (Moseley, 1876)		x	x		NZ			x		536-619
<i>Pleotrochus venustus</i> (Alcock, 1902)		x	x		NZ					647
<i>P. zibrowii</i> Cairns, 1997			x	x	NZ					700-830
<i>Tropidocyathus lessonii</i> (Michelin, 1842)	x	x	x					x		291-300
<i>T. labidus</i> Cairns & Zibrowius, 1997	x	x	x							419-536
<i>Cyathotrochus pileus</i> (Alcock, 1902)	x	x	x		NZ			x		300-497
<i>Deltocyathoides orientalis</i> (Duncan, 1876)	x	x	+	x				x	x	245-455(+)
<i>Notocyathus conicus</i> (Alcock, 1902)		x	x		NZ			x		301-366
<i>N. venustus</i> (Alcock, 1902) sensu WELLS, 1984	x	x	?	+				x		(+)
<i>Cryptotrochus brevivalus</i> sp. nov.			x							466-700
<i>Idiotrochus kikutii</i> (Yabe & Eguchi, 1941)	x	x		x				x		240-260
<i>Peponocyathus folliculus</i> (Pourtales, 1868)		x	x				x	x		425-455
GUYNIIDAE										
<i>Guynia annulata</i> Duncan, 1872	x	x	x	x	H		x		x	260-300
<i>Truncatoguyonia irregularis</i> Cairns, 1989		x	x		NZ					295-334
<i>Temnotrochus kermadecensis</i> Cairns, 1995			x		NZ					321-400
FLABELLIDAE										
<i>Flabellum</i> ( <i>F.</i> ) <i>pavoninum</i> Lesson, 1831	x	x	x	x	H			x		161-455
<i>F. (F.) arcuatile</i> sp. nov.				x	NZ					300-640
<i>F. (Ulocyathus) deludens</i> Marenzeller, 1904	x	x		x				x		516-530
<i>F. (U.) aotearoa</i> Squires, 1964			x		NZ, NC				x	287-436(+)
<i>F. (U.) marcus</i> Keller, 1974			x		H, OI					1050-1075
<i>F. (U.) hoffmeisteri</i> Cairns & Parker, 1992	x	x	x		NZ				x	495-498
<i>F. (U.) apertum apertum</i> Moseley, 1876	x			x					x	795-1280
<i>Truncatoflabellum stabile</i> (Marenzeller, 1904)	x	x	x				x			786-1160
<i>T. dens</i> (Alcock, 1902)		x	x	x	NZ, NC					286-500
<i>T. pusillum</i> Cairns, 1989	x	x	x							285-460
<i>T. angustum</i> Cairns & Zibrowius, 1997		x	x	x	NZ					295-530
<i>T. phoenix</i> Cairns, 1995		x		x	NZ			x		240-441
<i>T. vigintifarium</i> sp. nov.			x							288-700
<i>T. mortenseni</i> Cairns & Zibrowius, 1997		x	x	x						165-455
<i>T. vanuatu</i> (Wells, 1984)			+	x						240-375(+)
<i>T. aculeatum</i> (H. Milne Edwards & Haime, 1848)	x	x	x							30-50
<i>T. candeanum</i> (H. Milne Edwards & Haime, 1848)		x	x					x		182-215
<i>T. martensii</i> (Studer, 1878)			x						x	161-182(+)
<i>Javania lamprotichum</i> (Moseley, 1880)	x	x	x	x	H, NZ, OI					486-920
<i>J. fuscus</i> (Vaughan, 1907)		x	x	x	H, NZ, OI				x	314-778
<i>J. exserta</i> sp. nov.		x	x	x	OI					130-455
<i>Rhizotrochus typus</i> H. Milne Edwards & Haime, 1848	x	x	x					x		130-194

	TROPICAL							TEMPERATE		Depth (m)
	1	2	3	4	5	6	7	8	9	
<i>R. flabelliformis</i> Cairns, 1989		x		x	NZ				x	400-450
<i>Polymyces wellsi</i> Cairns, 1991		x	x		NZ		x			536-566
GARDINERIIDAE										
<i>Gardineria hawaiiensis</i> Vaughan, 1907	x	x	x		H, NZ, NC				x	366-574
<i>G. paradoxa</i> (Pourtalès, 1868)		x	x					x		495-498
DENDROPHYLLIIDAE										
<i>Balanophyllia desmophyllioides</i> Vaughan, 1907		x	x	x	H, NC					190-516
<i>B. laysanensis</i> Vaughan, 1907				x	H					
<i>B. rediviva</i> Moseley, 1881		x	x							210-252
<i>B. gemma</i> (Moseley, 1881)		x	x							397-430
<i>B. gigas</i> Moseley, 1881	x	x	x		H			x	x	410-505(+)
<i>B. crassithecra</i> Cairns, 1995			x		NZ				x	408-413
<i>Endopachys grayi</i> H. Milne Edwards & Haime, 1848	x	x	x	x	H, NZ		x	x	x	181-441
<i>Heteropsammia cochlea</i> (Spengler, 1781)	x	x	x	x						110-622
<i>Dendrophyllia ijimai</i> Yabe & Eguchi, 1934	x	x	+					x		(+)
<i>D. arbuscula</i> van der Horst, 1922	x	x	x		NZ			x		130-319
<i>D. alcocki</i> (Wells, 1954)	x	x	x	x	NZ, OI				x	315-475
<i>Enallopsammia rostrata</i> (Pourtalès, 1878)	x	x	x	x	H, NZ, OI		x	x	x	370-920

NUMBER OF SPECIES IN EACH AREA: 1 = 62; 2 = 95; 3 = 116; 4 = 83; 5 = 72; 6 = 7; 7 = 11; 8 = 42; 9 = 32.

## SYSTEMATIC ACCOUNT

### Order SCLERACTINIA

#### Suborder ASTROCOENIINA

#### Family POCILLOPORIDAE

Genus *MADRACIS* H. Milne Edwards & Haime, 1849

#### *Madracis kauaiensis* Vaughan, 1907

Figs 1 a-e

?*Madracis hellena* - STUDER, 1878: 636 [Not *M. hellana* H. Milne Edwards & Haime, 1850].

?*Madracis singularis* Rehberg, v\*1892: 10-11, pl. 1, figs 3-4 (Not specimen from Fiji).

*Madracis kauaiensis* Vaughan, v\*1907: 83-84, pl. 9, figs 1-4. — CAIRNS, 1984: 6.

?*Madracis interjecta* Marenzeller, \*1907: 20-21, pl. 2, fig. 3.

MATERIAL EXAMINED. — **Wallis and Futuna Islands.** MUSORSTOM 7: stn 496, 1 branch (MNHN). — Stn 499, 1 branch (98543). — Stn 500, 1 branch (USNM 98544). — Stn 502, 1 branch (MNHN). — Stn 504, 6 branches (MNHN). — Stn 507, 1 branch (MNHN). — Stn 508, 1 branch (MNHN). — Stn 509, 1 large colony and numerous branches (MNHN). 5 branches and SEM stubs 869-870 (USNM 98541). — Stn 515, 5 branches (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 988, 41 branches (MNHN). — Stn 1077, 2 colonies and several branches (USNM 98549).

**Hawaii Islands.** HURL: stn 83-202, 1 colony (USNM 83460).

**New Zealand.** NZOI: stn K803, 1 branch (USNM 93996). — Stn K825, 4 branches (USNM 93997). — Stn K826, 1 branch (USNM 93998).

**TYPE LOCALITY.** — "*Albatross*" stn 3982: 21°56'25"N, 159°21'40"W (Kauai, Hawaiian Islands), 73-426 m.

**DIAGNOSIS.** — Colonies flabellate to slightly bushy; irregularly branched; lower branches of large colonies often anastomosing with one another. Largest corallum (MUSORSTOM 7 stn 509) 14 cm in height, 14 cm wide, and uniplanar. Branches circular in cross-section: basal branches up to 8 mm in diameter, distal branches 2.5-3.0 mm in diameter. Corallites slightly elliptical in shape, their greater axis aligned with the branch axis; corallites 1.25-1.35 mm in greater diameter, occurring homogeneously and well spaced on all branch surfaces. Coenosteum white, bearing prominent spines up to 15 mm in height. Corallites contain 10 equal-sized septa, each about 0.15 mm exsert and bordered internally by a small (0.05 mm wide) paliform lobe. Central region of calice a broad, flat platform, connected to axial edges of septa and supporting a laterally compressed styliform to lamellar columella, the greater axis of columella aligned with the greater axis of corallite.

**REMARKS.** — H. MILNE EDWARDS & HAIME (1850) described *Madracis hellana* from Reunion at a depth of 37 m, for a branching species of this genus having 10-12 septa per corallite. STUDER (1878) reported a second specimen of this species from Bougainville Island (88 m), this specimen deposited at the ZMB, the first report of this genus for the Pacific. REHBERG (1892), believing that STUDER's southwest Pacific specimen must be different from the western Indian Ocean *M. hellana*, redescribed STUDER's specimen as *Madracis singularis*, n. sp., and reported another specimen of his presumed new species from Viti (Fiji) at 146 m. Finally, VAUGHAN (1907) described another decamerall Pacific *Madracis* species, *M. kauaiensis*, from the Hawaiian Islands (44-541 m). The type of *M. hellana* was not examined and the type of *M. singularis* Rehberg, 1892 (Studer's *M. hellana* from Bougainville, ZMB 1842) was not available for examination and thus their identity with the specimens reported herein remains in doubt, but the second specimen reported by REHBERG from Fiji at 80 fathoms (= 146 m) (ZMB 601) was examined and found to be quite different from the specimens reported herein. The Fiji specimen, which might be interpreted as a syntype of *M. singularis*, has thicker, blunt to clavate branches; larger calices (GCD 1.6-2.2 mm); no paliform lobes; and a continuous, spinose ridge that encircles each calice. The specimens reported above are, however, indistinguishable from the type series of *M. kauaiensis* Vaughan, 1907, and thus are identified as such.

**DISTRIBUTION.** — Wallis and Futuna region: Futuna; 240-516 m. Vanuatu region: Tanna and Malakula; 210-372 m. Elsewhere: Hawaiian Islands; Johnston Island (reported herein); Kermadec Ridge (reported herein); ?Bougainville (STUDER, 1878); ?Gulf of Aqaba (MARENZELLER, 1907); 44-541 m.

#### Suborder FUNGIINA

#### Family FUNGIACYATHIDAE

#### Genus *FUNGIACYATHUS* Sars, 1872

#### Subgenus *FUNGIACYATHUS (FUNGIACYATHUS)* Sars, 1872

#### *Fungiacyathus (F.) stephanus* (Alcock, 1893)

*Bathyaectis stephanus* Alcock, \*1893: 149, pl. 5, figs 12-12a.

*Bathyaectis sibogae* Alcock, v\*1902a: 108 (in part); v.1902c: 38 (in part: "*Siboga*" stn 95 and large specimen of 57 mm GCD).

*Fungiacyathus (F.) stephanus* - CAIRNS, 1989a: 7-9, pl. 1, figs a-k, pl. 2, figs a-b (synonymy); 1994: 37, pl. 13, figs g-i; 1995: 31-32, pl. 1, figs a-c, map 1; 1998: 369. — CAIRNS & ZIBROWIUS, 1997: 68-69 (synonymy).



MATERIAL EXAMINED. — **Wallis and Futuna region.** MUSORSTOM 7: stn 551, 2 (MNHN). — Stn 552, 3 (MNHN). — Stn 565, 1 (MNHN). — Stn 621, 1 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 963, 2 (MNHN). — Stn 975, 1 (MNHN). — Stn 990, 1 (MNHN). — Stn 992, 1 (USNM 98539). — Stn 996, 3 (USNM 98537). — Stn 1007, 1 (MNHN). — Stn 1036, 3 (MNHN). — Stn 1074, 1 (MNHN). — Stn 1080, 1 (USNM 98540). — Stn 1125, 1 (MNHN). — Stn 1129, 13 (MNHN).

TYPE LOCALITY. — "Investigator" stn 133: 15°43'30"N, 81°19'30"E (off Kristna Delta, Bay of Bengal), 1240 m.

TABLE 3. — Characteristics of the seven Indo-Pacific species of *Fungiacyathus* (*Fungiacyathus*).

	<i>F. stephanus</i> (Alcock, 1893)	<i>F. fragilis</i> Sars, 1872	<i>F. pusillus pacificus</i> Cairns, 1995	<i>F. sandoi</i> sp. nov.	<i>F. paliferus</i> (Alcock, 1902)	<i>F. multicarinatus</i> Cairns, 1998	<i>F. sp. A sensu</i> CAIRNS, 1994
Maximum Calicular Diameter (mm)	57	45	23	20	25	26	36
Shape of Base	Concave or flat	Flat to slightly concave	Flat to slightly concave	Patellate (140°-170°)	Flat to slightly concave	Undulating	Flat
Nature of Costae	Thin, serrate, sinuous ridges	Thin ridges	Thin, serrate, closely spaced ridges	Rounded, coarsely granular	Rounded, finely granular	Finely dentate ridges	Thin ridges
Marginal Shelf	Present, especially in concave-based forms	Present	Present	Well developed	Present	Absent	Present
Septal Faces; Septal Edges	Corrugated; sinuous	Corrugated; sinuous	Planar; straight	Planar; straight	Planar; straight	Planar; straight	Planar; straight
Number and Largest of S <sub>1</sub> Synapticulae	12-15 (6-8th tallest)	12-14 (6-7th tallest)	11-12 (6th tallest)	7-9 (4-5th tallest)	9-14 (7th tallest)	Small, poorly developed	8-9 (8th tallest)
Number of S <sub>1</sub> Carinae/Face	20-23	11-12	28-34	15-21	15-20	30-34	20-23
S <sub>2</sub> Paliform Lobes or Spines	Small, acute, triangular lobes	Crispate spines	Slender trabecular spines	Thick, blunt spines	Small, rounded paliform lobes	Spatulate spines	Spinose
Other Characters	Very fragile; S <sub>1-2</sub> lobes high	Very fragile	Robust; innermost S <sub>3</sub> spines most prominent; peripheral septal edges form vertical wall	Robust; S <sub>1-3</sub> lobes tall and slender, undercut at calicular edge	Robust; corallum regeneration common	Robust; corallum regeneration; septal carinae quite tall	Fragile; septal canopies and columella porous
Distribution; Depth	Indo-West Pacific; 245-2000 m	N. Atlantic; Macquarie Ridge; Hawaiian Is.; 285-2200 m	New Zealand to Wallis and Futuna; 350-988 m	Wallis and Futuna; 295-600 m	Indo-West Pacific; 69-823 m	Western Australia; 348-350 m	Kuril Islands; 3175-4110 m

REMARKS. — This species is more fully described and illustrated by CAIRNS (1989a, 1994). It is distinguished from its consubgenerics by having corrugated septa and sinuous costae; small, acute paliform lobes (P<sub>2</sub>); and a very fragile corallum, probably a result of its greater depth of occurrence (Table 3).

DISTRIBUTION. — Wallis and Futuna region: Combe Bank; 795-1280 m. Vanuatu region: Anatom, Tanna, Erromango, Efaté, Espiritu Santo, and Malakula; Guyot Bougainville; 440-1160 m. Elsewhere: widespread throughout Indo-West Pacific; 245-2000 m (CAIRNS & ZIBROWIUS, 1997).

*Fungiacyathus (F.) pusillus pacificus* Cairns, 1995

*Fungiacyathus (F.) pusillus pacificus* Cairns, \*1995: 32-33, pl. 1, figs g-i, l, map 13.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 522, 3 (MNHN). — Stn 534, 1 (USNM 98536). — Stn 535, 2 (MNHN). — Stn 540, 2 (MNHN). — Stn 570, 1 (MNHN). — Stn 572, 3 (USNM 98535). — Stn 575, 1 (USNM 98534). — Stn 581, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 1128, 1 (MNHN).

TYPE LOCALITY. — NZOI stn U599: 30°43'S, 173°16'E (northern Three Kings Ridge), 590-640 m.

REMARKS. — Based on these specimens little can be added to the original description, except to note a maximum size of 23.3 mm GCD (MUSORSTOM 7 stn 535). The species is distinguished by its tall S<sub>1-4</sub> septal lobes, the peripheral edges of which all extend about the same distance outward and are almost vertical, which results in an almost cylindrical corallum with a domed surface, like a thick button. The species is compared to other consubgenerics from this region in Table 3.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch and Combe Banks; 425-650 m. Vanuatu region: Guyot Bougainville; 778-811 m. Elsewhere: Norfolk, Three Kings, and Colville Ridges north of New Zealand; 350-988 m.

*Fungiacyathus (F.) sandoi* sp. nov.

Figs 1 f-h

MATERIAL EXAMINED/TYPES. — Wallis and Futuna region. MUSORSTOM 7: stn 523, 2 paratypes (MNHN). — Stn 538, holotype (MNHN) and 1 paratype (USNM 98531). — Stn 540, 1 paratype (MNHN). — Stn 541, 1 paratype (MNHN). — Stn 542, 1 paratype (USNM 98533). — Stn 569, 5 paratypes (USNM 98532). — Stn 589, 1 paratype (MNHN). — Stn 590, 3 paratypes (MNHN). — Stn 597, 1 paratype (MNHN). — Stn 605, 1 paratype (MNHN).

TYPE LOCALITY. — MUSORSTOM 7, stn 538: 12°30.8'S, 176°40.3'W (Waterwitch Bank), 275-295 m.

ETYMOLOGY. — This species is named in honour of my friend and colleague William J. SANDO (1927-1996), noted Lower Carboniferous coral taxonomist and stratigrapher.

DESCRIPTION. — Corallum circular: largest specimen (MUSORSTOM 7 stn 542) 20.2 mm in CD; holotype 15.2 mm in CD. Base slightly convex, the basal angle ranging from 140°-170°. All costae equally wide and prominent (no cycle larger than another), rounded, each ornamented with a row of coarse (0.16-0.18 mm diameter) rounded granules. All costae project about 0.4 mm beyond calicular edge. Septa hexamerally arranged in 5 complete cycles in typical fungiacyathid fashion, the S<sub>5</sub> easily visible in a corallum of 8 mm CD. S<sub>1</sub> consist of 3 or 4 blunt, axial trabecular spines inclined toward the fossa; peripheral to these spines is a tall septal lobe composed of 9-13 vertically oriented trabeculae, each trabeculum corresponding to a serrate ridge on the septal face. The peripheral edge of the S<sub>1</sub> lobe is vertical, changing abruptly into a low marginal shelf region consisting of 3 or 4 low spines. Seven to nine synapticular plates occur along the length of an S<sub>1</sub>, the 4th or 5th from the centre being the tallest. S<sub>2</sub> also consist of 3 or 4 blunt, axial trabecular spines, but these spines are longer and wider than

those on the S<sub>1</sub>, some composed of 2 trabeculae; peripheral to these spines is a prominent septal lobe composed of 7-9 trabeculae, the lobe inclined slightly outward. The peripheral edge of the S<sub>2</sub> lobe is vertical to slightly undercut, also changing abruptly to a low marginal shelf. S<sub>3</sub> consist of 4-6 slender, axial trabecular spines peripheral to which is a small septal lobe composed of 3-6 trabeculae. S<sub>3</sub> septal lobe shorter and more inclined outward than S<sub>2</sub> lobe, but its peripheral edge is similar. S<sub>4</sub> consist of 5-7 small trabecular spines; S<sub>5</sub>, 3 or 4 spines. All septa planar, with straight upper and peripheral edges. A low marginal shelf of about 0.4 mm width surrounds the corallum. The columella is an intermingling of the innermost, blunt S<sub>1-2</sub> trabecular spines.

REMARKS. — *Fungiacyathus sandoi* appears to be most similar to *F. paliferus* (Alcock, 1902), both species having granular costae, a similar septal structure, and achieving the same size. But, *F. sandoi* is distinguished in having: a convex base; coarsely granular costae; thick, blunt S<sub>2</sub> trabecular spines (not small P<sub>2</sub> paliform lobes); and uniformly exsert costosepta (Table 3).

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch, Combe, and Field Banks; 295-600 m.

*Fungiacyathus (F.) paliferus* (Alcock, 1902)

Fig. 2 a

*Bathyactis palifera* Alcock, v\*1902a: 108; v.1902c: 38, pl. 5, figs 34, 34a.

*Fungiacyathus* sp. cf. *F. stephanus* - WELLS, v.1984: 207, fig. 1, 3-4 (USGS 25715, USNM 71828).

*Fungiacyathus fragilis* - WELLS, v.1984: 205-206 (in part: USGS 25718, USNM 73957).

*Fungiacyathus (F.) paliferus* - CAIRNS, 1989a: 9-10, pl. 2, figs c-i, pl. 3, figs a-c (synonymy and description); 1994: 37-38, pl. 14, figs a-e (synonymy and description); 1998: 369-370. — CAIRNS & ZIBROWIUS, 1997: 69-70.

MATERIAL EXAMINED. — Vanuatu, MUSORSTOM 8: stn 963, 8 (USNM 98529). — Stn 967, 3 (USNM 98530). — Stn 969, 1 (MNHN). — Stn 988, 1 (MNHN). — Stn 1003, 5 (MNHN). — Stn 1005, 3 (MNHN). — Stn 1016, 2 (MNHN). — Stn 1017, 2 (MNHN). — Stn 1018, 9 (USNM 98528). — Stn 1043, 1 (MNHN). — Stn 1070, 1 (MNHN). — Stn 1106, 1 (MNHN).

TYPE LOCALITY. — "*Siboga*" stns 153 and 98: Sulu Sea and Moluccas, 141-350 m.

REMARKS. — The species was redescribed and illustrated by CAIRNS (1989a, 1994); however, several well-preserved specimens listed above allow an additional observation that the CS<sub>1-2</sub>, and their adjacent CS<sub>5</sub>, project about 1.2 mm beyond the other costosepta as rectangular lancets.

All specimens reported above were intact coralla, not the result of asexual fragmentation. Comparisons to other species in this region are made in Table 3.

Although the Pleistocene Vanuatu specimens reported by WELLS (1984) as *F. fragilis* from USGS stn 25718 are reidentified herein as *F. paliferus*, those he reported and illustrated from USGS stn 24918 (USNM 71837 and 73977) belong to the subgenus *F. (Bathyactis)*, but are too small to identify to species.

DISTRIBUTION. — Vanuatu region: Anatom, Tanna, Erromango, Efaté, Epi, and Espiritu Santo (also Pleistocene of Vanuatu: WELLS, 1984); 190-400 m. Elsewhere: widespread throughout Indo-West Pacific; 69-823 m (CAIRNS & ZIBROWIUS, 1997).

Subgenus *FUNGIACYATHUS (BATHYACTIS)* Moseley, 1881

*Fungiacyathus (B.) margaretae* Cairns, 1995

Figs 2 b-c

*Fungiacyathus (B.) margaretae* Cairns, \*1995: 33-34, pl. 2, figs a-c.

**MATERIAL EXAMINED.** — Wallis and Futuna region. MUSORSTOM 7: stn 534, 9 (MNHN). — Stn 535, 4 (MNHN). — Stn 540, 21 (USNM 98524). — Stn 541, 1 (MNHN). — Stn 546, 7 (MNHN). — Stn 564, 57 (USNM 98527). — Stn 565, 56 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 956, 2 (MNHN). — Stn 963, 47 (MNHN). — Stn 1011, 1 (USNM 98525). — Stn 1014, 1 (MNHN). — Stn 1051, 2 (USNM 98526).

**TYPE LOCALITY.** — NZOI stn P944: 27°20.8'S, 179°20.9'W (northern Colville Ridge), 673 m.

**REMARKS.** — Previously known from a type series of only 5 specimens: 188 additional coralla are reported herein, the largest specimen (MUSORSTOM 8 stn 963) 18.6 mm in CD, the same diameter as the largest type. Although the base of this species is always concave, the MUSORSTOM specimens show that the types had unusually concave bases. Many of these specimens also show a pronounced ridging of the C<sub>1-2</sub> (Fig. 2 c).

*Fungiacyathus margaretae* is most similar to *F. granulatus*, small and/or damaged specimens of the latter being difficult to distinguish from the former. In general, *F. margaretae* is distinguished by having a concave base (that of *F. granulatus* is usually flat); higher S<sub>1</sub> septal lobes with vertical peripheral edges, and constructed of vertically aligned trabeculae (the S<sub>1</sub> septal lobes of *F. granulatus* are lower and sloped at the peripheral calicular edge, and composed of trabeculae that are inclined outward toward the peripheral edge); and having taller synapticular plates between septa. Both species have fine or coarse granular costae, and often granular coenosteum between the costae.

**DISTRIBUTION.** — Wallis and Futuna region: Waterwitch, Combe, and Tuscarora Banks; 470-1015 m. Vanuatu region: Anatom, Efaté, and Epi; 440-1175 m. Elsewhere: northern Colville Ridge; 635-673 m.

#### *Fungiacyathus (B.) granulatus* Cairns, 1989

*Fungiacyathus (B.) granulatus* Cairns, \*1989a: 11, pl. 4, figs d-i; 1994: 39, pl. 15, figs d-e; 1998: 370. — CAIRNS & ZIBROWIUS, 1997: 71.

**MATERIAL EXAMINED.** — Wallis and Futuna region. MUSORSTOM 7: stn 619, 2 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 977, 1 (MNHN). — Stn 980, 3 (USNM 98520).

**TYPE LOCALITY.** — "Albatross" stn 5590: 4°10'50"N, 118°39'35"E (Celebes Sea off Sabah), 567 m.

**REMARKS.** — See Remarks for previous species.

**DISTRIBUTION.** — Wallis and Futuna region: Alofi; 455 m. Vanuatu region: Tanna; 433-450 m. Elsewhere: northern Ryukyu Islands to Rowley Shoals, Western Australia; 287-640 m (CAIRNS & ZIBROWIUS, 1997; CAIRNS, 1998).

#### *Fungiacyathus (B.) variegatus* Cairns, 1989

Fig. 2 d

*Fungiacyathus fragilis* - WELLS, v.1984: 205-206 (in part: USGS 24918, pl. 1, figs 1-2) [Not *F. fragilis* Sars, 1872].

*Fungiacyathus variegatus* Cairns, \*1989a: 11-12, pl. 5, figs a-h; 1994: 38-39, pl. 15, figs a-b. — CAIRNS & ZIBROWIUS, 1997: 71-72.

**MATERIAL EXAMINED.** — Vanuatu. MUSORSTOM 8: stn 963, 1 cemented to *Xenophora* shell (MNHN).

**TYPE LOCALITY.** — "Albatross" stn 5113: 13°52'N, 120°51'E (Verde Is. Passage, Luzon, Philippines), 291 m.

**REMARKS.** — This species is more fully described by CAIRNS (1989a) and CAIRNS & ZIBROWIUS (1997).

**DISTRIBUTION.** — Vanuatu region: Anatom; 400-440 m (Late Pleistocene of Espiritu Santo, WELLS, 1984). Elsewhere: Japan through Indonesia; 84-715 m (CAIRNS & ZIBROWIUS, 1997).

## Family MICRABACIIDAE Vaughan, 1905

Genus *LETEPSAMMIA* Yabe & Eguchi, 1932*Letepsammia franki* Owens, 1994

*Letepsammia franki* Owens, v\*1994: 586-589, figs 1-2.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 597, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 962, 1 (MNHN). — Stn 980, 3 (MNHN). — Stn 1016, 2 (MNHN). — Stn 1017, 8 (MNHN). — Stn 1018, 18 (USNM 98519). — Stn 1023, 1 (USNM 98518). — Stn 1070, 2 (MNHN). — Stn 1134, 1 (USNM 98517).

TYPE LOCALITY. — "Anton Bruun" stn 390-S: 29°35'S, 31°42'E (off Durban, South Africa), 138 m.

REMARKS. — In describing the type material, OWENS (1994) stated that the septa were highly perforate, which led to an assignment of this species to *Letepsammia*. However, re-examination of the type series shows that, whereas the higher cycle septa are always highly perforate, the S<sub>1</sub> of the holotype and most paratypes are imperforate. (The S<sub>1</sub> of some paratypes from the same lots are highly perforate). The same is the case for the southwest Pacific specimens reported above. The imperforate nature of the S<sub>1</sub> suggests an affinity with *Rhombopsammia*, and the variation in the expression of this character casts doubt on the distinction between the genus *Rhombopsammia* and *Letepsammia*.

The specimens reported above are very similar to the type series, except that many of the specimens contain 108 septa (18 septa per system), instead of 120 septa (20 septa per system). The largest paratype (USNM 75640) measures 32.2 mm in CD (slightly larger than that reported by OWENS, 1994), whereas the largest Pacific (MUSORSTOM 8 stn 1018) specimen measures 32.4 mm in CD.

*Letepsammia franki* differs from *L. formosissima* in having a papillose columella, coarser septal dentition, and a more robust corallum. It differs from *L. superstes* in having more septa; a larger corallum; and nondentate, vertical axial edges of the S<sub>1</sub>.

DISTRIBUTION. — Wallis and Futuna region: Field Bank; 469-475 m. Vanuatu region: Anatom, Tanna, Efate, and Espiritu Santo; 190-433. Elsewhere: southwest Indian Ocean; 50-650 m.

Genus *STEPHANOPHYLLIA* Michelin, 1841*Stephanophyllia neglecta* Boschma, 1923

*Stephanophyllia neglecta* Boschma, v\*1923: 144-145, pl. 10, figs 28-30. — CAIRNS, 1989a: 23-24, pl. 11, figs c-j (synonymy). — CAIRNS & ZIBROWIUS, 1997: 77.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 542, 1 (MNHN). — Stn 556, 5 (MNHN). — Stn 618, 1 (USNM 98523).

Vanuatu. MUSORSTOM 8: stn 958, 1 (MNHN). — Stn 963, 1 (MNHN). — Stn 965, 7 (MNHN). — Stn 969, 2 (MNHN). — Stn 978, 1 (MNHN). — Stn 988, 3 (USNM 98522). — Stn 1019, 1 (USNM 98521).

TYPE LOCALITY. — "Siboga" stn 260: 5°36.5'S, 132°55.2'E (Kai Islands, Banda Sea), 90 m.

REMARKS. — This species was redescribed and compared to all congeners by Cairns (1989a).

DISTRIBUTION. — Wallis and Futuna region: Alofi; Combe and Tuscarora Banks; 370-440 m. Vanuatu region: Anatom, Tanna, and Espiritu Santo; 280-497 m. Elsewhere: Philippines; Indonesia; 49-555 m (CAIRNS & ZIBROWIUS, 1997).

*Stephanophyllia complicata* Moseley, 1876

*Stephanophyllia complicata* Moseley, v\*1876: 558-561, text-fig.; v.1881: 198-201, pl. 4, fig. 12, pl. 13, figs 3-5. — CAIRNS, 1989a: 21, pl. 12, figs a-b; 1995: 37-38, pl. 3, fig. h, pl. 4, figs a-e, map 10 (synonymy). — CAIRNS & ZIBROWIUS, 1997: 77-78.

*Stephanophyllia japonica* - WELLS, v.1984: 207, pl. 1, figs 5-6 (USGS stn 24918, USNM 71839) [Not *S. japonica* Yabe & Eguchi, 1934a].

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 523, 2 (MNHN). — Stn 535, 2 (MNHN). — Stn 540, 10 (USNM 98552). — Stn 557, 9 (USNM 98551).

Vanuatu. MUSORSTOM 8: stn 959, 22 (USNM 98553). — Stn 963, 3, including 1 cemented to *Xenophora* shell (MNHN). — Stn 1005, 1 (MNHN). — Stn 1018, 1 (MNHN). — Stn 1091, 1 cemented to *Xenophora* shell (MNHN). — Stn 1097, 1 cemented to *Xenophora* shell (MNHN). — Stn 1113, 1 (MNHN).

TYPE LOCALITY. — "Challenger" stn 192: 5°42'S, 132°25'E (Kai Islands, Banda Sea), 236 m.

REMARKS. — *Stephanophyllia complicata* was redescribed and illustrated by CAIRNS (1989a, 1995). It is distinguished from *S. neglecta* by having a thin, lamellar columella; a narrow marginal shelf; S<sub>1</sub> with vertical, non-spinose axial edges; and in attaining a larger size.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch, Combe, and Tuscarora Banks; 470-600 m. Vanuatu region: Anatom, Erromango, Efaté, and Espiritu Santo (also Pleistocene, WELLS, 1984); 288-700 m. Elsewhere: Indo-West Pacific; 73-635 m (CAIRNS & ZIBROWIUS, 1997).

## Suborder FAVIINA

## Superfamily FAVIOIDEA Gregory, 1900

## Family OCULINIDAE Gray, 1847

Genus *OCULINA* Lamarck, 1816*Oculina virgosa* Squires, 1958

*Oculina virgosa* Squires, v\*1958: 39, pl. 5, figs 8-16, text-fig. 11. — CAIRNS, 1995: 40, pl. 4, figs f, i, pl. 5, figs c-d, color frontispiece (top left), color cover (synonymy and description), map 8.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1077, 6 branches: 4 (MNHN), 2 (USNM 98550). — Stn 1102, 1 colony (MNHN).

TYPE LOCALITY. — Sandstone, Waitemata Group, The Funnel, Kaipara Harbour, Auckland, North Island (Altonian, early Miocene).

REMARKS. — This species was recently redescribed and figured by CAIRNS (1995). The two lots reported above differ slightly from New Zealand specimens in lacking S<sub>4</sub>, all corallites having only 24 septa arranged in three complete cycles, the New Zealand populations usually having 28 septa. This is the first report of this species outside New Zealand waters.

DISTRIBUTION. — Vanuatu region: southeast and northeast of Espiritu Santo; 180-210 m. Elsewhere: northeastern North Island, New Zealand; 29-388 m (CAIRNS, 1995); early Miocene to early Pliocene, New Zealand (SQUIRES, 1958).

Genus *MADREPORA* Linnaeus, 1758*Madrepora oculata* Linnaeus, 1758

Figs 2 e-f

- Madrepora oculata* Linnaeus, \*1758: 798. — ZIBROWIUS, 1974a: 762-766, pl. 2, figs 3-5 (synonymy). — CAIRNS, 1991a: 9-10, pl. 2, fig. j, pl. 3, figs a-d (synonymy); 1994: 18-19, pl. 3, figs f-h (synonymy); 1995: 41, pl. 5, figs e-f, pl. 6, figs a-b, map 2; 1998: 372-373, figs 1 f-i. — CAIRNS & ZIBROWIUS, 1997: 79-80.
- Lophohelia tenuis* Moseley, \*1881: 180-181, pl. 8, figs 11-14. — BOURNE, 1903: 26.
- Cyathohelia formosa* Alcock, \*1898: 26-27, pl. 3, figs 2, 2a.
- Sclerohelia formosa* - ALCOCK, 1902c: 36.
- Madrepora kauaiensis* Vaughan, v\*1907: 81-83, pl. 8, figs 1-2.
- Madrepora tenuis* - FAUSTINO, 1927: 107-108, pl. 14, figs 2, 5.
- Madrepora formosa* - ZIBROWIUS, 1974b: 568-570, figs 6-9.

**MATERIAL EXAMINED.** — **Wallis and Futuna region.** MUSORSTOM 7: forma *tenuis*: stn 502, 1 branch (MNHN). — Stn 551, numerous branches (USNM 98545). — Stn 552, 19 branches (MNHN), SEM stub 874 (USNM 98548). — Stn 598, 6 branches (MNHN). — Stn 621, 8 branches (MNHN). — Stn 623, 1 branch (USNM 98547). — Stn 637, 2 branches (MNHN); forma *formosa*: Stn 507, 3 branches (MNHN). — Stn 585, 1 branch (MNHN). — Stn 586, 1 branch (USNM 98581). — Stn 601, 1 branch (MNHN). — Stn 606, 5 colonies and numerous branches (USNM 98583). — Stn 609, 3 colonies (MNHN), SEM stub 875 (USNM 98580). — Stn 618, 3 branches (MNHN). — Stn 620, 5 branches (USNM 98546).

**Vanuatu.** MUSORSTOM 8: forma *tenuis*: stn 1028, 2 branches (98546). — Stn 1031, 1 branch (MNHN); forma *formosa*: stn 1088, 1 branch (MNHN).

**TYPE LOCALITY.** — Tyrrhenian Sea and off Sicily (depth not given).

**REMARKS.** — This widespread and variable species has been redescribed and discussed at great length (ZIBROWIUS, 1974a,b; CAIRNS, 1991a, 1994, 1995; CAIRNS & ZIBROWIUS, 1997). Two forms of the species occur in the material reported herein. One form is characterized by having rather large, uniplanar colonies with nonanastomosing branches formed of regular, sympodially budded corallites. The coenosteum is light beige, finely granular, and longitudinally striate. Corallites are 3.0-3.6 mm in CD, containing 2 or 3 cycles of slightly exsert septa, the S<sub>3</sub> often rudimentary or absent. The axial edges of S<sub>2</sub> often bear lacinate paliform lobes. The fossa is deep and the columella rudimentary. This form corresponds to MOSELEY's (1881) *Madrepora tenuis*; probably *M. kauaiensis* Vaughan, 1907; *Madrepora oculata* forma *beta* of CAIRNS (1991a); and most specimens reported by CAIRNS & ZIBROWIUS (1997) from the Philippines and Indonesia. It is herein reported as forma *tenuis*. The second form is characterized by having smaller, uniplanar to bushy colonies. Colonies are formed by sympodially branched corallites, but often result in anastomosing branches caused by a symbiosis with a eunicid polychaete worm, which produces a gall tube along the larger branches. The coenosteum is usually white and finely granular. Corallites are smaller (2.2-2.5 mm in CD), more closely spaced, containing 3 cycles of highly exsert septa, the S<sub>1</sub> usually well developed. The axial edges of the S<sub>2</sub> usually bear prominent paliform lobes. The fossa is shallow and the columella well developed. This form was described as *Cyathohelia formosa* by ALCOCK (1898) and as the "symbiotic form" by CAIRNS (1995). It is herein reported as forma *formosa*.

**DISTRIBUTION.** — Wallis and Futuna region: Wallis and Futuna; Combe, Field, Rotumah, and Alofi Banks; 350-1280 m. Vanuatu region: Efaté and Espiritu Santo; 310-624 m. Both forms are equally distributed in these regions. Elsewhere: cosmopolitan, except for off continental Antarctica: 15-1500 m (CAIRNS & ZIBROWIUS, 1997).

*Madrepora minutiseptum* Cairns & Zibrowius, 1997

*Madrepora minutiseptum* Cairns & Zibrowius, \*1997: 82-84, figs 4a-d, 5a-b.

**MATERIAL EXAMINED.** — Wallis and Futuna region. MUSORSTOM 7: stn 513, 3 branches (MNHN). — Stn 515, 3 colonies and several branch fragments (MNHN). — Stn 517, 4 colonies and many branch fragments (USNM 98549).

**Ryukyu Islands.** "Toyoshio-Maru" : stn 11, 2 colonies (USNM 98461).

**TYPE LOCALITY.** — "Snellius 2" stn 4.196: 6°23'S, 120°26.5'E (southwest of Salayer, Flores Sea), 150- 200 m.

**REMARKS.** — Nothing can be added to the description of this recently named species. It is distinctive within the genus by having 24 rudimentary septa; small, infundibuliform corallites; and a low, papillose columella. All colonies contain a polychaete-induced tubular deformation that runs the length of all major branches.

**DISTRIBUTION.** — Wallis and Futuna region: Futuna; 233-260 m. Elsewhere: Ryukyu Islands (reported herein), Taiwan, Indonesia; 150-302 m.

### *Madrepora porcellana* (Moseley, 1881)

*Neohelia porcellana* Moseley, v\*1881: 176-177, pl. 10, figs 7, 7a. — PRATT, 1900: 591-603, pls 62-63. — HICKSON, 1903: 344.

*Madrepora porcellana* - WELLS, v.1984: 207, figs 1, 7-9.

*Neohelia* sp. cf. *N. porcellana* - CAIRNS & ZIBROWIUS, 1997: 84-85, figs 5c-e, g-h.

**MATERIAL EXAMINED.** — Wallis and Futuna region. MUSORSTOM 7: stn 499, 1 branch (MNHN). — Stn 500, 1 branch (MNHN). — Stn 502, 1 branch (MNHN). — Stn 508, 2 branches (MNHN). — Stn 509, 2 branches (MNHN). — Stn 512, 4 branches (MNHN). — Stn 513, 5 branches (MNHN). — Stn 514, 1 colony (USNM 98569). — Stn 515, 3 colonies (USNM 98575). — Stn 618, 1 branch (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 962, 4 colonies (USNM 98578). — Stn 963, 1 branch (MNHN). — Stn 964, 5 branches (MNHN). — Stn 968, 1 colony (MNHN). — Stn 969, 1 colony (USNM 98576). — Stn 976, 1 branch (MNHN). — Stn 988, 2 branches (MNHN). — Stn 1077, 2 branches (MNHN). — Stn 1084, 2 colonies (USNM 98577). — Stn 1089, 1 branch (MNHN).

USGS: stn 25718, 6 fragments (USNM 73958). — Stn 25715, (USNM 71840). — Stn 24918 (USNM 71841), all reported by WELLS (1984).

**TYPE LOCALITY.** — "Challenger" stn 177: 16°45'S, 168°07'E [Api (= Epi), Vanuatu Archipelago], 115 m.

**REMARKS.** — Without explanation, WELLS (1984) placed this species in *Madrepora*, which automatically synonymized the genus *Neohelia* with *Madrepora*, a view not adopted by CAIRNS & ZIBROWIUS (1997). The basic difference between the genera is that *Neohelia* is reputed to lack a columella, *Madrepora* to have one. However, examination of many additional specimens of *Neohelia* shows that it usually does have a well-formed papillose columella, even though some distal corallites sometimes lack one. Likewise, corallites of *Madrepora* often have well-developed columella, but sometimes lack them altogether. Because the presence or absence of a columella does not appear to be a conservative generic character, even within species, I now agree with WELLS (1984) in considering *Neohelia porcellana* to belong to the genus *Madrepora*.

All of the specimens reported above are pentamerally symmetrical, having 20 septa. The hexamerally symmetrical specimens having 24 septa reported by CAIRNS & ZIBROWIUS (1997) from Indonesia are considered as a form of *M. porcellana* that occurs to the west and usually in shallower water than the typical form.

This species was recently redescribed by CAIRNS and ZIBROWIUS (1997) and more fully monographed by Pratt (1900). A consistent characteristic of the species is a tubular cavity that runs the length of the larger branches, which is lined by a parchment-like encrustation. PRATT (1900) suggested that the encrustation was secreted by the coral, but HICKSON (1903) implied that a polychaete was responsible. Polychaetes are often found in these tubes, and it cannot be doubted that gorgonians or antipatharians often form the framework for the encrustation of *M. porcellana*. However, the specimens reported herein also indicate that a thecate hydroid may be responsible for the internal parchment-like lining of the tubes, short branches of which project from the apertures of the tube through the coenosteum. This complex symbiosis is a fascinating one that requires the examination of additional well-preserved specimens.



DISTRIBUTION. — Wallis and Futuna region: Futuna and Alofi; 240-516 m. Vanuatu region: Anatom, Tanna, Epi, Malakula, and Espiritu Santo (also Pleistocene: WELLS, 1984); 115-494 m. Elsewhere: Loyalty Islands; New Caledonia; Indonesia (as the hexamerall form); 55-238 m.

Family ANTHEMIPHYLLIIDAE Vaughan, 1907

Genus *ANTHEMIPHYLLIA* Pourtalès, 1878

*Anthemiphyllia dentata* (Alcock, 1902)

?*Discotrochus investigatoris* Alcock, \*1893: 142, pl. 5, figs 5, 5a.

*Discotrochus dentatus* Alcock, v\*1902a: 104; v.1902c: 27, pl. 4, figs 26, 26a.

Not *Anthemiphyllia dentata* - CAIRNS, 1984: 11, pl. 1, figs F-G (= *A. macrodentata* sp. nov.).

*Anthemiphyllia dentata* - ZIBROWIUS & GRYGIER, 1985: 137 (New Caledonia). — CAIRNS & PARKER, 1992: 16-17 (in part: only those specimens from Western Australia). — CAIRNS, 1994: 44, pl. 18, figs d-f (synonymy); 1995: 41-42 (in part: not stns NZOI K842 and K872 (= *A. pacifica*) and C527 (= *A. macrodentata*), pl. 6, figs c-g (synonymy); 1998: 374-375. — CAIRNS & ZIBROWIUS, 1997: 86.

*Deltocyathus andamanicus* - KELLER, 1982: 52 (in part: pl. 1 [=4], figs 3-4, *Dimitri Mendeleev* stn 1411) [Not *D. andamanicus* Alcock, 1898].

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 511, 1 (MNHN). — Stn 522, 3 (MNHN). — Stn 525, 1 (MNHN). — Stn 530, 6 (MNHN). — Stn 534, 2 (MNHN). — Stn 535, 12 (USNM 98565). — Stn 537, 3 (MNHN). — Stn 538, 2 (MNHN). — Stn 540, 1 (MNHN). — Stn 542, 4 (MNHN). — Stn 546, 1 (MNHN). — Stn 555, 1 (MNHN). — Stn 569, 3 (MNHN). — Stn 570, 6 (USNM 98564). — Stn 572, 2 (USNM 98563). — Stn 585, 3 (USNM 98562). — Stn 586, 1 (USNM 98566). — Stn 589, 2 (MNHN). — Stn 590, 4 (MNHN). — Stn 591, 4 (USNM 98574). — Stn 594, 3 (USNM 98561). — Stn 597, 1 (USNM 98560). — Stn 618, 1 (USNM 98567). — Stn 619, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 959, 2 (MNHN). — Stn 967, 2 (MNHN). — Stn 969, 2 (MNHN). — Stn 977, 6 (MNHN). — Stn 982, 1 (MNHN). — Stn 983, 1 (MNHN). — Stn 1016, 1 (MNHN).

TYPE LOCALITY. — "Siboga" stns 95, 98, 100: Sulu Sea, 350-522 m.

REMARKS. — The holotype of *Discotrochus investigatoris* Alcock, 1893 is probably a juvenile specimen of *A. dentata* and thus would have nomenclatural priority. It has a CD of only 8 mm and 48 septa, which is consistent with the number of septa present in an *A. dentata* at that size. However, the type, presumed to be deposited at the Indian Museum, Calcutta, was not examined by the author. Until this verification can be made, the later name of *A. dentata* is used.

Whereas some of the largest specimens have a full fifth cycle (96 septa), most adult coralla have 60-72 septa, resulting from the insertion of one or two pairs of  $S_5$  in each system, respectively. The addition of  $S_5$  pairs usually occurs in a fixed manner as follows. In most coralla a bilateral symmetry can be determined by drawing a line through the slightly elongate or elliptical columella, dividing the corallum into two halves each containing six half-systems (Fig. A). If the 12 half-systems are numbered clockwise, pairs of  $S_5$  first occur in half-systems I, II, V, VIII, X, and XII, which results in a mirror image septal complement, but with two adjacent half-systems with pairs of  $S_5$  (I and XII) and two other half-systems (V and VIII) separated by two half-systems having no  $S_5$  at all. Note that the numbering of half-systems is somewhat arbitrary in that, if the corallum is rotated 180°, the half-systems with pairs of  $S_5$  are then: II, IV, VI, VII, IX, and XI, but the configuration is the same.

*Anthemiphyllia dentata* is more fully described by CAIRNS (1995) and compared to other congeners in Table 4. All specimens were unattached, except for one (MUSORSTOM 8 stn 977), which was firmly attached to a rock. I (CAIRNS & PARKER, 1992; CAIRNS, 1995) had previously identified all *Anthemiphyllia* with  $S_5$  as *A. dentata* (synonymy), but it now appears that at least three other species are involved, which consistently differ from one another in corallum shape, basal ornamentation, and septal architecture (Table 4).

Table 4. — Comparison of the Recent species and subspecies of the genus *Anthemiphyllia*.

	<i>A. dentata</i> Alcock, 1902	<i>A. multi-</i> <i>dentata</i> sp. nov.	<i>A. pacifica</i> Vaughan, 1907	<i>A. macro-</i> <i>lobata</i> sp. nov.	<i>A. patera</i> <i>costata</i> subsp. nov.	<i>A. patera</i> <i>patera</i> Pourtalès, 1878	<i>A. spinifera</i> sp. nov.	<i>A. frustum</i> Cairns, 1994
Shape of Colony; Attachment	Flat to shallow bowl; usually free	Shallow bowl; free	Shallow bowl to turbinate; free or attached	Deep bowl; attached or free	Shallow bowl; free	Shallow bowl; free or attached	Short cylinder with 6 costal spines; anthocyathus free	Frustum-shaped; anthocyathus free
Maximum Calicular Diameter (mm)	26.4	25.3	10.5	16.9	9.3	13.1	6.2	9.9
Nature of Base	Costate, with intercostal ridges	Costate, with intercostal ridges	Covered with epithelial bands	Costate	Costate	Porcellaneous (no costae)	Porcellaneous	Costate
Transverse Division	No	No	No	No	No	No	Yes	Yes
Colour of Corallum	White	White	White	White	White	White	Reddish-brown calicular margin	White to reddish brown
Septal Formula; Adult Number of Septa	S <sub>1</sub> >S <sub>2</sub> >S <sub>3</sub> >S <sub>4</sub> >>S <sub>5</sub> ; 60-72-96	S <sub>1</sub> >S <sub>2</sub> >S <sub>3</sub> >S <sub>4</sub> >>S <sub>5</sub> ; 96	S <sub>1</sub> >S <sub>2</sub> >S <sub>3</sub> >>S <sub>4</sub> >S <sub>5</sub> ; 48-56	S <sub>1</sub> >S <sub>2</sub> >S <sub>3</sub> >S <sub>4</sub> >>S <sub>5</sub> ; 60	S <sub>1</sub> >S <sub>2</sub> >>S <sub>4</sub> ; 48	S <sub>1</sub> >S <sub>2</sub> >>S <sub>4</sub> ; 48	S <sub>1-3</sub> >>S <sub>4</sub> ; 36	S <sub>1</sub> >S <sub>2</sub> >S <sub>3</sub> >S <sub>4</sub> ; 48
S <sub>1</sub> Trabecular Spines: Number; Largest Spine: Cross Section of Inner S <sub>1</sub> Spines	10-12; 3-4th from calicular edge; circular	20-23; uniform-sized; flattened perpendicular to septal plane	7; 3rd from calicular edge; circular	5-8; outermost septum a large lobe; inner spines flattened perpendicular to septal plane	7-8; 4-5th from edge; flattened perpendicular to septal plane	7-9; 4-5th from edge; flattened perpendicular to septal plane	4-5; equal-sized; slightly flattened in septal plane	6-7; largest lobes near columella; flattened in septal plane
Columella: Type; Similarity to Inner Trabeculae	Papillose; indistinguishable	Papillose; indistinguishable	Papillose; indistinguishable	Papillose; indistinguishable	Massive; irregularly shaped elements, undercut; discrete	Massive; irregularly shaped elements, undercut; discrete	Fused papillae; discrete	Papillose; indistinguishable
Distribution: Depth	Indo-West Pacific; 50-570 m	Southeastern Australia; 128-270 m	Hawaiian Is., Vanuatu, Kermadec Is; 205-325 m	Hawaiian Is, Kermadec Ridge; 369-508 m	Wallis & Futuna Is.; 320-700 m	Tropical northwestern Atlantic; 500-700 m	Tropical southwestern Pacific; 282-534 m	Japan through Indonesia; 209-340 m

DISTRIBUTION. — Wallis and Futuna region: Wallis, Futuna, and Alofi; Waterwitch, Combe, Tuscarora, and Field Banks; 295-650 m. Vanuatu region: Anatom, Tanna, and Efaté; 280-475 m. Elsewhere: widespread throughout Indo-West Pacific; 50-570 m (CAIRNS & ZIBROWIUS, 1997).

*Anthemiphyllia multidentata* sp. nov.

Figs 3 a-b

*Anthemiphyllia dentata* - Wells, v.1958: 264, pl. 1, figs 8-11. — CAIRNS & PARKER, 1992: 16-17, figs 4e-f (in part: all but Western Australian specimen).

MATERIAL EXAMINED/TYPES. — **Australia**. Off Cronulla, NSW, depth unknown, holotype (USNM 83010).

"*Nimbus*": stn 12, 1 paratype (USNM 78611). — Stn 55, 2 paratypes (USNM 78609).

BANZARE: stn 115, 3 paratypes (SAM H500-501).

"*Kimbla*": stn K7/73-37, 1 paratype (NMV F57153).

TYPE LOCALITY. — Off Cronulla, New South Wales, depth unknown.

ETYMOLOGY. — The species name *multidentata* (Latin *multi*, many + *dens*, tooth), literally bearing many teeth, refers to the numerous trabecular teeth on all septa.

DESCRIPTION. — Corallum unattached, with a flat to slightly bowl-shaped base. Holotype 25.3 mm in CD and 6.5 mm in height. Costae equal in width, rounded, and finely granular. Intercostal grooves shallow; however, in most specimens there is a very narrow ridge that bifurcates the intercostal region. No evidence of transverse division or attachment to substrate. Corallum white.

Septa hexamerally arranged in 5 cycles, the fifth cycle often missing several pairs of septa, e.g., the holotype has only 88 septa. Septal formula:  $S_1 > S_2 > S_3 > S_4 > S_5$  regarding size and exsertness;  $S_{1-3}$  all extend to the columella, whereas the  $S_4$  do only as rudimentary structures. All septa low in profile, closely fitting contour of inner wall.  $S_1$  bear 20-23 tall, slender, similarly-sized trabecular spines, the innermost (axial) spines highly compressed perpendicular to plane of septum.  $S_2$ ,  $S_3$ , and  $S_4$  similar in shape to  $S_1$  but progressively smaller and having more slender trabecular spines. There are actually more spines on the  $S_3$  (22-24) than the  $S_{1-2}$  because the spines on the  $S_3$  are more slender and yet the width of the septum is about the same.  $S_5$  bear 10-13 extremely slender trabecular spines, the septa becoming rudimentary near the columella. Fossa shallow, containing a papillose columella consisting of numerous small papillae that are indistinguishable from the inner (axial) septal spines.

REMARKS. — *Anthemiphyllia multidentata* is similar to *A. dentata*, and has been reported as such at least twice (see synonymy). However, *A. multidentata* differs from that species in having a significantly different septal architecture, consisting of more uniformly-sized trabecular spines per septum, and spines that are flattened in the plane perpendicular to the septum (Table 4). Thus far, *A. multidentata* is known only from southeastern Australia at relatively shallow depths. Although not found in the study region of this report, it is included to make the name available, and to facilitate comparisons among all Recent species (Table 4).

DISTRIBUTION. — Southeastern Australia from northeastern Tasmania to New South Wales; 128-270 m.

*Anthemiphyllia pacifica* Vaughan, 1907

Figs 2 g-h

*Anthemiphyllia pacifica* Vaughan, v\*1907: 79-80, pl. 7, fig. 5. — CAIRNS, 1984: 10-11.

*Anthemiphyllia dentata* - CAIRNS, 1995: 41-42 (in part: NZOI stns K842 and K872).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1031, I (MNHN).

TYPE LOCALITY. — "*Albatross*" stn 3858: 21°01'25"N, 156°47'20"W (off Molokai, Hawaiian Islands), 225-252 m.

REMARKS. — Both VAUGHAN (1907) and CAIRNS (1984) noted that this species occurred in the free and attached (pedicellate) forms, the types being free. The MUSORSTOM specimen reported above belongs to the pedicellate form and is the largest specimen known, measuring 10.5 mm in CD and 7.3 mm in height, with a basal fracture of 5.2 mm. It bears well-developed epithelial bands, characteristic of the species, and perhaps because of its large size, contains 56 septa (4 pairs of S<sub>4</sub>). It is otherwise similar to typical Hawaiian specimens and is compared to other congeners in Table 4. One of the pedicellate species reported as *A. dentata* by CAIRNS (1995) is reidentified as *A. pacifica* herein.

DISTRIBUTION. — Vanuatu region: Efaté; 310 m. Elsewhere: Hawaiian Islands; Kermadec Islands (reported herein); 205-325 m.

*Anthemiphyllia macrolobata* sp. nov.

Figs 3 c-d

*Anthemiphyllia dentata* - CAIRNS, 1984: 11, pl. 1, figs F-G; 1995: 41-42 (in part: NZOI stn C527).

MATERIAL EXAMINED. — **Hawaiian Islands.** "Townsend Cromwell": stn 81-01-14, holotype (USNM 60559). **Kermadec Ridge.** NZOI: stn C527, 9 paratypes (USNM 93990).

TYPE LOCALITY. — "Townsend Cromwell" stn 81-01-14; 23°15'48"N, 161°50'12"W (Hawaiian Is.), 369 m.

ETYMOLOGY. — The species name *macrolobata* (Greek *makros*, long or large + *lobos*, lobe), literally bearing large lobes, refers to the large septal lobes on the S<sub>1-3</sub>.

DESCRIPTION. — Holotype shaped as a deep bowl, unattached, measuring 16.9 mm in CD and 10.0 mm in height. Costae well developed, rounded, and finely granular, separated by deep intercostal grooves only at calicular edge. No evidence of transverse division; however, the Kermadec paratypes are firmly attached to the substrate. Corallum white.

Septa hexamerally arranged in 5 cycles, the fifth incomplete, only 1 pair of S<sub>5</sub> occurring in each system, resulting in 60 septa. Each S<sub>1</sub> consists of a highly exsert (3.3 mm), very wide (up to 5 mm) peripheral septal lobe, which occasionally bears shallow indentations, but is not completely subdivided into smaller lobes. Proximal to this lobe are 1-3 (depending on size of peripheral lobe) smaller, blunt lobes that are cylindrical in cross section. Most proximal (axial) are 3 or 4 narrow septal spines that are flattened perpendicular to septal plane. S<sub>2</sub> similar in shape to S<sub>1</sub>, but slightly less exsert, having smaller peripheral lobes. S<sub>3</sub> and S<sub>4</sub> that are flanked by S<sub>5</sub> are equally as wide as S<sub>2</sub>, but slightly less exsert and have smaller septal lobes. S<sub>5</sub> and unflanked S<sub>4</sub> are smallest septa, only about half the width of an S<sub>3</sub>, bearing 10-12 narrow trabecular teeth. All septa bear relatively low granules on their faces. Fossa deep, containing a well-developed papillose columella composed of elements that are indistinguishable from the inner axial septal spines.

REMARKS. — As well as being reported as *A. dentata* twice (see synonymy), this species has been referred to as an "undescribed species" by CAIRNS & PARKER (1992), CAIRNS (1995), and CAIRNS & ZIBROWIUS (1997). Although not yet found in the study region, this species is included to make the name available, and to facilitate comparisons among the Recent species (Table 4). *A. macrolobata* is unique in having large peripheral S<sub>1-3</sub> septal lobes.

DISTRIBUTION. — Hawaiian Islands; Kermadec Ridge; 369-508 m.

*Anthemiphyllia patera costata* subsp. nov.

Figs 3 e-h, 4 a-b

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region.** MUSORSTOM 7: stn 522, 1 paratype (MNHN). — Stn 530, 5 paratypes (USNM 98558). — Stn 535, 2 paratypes (MNHN). — Stn 540, 2 paratypes (MNHN). — Stn 542, 1 paratype (MNHN). — Stn 546, 1 paratype (USNM 98557). — Stn 575, 19 paratypes (USNM 98554). — Stn 578,

2 paratypes (MNHN). — Stn 586, holotype (MNHN), and 7 paratypes (MNHN). — Stn 590, 5 paratypes (MNHN). — Stn 591, 1 paratype (MNHN). — Stn 594, 8 paratypes (MNHN), SEM stub 871 (USNM 98555). — Stn 595, 7 paratypes (USNM 98556). — Stn 635, 5 paratypes (USNM 98559).

TYPE LOCALITY. — MUSORSTOM 7, stn 586: 13°10.7'S, 176°13.1'W (north of Wallis), 510-600 m.

ETYMOLOGY. — The subspecies name *costata* (Latin *costa*, rib) refers to the presence of costae on the theca of this species.

DESCRIPTION. — Corallum shaped as a shallow bowl, with rounded, slightly upturned edges. Holotype 8.3 mm in CD and 3.9 mm in height; largest specimen (MUSORSTOM 7 stn 594) 9.3 mm in CD. Base covered by equal, rounded, finely granulated costae. Intercostal regions shallow and narrow on base, but deeply incised at calicular edge, as in a turbinoliid. No evidence of a basal scar or propagation by transverse division. Corallum uniformly white.

Septa hexamerally arranged in 4 complete cycles (48 septa) according to the formula:  $S_1 > S_{2-3} \gg S_4$ .  $S_1$  bear 7 or 8 narrow trabecular spines, the outermost peripheral spines quite small and directed outward, the fourth and fifth from the outside usually the tallest, and the innermost (axial) 2 or 3 inclined toward and over the columella, these spines highly compressed perpendicular to plane of septum.  $S_1$  extend approximately 1 mm into central columella.  $S_{2-3}$  only slightly less wide than the  $S_1$ , usually bearing one less trabecular spine.  $S_4$  much smaller, about one-third width of  $S_{1-3}$ , but equally as exsert, consisting of 2 or 3 slender trabecular spines, and a lacinate axial edge that follows the contour of the inner theca. Fossa shallow, containing a massive (up to 4 mm in diameter), irregularly circular, flat columella composed of irregularly-shaped, fused elements. The columella protrudes into each of the 6 systems, fusing with and uniting the axial edges of the  $S_2$  and their flanking  $S_3$ , increasing the columellar diameter to over 5 mm at these points. Edges of columella undercut, being wider at the top than the base.

REMARKS. — This subspecies is very similar to the nominate subspecies *A. patera patera* Pourtalès, 1878, both taxa having the same septal and columellar structure and corallum shape. *A. patera costata* differs primarily in having a costate base (that of *A. patera patera* is smooth and porcellaneous), and in not attaining quite as large a size (Table 4). *A. patera patera* is also known to have attached as well as free coralla. The nominate subspecies is known only from tropical northwestern Atlantic at depths of 500-700 m (CAIRNS, 1979). Because of these slight, but consistent morphological differences and the apparent geographic separation, a new subspecies is warranted.

*Anthemiphyllia patera costata* is compared to other Recent congeners in Table 4, but it also bears a resemblance to the fossil species *A. catinata* Wells, 1977 (Late Eocene, Tonga), as noted by WELLS (1977). Both species are similar in corallum size and shape, costal ornamentation, and columellar structure, but *A. patera costata* differs in having more septa (48 vs 32-40). Details of septal dentition are similar, but not possible to compare due to the poor preservation of the four known specimens of the fossil species.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch, Combe, Field, and Rotumah Banks; 320-700 m.

#### *Anthemiphyllia spinifera* sp. nov.

Figs A, 4 c-j.

*Discotrochus* sp. Alcock, v.1902c: 27-28.

*Deltocyathus andamanicus* - KELLER, 1982: 52 (in part: pl. 1 [= 4], figs 5a-b).

MATERIAL EXAMINED/TYPES. — Wallis and Futuna region. MUSORSTOM 7: stn 512, 1 paratype (USNM 98571). — Stn 513, 2 paratypes (MNHN). — Stn 514, 13 paratypes: 12 (MNHN), 1 (USNM 98573). — Stn 530, 2 paratypes (MNHN). — Stn 537, 2 paratypes (USNM 98572). — Stn 541, 1 paratype (MNHN). — Stn 542, 4 paratypes (USNM 98569). — Stn 569, 3 paratypes (MNHN). — Stn 586, 1 paratype (MNHN). — Stn 589, 1 paratype (MNHN). — Stn 605, holotype (MNHN) and 18 paratypes (MNHN). — Stn 610, 2 paratypes, including SEM stub 872 (USNM 98570).

**Vanuatu.** MUSORSTOM 8: stn 988, 1 paratype (MNHN). — Stn 1014, 1 paratype (MNHN).

**Indonesia** (*Moluccas*). KARUBAR: stn 18, 6 paratypes (USNM 96777).

"*Albatross*": stn 5584, 4°17'40"N, 118°57'42"E, 532 m, 27.09.1909, 1 paratype (USNM 87605).

TYPE LOCALITY. — MUSORSTOM 7 stn 605: 13°21.3'S, 176°08.4'W (southeast of Wallis), 335-340 m.

ETYMOLOGY. — The species name *spinifera* (Latin *spina*, thorn + *fer*, to bear) refers to the 6 costal spines.

DESCRIPTION. — Corallum (anthocyathus) discoidal, with a flat base, vertical edges, and circular calice. Holotype 4.76 mm in CD and 2.34 mm in height; largest specimen (MUSORSTOM 7 stn 513) 6.2 mm in CD and tallest (MUSORSTOM 7 stn 605) 3.8 mm in height. Base smooth, porcellaneous, and white, usually with a small (2.3 mm in diameter), slightly concave scar or repaired scar of attachment in centre. Six elongate, tapered, smooth costal spines ( $C_3$ ) project from the calicular edge in a specific pattern (see Remarks). Spines straight, or sometimes curved or bent, and often broken, the longest spine 3.7 mm. Well-preserved coralla reddish brown at calicular edge, otherwise white. One anthocaulus is known (MUSORSTOM 8 stn 1014, Fig. 4j), consisting of a nondescript, faintly costate, cylindrical corallum 2.3 mm in height and 4.2 mm in diameter, bearing an anthocyathus 4.8 mm in CD. There is an annular constriction between the anthocaulus and anthocyathus, but at this stage they are still firmly attached. The attached anthocyathus bears 36 septa but has no evidence of costal spines.

Septal hexamerally arranged in 3 1/2 cycles, each system containing one pair of  $S_4$  inserted in a very specific pattern (see Remarks), resulting in 36 septa. Only 2 size classes of septa exist: the larger septa, consisting of the 12  $S_{1-2}$  and the 6  $S_3$  that are flanked by  $S_4$  (18 of the 36 septa), and the smaller septa, consisting of all 12  $S_4$  and the remaining 6  $S_3$  that are unflanked by  $S_4$  (the remaining 18 septa), which alternate with the larger septa. The larger septa extend to the columella, and bear of 4 or 5 equally sized, prominent, highly granular trabecular spines, the innermost spines only slightly compressed in the plane of the septum. Innermost 2 trabecular spines of larger septa inclined toward columella more than peripheral spines, the latter being vertical, which produces a small notch in each septum, and altogether, a narrow circumferential demarcation about half way between the columella and calicular edge. Although the  $S_{1-3}$  are of the same size, the  $S_2$  and accelerated  $S_3$  can be distinguished because the columella extends slightly outward in each system to fuse these inner edges of the  $S_2$  and its adjacent accelerated  $S_3$ , as in *A. patera costata*. Smaller septa only about one-third width of the larger septa, bearing 3 slender trabecular teeth. Fossa shallow, containing a low, massive (up to 2 mm in diameter) papillose columella, the elements of which are often fused. Columellar elements usually easily distinguished from inner septal trabeculae.

REMARKS. — Most specimens reported above bear six elongate costal spines ( $C_3$ ) associated with the 6  $S_3$  that are flanked by pairs of  $S_4$ , one of which occurs in each half-system. Because the columella is circular, not elongate as in *A. dentata*, an obvious plane of symmetry is not available for the numbering of half-systems. But, if the 12 half-systems are arbitrarily numbered in a clockwise direction beginning from the  $S_1$  that occurs between the two most closely spaced spines (Fig. A), then the costal spines invariably occur in half-systems I, III, V, VIII, X, and XII, which are the same half-systems in which  $S_5$  pairs first occur in *A. dentata*. This results in two closely spaced spines (half-systems XII and I) separated from one another by only 3 septa, or an angular separation of 40°; and four spines (half-systems III, V, VIII, and X) separated from their adjacent dorsal spines by 5 septa, or 60°; and the spines of half-systems V and VIII separated from each other by 80° (Fig. A). There are only three anomalies to this pattern in the material examined: a specimen from "*Albatross*" 5584 has 8 spines and thus 40 septa, the additional costal spines occurring in half-systems IV and IX; a specimen from MUSORSTOM 7 stn 542 has 7 spines and 38 septa, the additional spine in half-system V; and the specimen reported by KELLER (1982), which appears to have a seventh spine in half-system VIII.

*Anthemiphyllia spinifera* is easily distinguished from congeners by having costal spines. Other differences are noted in Table 4.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch, Combe, and Field Banks; 245-510 m. Vanuatu region: Tanna and Efaté; 466-495 m. Elsewhere: Indonesia (Kai Islands, Banda Sea; south of Sumba); Malaysia (Darvel Bay); Celebes Sea (off Mindanao); 212-534 m.

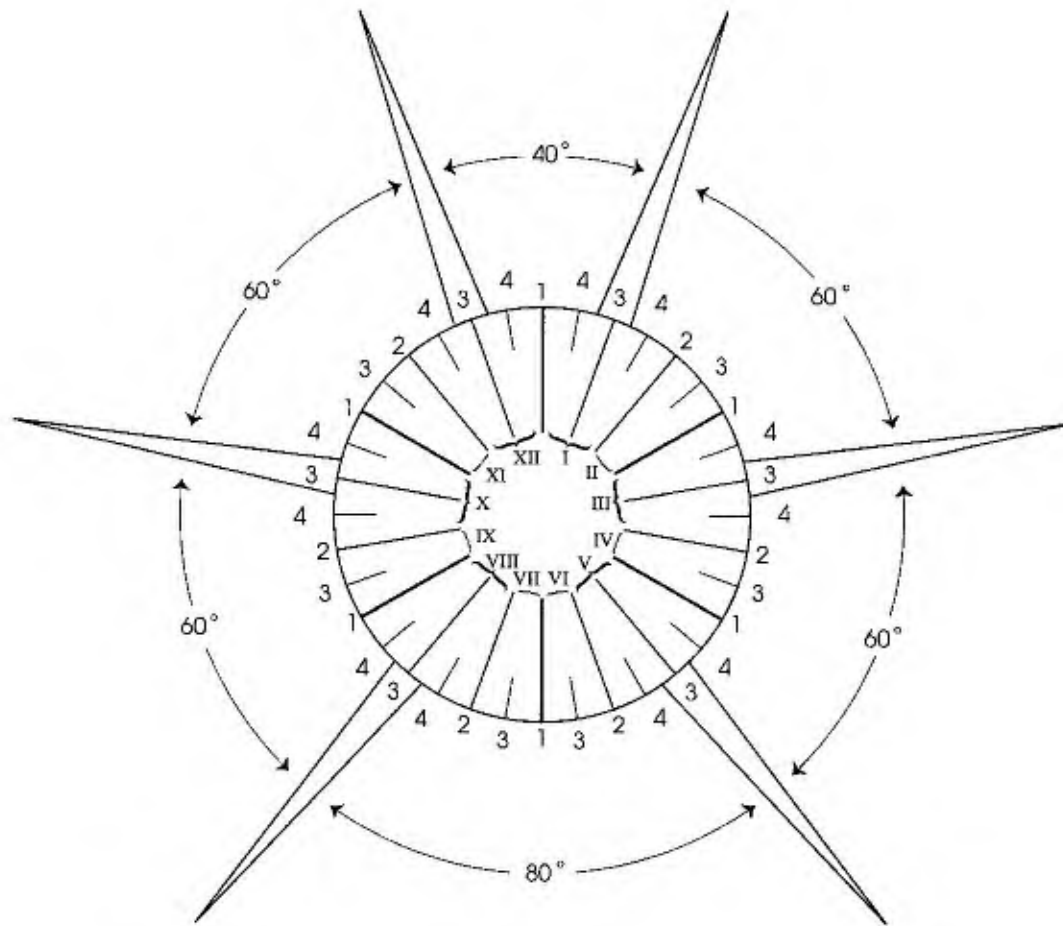


FIG. A. — Diagrammatic representation of the calice of *Anthemiphyllia spinifera* or *Deltocyathus heteroclitus*, showing the insertion pattern of the six costal spines ( $C_3$ ). Roman numerals define the 12 half-systems in the corallum, arbitrarily beginning with the  $S_1$  that bifurcates the smallest angular separation of costal spines, and proceeding in a clockwise direction. Arabic numerals indicate the respective septal cycles. Length of costal spines and septa drawn in proportion to calicular diameter of *A. spinifera*.

Suborder CARYOPHYLLIINA

Superfamily CARYOPHYLLIOIDEA Dana, 1846

Family CARYOPHYLLIIDAE Dana, 1846

Genus *CARYOPHYLLIA* Lamarck, 1816

Subgenus *CARYOPHYLLIA* (*CARYOPHYLLIA*) Lamarck, 1816

*Caryophyllia* (*C.*) *hawaiiensis* Vaughan, 1907

*Caryophyllia hawaiiensis* Vaughan, v\*1907: 76, pl. 5, figs 4a-b. — CAIRNS, 1984: 11; 1995: 44-45, pl. 7, figs d-f, map 18. — CAIRNS & ZIBROWIUS, 1997: 93.

**MATERIAL EXAMINED.** — **Wallis and Futuna region.** MUSORSTOM 7: stn 504, 1 (MNHN). — Stn 538, 1 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 969, 1 (USNM 98619).

**TYPE LOCALITY.** — "*Albatross*" stn 3838: 21°04'05"N, 157°10'35"W (Molokai, Hawaiian islands), 168-388 m.

**REMARKS.** — Of the approximately 56 Recent species of *Caryophyllia*, only three have pentamerall septal symmetry: *C. hawaiiensis*, *C. paucipalata* Moseley, 1881, and *C. crosnieri*, the first species primarily pentamerall, the second primarily hexamerall (the pentamerall condition probably being aberrant, see CAIRNS, 1979), and the last a mixture of pentamerall and hexamerall (see below). *C. paucipalata* is further distinguished from *C. hawaiiensis* by having pali only before its antepenultimate cycle. *C. crosnieri* differs in having a denser, more robust, and differently pigmented corallum; less exsert septa; and a deeper fossa. *C. hawaiiensis* was redescribed and illustrated in detail by CAIRNS (1995).

**DISTRIBUTION.** — Wallis and Futuna region: Futuna Island; Waterwitch Bank: 295-300 m. Vanuatu region: Anatom; 252-280 m. Elsewhere: Hawaiian Islands; Japan; South China Sea; Philippines; Indonesia; Kermadec Ridge; 85-279 m (CAIRNS & ZIBROWIUS, 1997).

### *Caryophyllia (C.) crosnieri* Cairns & Zibrowius, 1997

Figs 5 a-b

*Caryophyllia elongata* Cairns in CAIRNS & KELLER, \*1993: 236-237, pl. 4, figs A-B [Not *Caryophyllia clavus* var. *elongata* Duncan, \*1873: 311-312 (= *C. smithii* Smith & Broderip, \*1828)]. — CAIRNS, 1995: 52, pl. 10, figs d-f, map 14.

*Caryophyllia crosnieri* Cairns & Zibrowius, \*1997: 89 (nom. nov.).

**MATERIAL EXAMINED.** — **Wallis and Futuna region.** MUSORSTOM 7: stn 540, 1 (MNHN). — Stn 572, 1 (USNM 98623). — Stn 581, 1 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 973, 1 (MNHN). — Stn 974, 3 (MNHN). — Stn 975, 1 (MNHN). — Stn 982, 2 (USNM 98621). — Stn 1009, 1 (USNM 98620). — Stn 1067, 1 (MNHN). — Stn 1074, 1 (USNM 98622). — Stn 1108, 1 (MNHN).

**TYPE LOCALITY.** — "*Vityaz*" stn 2716: 33°17'S, 44°55'E (Walters Shoal, Madagascar Plateau), 630-680 m.

**REMARKS.** — Additional large, well-preserved specimens reported herein allow the observation that this species is not consistently hexamerally symmetrical. Whereas most previously reported specimens were hexamerally symmetrical ( $S_1 > S_2 > S_4 \geq S_3$ , 48 septa and 12 pali), most of the specimens listed above are pentamerally symmetrical (5:5:10:20, 40 septa and 10 pali), only the 3 specimens from MUSORSTOM 8 stns 975, 1067, and 1074 being hexamerally symmetrical ( $S_1 > S_2 > S_4 > S_3$ , 12 pali), and the specimen from MUSORSTOM 8 stn 974 having 11 pali (44 septa). Furthermore, a lot reported by CAIRNS & ZIBROWIUS (1997), e.g., KARUBAR stn 31, contains a mixture of specimens with pentamerall or hexamerall symmetry.

The species may be diagnosed as having: a robust, cylindrical corallum with a broadly encrusting base; noncostate, coarsely granular, yellowish-brown theca; pentamerall or hexamerall septal symmetry, usually resulting in 40 or 48 septa, respectively; highest cycle septa equal to or wider than penultimate septal cycle; carinate septal faces; and a very deep fossa with a well-defined columella of 3-9 slender twisted elements. The axial paler edges are highly sinuous, and, in some specimens, form a narrow lamella on their axial margin oriented perpendicular to the plane of the palus.

**DISTRIBUTION.** — Wallis and Futuna region: Waterwitch and Wallis; Combe Bank; 550-600 m. Vanuatu region: Tanna, Efaté, Malakula, and Espiritu Santo; 366-536 m. Elsewhere: southwest Indian Ocean; Philippines; Indonesia; Kermadec and Three Kings Ridges; 165-680 m (CAIRNS & ZIBROWIUS, 1997).



*Caryophyllia (C.) rugosa* Moseley, 1881

*Caryophyllia rugosa* Moseley, v\*1881: 141-143, pl. 1, figs 8a-b. — WELLS, v.1954: 469, pl. 177, figs 5-6. — CAIRNS, 1984: 11-12, pl. 2, figs A-B, pl. 4, fig. I; 1994: 47, pl. 20, fig. i, pl. 21, fig. a (synonymy); 1995: 43-44, pl. 6, fig. h, pl. 7, figs a-c, map 16; 1998: 375. — CAIRNS & ZIBROWIUS, 1997: 91-92.

**MATERIAL EXAMINED.** — **Wallis and Futuna region.** MUSORSTOM 7: stn 530, 1 (MNHN). — Stn 610, 2 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 967, 1 (USNM 98618). — Stn 988, 1 (98617). — Stn 1095, 1 (USNM 98616). — Stn 1097, 1 (MNHN).

**TYPE LOCALITY.** — "*Challenger*" stns 192 and 201: Banda and Sulu Seas, 187-230 m.

**REMARKS.** — This widely distributed and frequently collected deep-water species can be characterised as having: a small, cylindrical corallum with a transversely ridged theca; 32 octamerally arranged septa ( $S_1 > S_2 > S_3$ ) and 8 pali; and all septa and pali with extremely sinuous axial edges.

**DISTRIBUTION.** — Wallis and Futuna region: Wallis; Waterwitch Bank; 286-580 m. Vanuatu region: Anatom, Tanna, and Espiritu Santo; 288-372 m. Elsewhere: Indo-West Pacific from southwest Indian Ocean to Hawaiian Islands; 71-581 m (CAIRNS & ZIBROWIUS, 1997).

*Caryophyllia (C.) octonaria* Cairns & Zibrowius, 1997

*Caryophyllia octonaria* Cairns & Zibrowius, \*1997: 92, figs 7a-b.

**MATERIAL EXAMINED.** — **Vanuatu.** MUSORSTOM 8: stn 964, 5 (MNHN). — Stn 969, 6 (MNHN). — Stn 976, 12 (USNM 98614). — Stn 1072, 2 (USNM 98615). — Stn 1134, 1 (MNHN).

**TYPE LOCALITY.** — MUSORSTOM I stn 64: 14°01'N, 120°16'E (Lubang Island, Philippines), 194-195 m.

**REMARKS.** — Little can be added to the recent description of this species. It can be diagnosed as having: a small, straight corallum with a well-defined, white pedicel, the upper theca being light brown; granular costae sometimes covered with epitheca; a circular to only slightly elliptical calice; 32 octamerally arranged septa ( $S_1 > S_{2-3}$ ) with only moderately sinuous axial edges; and eight very sinuous pali with carinate faces.

**DISTRIBUTION.** — Vanuatu region: Anatom and Espiritu Santo; 182-622 m. Elsewhere: Philippines; 186-194 m.

*Caryophyllia (C.) abrupta* sp. nov.

Figs 5 d-e

**MATERIAL EXAMINED/TYPES.** — **Wallis and Futuna region.** MUSORSTOM 7: stn 522, 1 paratype (MNHN). — Stn 523, 8 paratypes (MNHN). — Stn 524, 2 paratypes (USNM 98607). — Stn 530, 1 paratype (MNHN). — Stn 534, 4 paratypes (MNHN). — Stn 535, holotype (MNHN), 14 paratypes (USNM 98609). — Stn 537, 2 paratypes (MNHN). — Stn 546, 2 paratypes (MNHN). — Stn 557, 3 paratypes (USNM 98610). — Stn 569, 1 paratype (USNM 98611). — Stn 570, 1 paratype (MNHN). — Stn 571, 2 paratypes (MNHN). — Stn 586, 4 paratypes (MNHN). — Stn 604, 5 paratypes (MNHN). — Stn 605, 2 paratypes (MNHN). — Stn 606, 1 paratype (MNHN). — Stn 608, 2 paratypes (USNM 98606). — Stn 619, 2 paratypes (USNM 98608).

**Vanuatu.** MUSORSTOM 8: stn 963, 1 nontype cemented to a *Xenophora* shell (MNHN). — Stn 988, 1 (MNHN). — Stn 1016, 1 paratype (USNM 98612), and another nontype cemented to a *Xenophora* shell (MNHN). — Stn 1065, 1 paratype (MNHN). — Stn 1088, 2 nontypes cemented to a *Xenophora* shell (MNHN). — Stn 1091, 2 nontypes cemented to *Xenophora* shells (MNHN). — Stn 1094, 1 paratype (MNHN).

TYPE LOCALITY. — MUSORSTOM 7 stn 535: 12°29.6'S, 176°41.3'W (Waterwitch Bank), 340-470 m.

ETYMOLOGY. — The species name *abrupta* (Latin *abruptus*, broken off, separated, sheer) refers to the process of transverse division that separates the anthocyathus from the anthocaulus.

DESCRIPTION. — Anthocaulus stage unknown. Anthocyathus ceratoid, curved between 45°-90° usually in plane of GCD; one to 7 episodes of rejuvenescence not uncommon in larger coralla. Holotype 8.4 x 7.5 mm in CD and 18.5 mm in height; largest corallum (MUSORSTOM 7 stn 619) 10.9 x 8.4 mm in CD. Basal scar circular to slightly elliptical: 1.8-2.1 x 1.7-1.8 mm in diameter, displaying 8 major septa. Calice strongly compressed: GCD:LCD = 1.12-1.29-1.37 (N=8). Costal expression variable, but 8 primary costae usually prominent, the other 24 flat and poorly defined; however, in some specimens the theca is smooth or bears uniformly small granules. Most coralla uniformly white, but some are reddish brown near calicular edge.

Septa usually octamerally arranged in 3 size classes: 8:8:16 (32 septa); however, two specimens of 6.6 mm CD from MUSORSTOM 7 stn 535 have a septal complement of 6:6:12 (6 pali) and 7:7:14 (7 pali), and the largest specimen has an extra pair of septa resulting in 34 septa and 9 pali. Eight primary septa highly exsert (1.5-1.6 mm), extend 3/4 distance to columella, having moderately sinuous axial edges. Secondary septa about half width and exsertness of primaries, but have extremely sinuous axial edges. Tertiaries slightly more exsert than secondaries, being fused to their adjacent primary septa to form low, triangular lancets. Tertiaries equal to or slightly less wide than secondaries, becoming relatively wider with age, having slightly sinuous axial edges. Fossa of moderate depth, containing 8 narrow P<sub>2</sub> that form a distinct palmar crown, each palus having extremely sinuous edges, equivalent to those of the secondary septa they border. Columella fascicular, composed of 2-4 narrow elements arranged linearly or in a rhomboid pattern.

REMARKS. — There are six species of octamerally symmetrical *Caryophyllia*, all of which generally have 32 septa: *C. rugosa* Moseley, 1881; *C. octopali* Vaughan, 1907; *C. mabahithi* Gardiner & Waugh, 1938; *C. barbadensis* Cairns, 1979; *C. marmorea* Cairns, 1984; and *C. octonaria* Cairns & Zibrowius, 1997; a seventh species has a variable symmetry that includes octamerally: *C. cornuformis* Pourtalès, 1868. *C. abrupta* differs from these species by propagating by transverse division, and by having a compressed corallum. It is perhaps most similar to *C. cornuformis* (a species known only from the Atlantic and the southwest Indian Ocean) in size, shape, and septal architecture. Both species also have an abruptly terminated base: in the case of *C. abrupta*, due to transverse division, in the case of *C. cornuformis*, probably due to budding, which results in an irregularly-shaped, open base. *C. abrupta* also differs from that species in having a very regular octamerally symmetrical symmetry with a well-defined palmar crown, an elongate calice, exsert primary and secondary septa, and often prominent primary costae.

One other species of this genus is known to have transverse division: *C. secta* Cairns & Zibrowius, 1997, from the Philippines and Indonesia (220-366 m), which differs from *C. abrupta* in septal symmetry (hexamerally, 48 septa), size (up to 15.7 mm GCD), and corallum shape (straight, trochoid).

DISTRIBUTION. — Wallis and Futuna region: Wallis and Alofi; Waterwitch, Combe, and Tuscarora Banks: 305-650 m. Vanuatu region: Anatom, Tanna, Efaté, Malakula, and Espiritu Santo; 300-400 m.

### *Caryophyllia* (*C.*) *marmorea* Cairns, 1984

Figs 5 c, f

*Caryophyllia marmorea* Cairns, \*1984: 13, pl. 2, figs C-D.

MATERIAL EXAMINED. — MUSORSTOM 7: stn 525, 1 (MNHN). — Stn 534, 1 (USNM 98613). — Stn 585, 1 (MNHN).

TYPE LOCALITY. — Deep Ocean Disposal Site Investigations, Hawaii, Stn HON 9-3: 19°48'N, 154°58'W (off Hilo, Hawaii), 337 m.

REMARKS. — This species is diagnosed as having a small (CD < 4 mm), straight, attached subcylindrical corallum. The theca is light brown, granular, and glisteny; primary costae are prominent. Septa are octamerally arranged:  $S_1 > S_2 > S_3$  (32 septa). This is the first report of this species subsequent to its original description from Hawaii.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch Bank; 475-500 m. Elsewhere: Hawaii, Hawaiian Islands; 331-337 m.

*Caryophyllia (C.) quadragenaria* Alcock, 1902

*Caryophyllia quadragenaria* Alcock, v\*1902a: 91-92; v.1902c: 10, pl. 1, figs 4, 4a. — CAIRNS, 1994: 46-47, pl. 20, figs c-h, pl. 41, figs c-d (synonymy); 1995: 45-46, pl. 7, figs g-h, map 7 (synonymy); 1998: 375. — CAIRNS & ZIBROWIUS, 1997: 93.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 556, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 962, 1 (MNHN). — Stn 965, 1 (MNHN). — Stn 967, 5 (USNM 98603). — Stn 1106, 1 (MNHN).

TYPE LOCALITY. — "*Siboga*" stns 90, 251, and 289; Makassar Strait, Banda, and Timor Seas, 54-281 m.

REMARKS. — In addition to *C. quadragenaria*, there are six other decamerally symmetrical *Caryophyllia*: *C. abyssorum* Duncan, 1873; *C. calveri* Duncan, 1873; *C. antillarum* Pourtalès, 1874; *C. zopyros* Cairns, 1979; *C. perculata* Cairns, 1991; and *C. solida* Cairns, 1991. *C. quadragenaria* can be diagnosed as having: a relatively small (GCD < 12 mm), straight corallum attached by a narrow pedicel; poorly defined costae; three cycles of decamerally arranged septa resulting in 40 septa, the tertiary septa usually equal to or wider than the secondaries; and a well-formed palmar crown of 10 pali. The species was recently redescribed and illustrated by CAIRNS (1994, 1995).

DISTRIBUTION. — Wallis and Futuna region: Tuscarora Bank; 440 m. Vanuatu region: Anatom, Efaté, and Espiritu Santo; 314-430 m. Elsewhere: western Pacific from Japan to New Zealand; 54-385 m (CAIRNS & ZIBROWIUS, 1997).

*Caryophyllia (C.)* sp. cf. *C. calveri* Duncan, 1873

Figs 5 g-i

?*Caryophyllia calveri* Duncan, \*1873: 316. — ZIBROWIUS, v.1980: 57-59, pl. 21, figs A-L.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1051, 1 (MNHN). — Stn 1056, 11: 7 (MNHN), 4 (USNM 98605).

TYPE LOCALITY of *C. calveri*. — "*Porcupine*": stn 24, 37°19'N, 9°13'W (off Portugal), 534 m.

DESCRIPTION. — Corallum elongate-conical and straight, having a robust pedicel (PD:GCD = 0.32-0.62) that is firmly attached by a thin, broadly encrusting base. All specimens examined attached to small bits of pumice. Largest specimen (MUSORSTOM 8 stn 1056) 10.9 x 9.3 mm in CD, and 3.5 mm in PD, having a basal encrustation of 16 mm. Calice slightly elliptical: GCD:LCD = 1.08-1.19. Costae low and poorly defined, the intercostal striae being infilled with glisteny textura. Base, pedicel, and calicular elements white; however, upper theca a light yellow-brown.

Septal symmetry variable. Half of the specimens examined have hexamerall symmetry ( $S_{1-2} > S_4 \geq S_3$ , 48 septa and 12 pali); 5 specimens have decamerall symmetry (10:10:20, 40 septa and 10 pali); and one specimen has nonamerall symmetry (11:11:22, 44 septa and 11 pali). The 10-12 larger septa (primaries) are highly exsert

(up to 2.1 mm), extend about 3/4 distance to the columella, and have moderately sinuous axial edges. Second size class of septa (secondaries) about 0.7 mm exsert, 4/5 width of a primary septum, also having moderately sinuous axial edges. Third size class of septa (tertiary septa) equal to or slightly wider than the secondaries, and about 0.9 mm exsert, fusing with their adjacent primary septa at the calicular edge to form low, triangular lancets. Depending on septal symmetry, 10-12 wide (1.1-1.2 mm) pali form a well-defined crown, the pali having highly sinuous edges and bearing prominent granules and short ridges. Fossa of moderate depth, bearing a fascicular columella composed of an elongate field of 3-10 slender (0.5 mm diameter), tightly twisted and closely spaced elements.

REMARKS. — Of the approximately 56 Recent valid species of *Caryophyllia*, nine species can be characterised as having an attached corallum, decamerale or hexamerale symmetry, and its highest cycle septa equal to or wider than its penultimate cycle: *C. calveri* Duncan, 1873; *C. atlantica* (Duncan, 1873); *C. polygona* Pourtalès, 1878; *C. lamellifera* Moseley, 1881; *C. arnoldi* Vaughan, 1900; *C. pauda* Alcock, 1902; *C. alberti* Zibrowius, 1980; *C. quadragenaria* Alcock, 1902; and *C. perculata* Cairns, 1991, the last two species usually having decamerale symmetry. The specimens reported above from Epi are morphologically indistinguishable from specimens identified as *C. calveri* by ZIBROWIUS (1980), even to the point of having a variable septal symmetry that includes both decamerale and hexamerale. *C. calveri* is known only from the northeast Atlantic and Mediterranean at 130-1050 m (ZIBROWIUS, 1980). This disjunct distribution would imply that the Epi Island population represents a different species or that intermediate populations between the south Pacific and northeast Atlantic have not yet been recorded.

DISTRIBUTION. — Vanuatu region: Epi; 558-602 m.

#### *Caryophyllia (C.) diomedae* Marenzeller, 1904

*Caryophyllia diomedae* Marenzeller, v\*1904: 79-80, pl. 1, fig. 2. — CAIRNS, 1995: 49-50, pl. 9, figs a-d, map 3 (synonymy). — CAIRNS & ZIBROWIUS, 1997: 88.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 959, 1 (MNHN). — Stn 1014, 1 (USNM 98604). — Stn 1080, 1 (MNHN). — Stn 1128, 3 (MNHN).

TYPE LOCALITY. — "Albatross" stn 3358: 6°30'N, 81°44'W (off Coiba Island, Panama), 1043 m.

REMARKS. — This widespread species was redescribed and discussed by CAIRNS (1995). It can be characterised as having: an elongate, slender but slightly flared, straight corallum attached by a narrow pedicel; flat to porcellaneous theca; only slightly exsert septa; a septal formula of  $S_{1-2} > S_3 > S_4$  (48 septa); and a shallow fossa.

DISTRIBUTION. — Vanuatu region: Anatom, Efaté, and Malakula; Guyot Bougainville; 475-799 m. Elsewhere: widespread, including Indo-Pacific and Atlantic Ocean; 225-2200 m (CAIRNS, 1995).

#### *Caryophyllia (C.) lamellifera* Moseley, 1881

*Caryophyllia lamellifera* Moseley, v\*1881: 140-141, pl. 1, figs 7a-b. — CAIRNS, 1995: 51-52, pl. 9, fig. i, pl. 10, figs a-c, map 18 (synonymy). — CAIRNS & ZIBROWIUS, 1997: 90.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 502, 1 (MNHN). — Stn 589, 2 (MNHN).

Vanuatu. MUSORSTOM 8: stn 1077, 1 (USNM 98591).

TYPE LOCALITY. — "Challenger" stn 170: 29°55'S, 178°14'W (north of Macauley Island, Kermadec Ridge), 1152 m.

REMARKS. — *Caryophyllia lamellifera* is distinguished from the many other Pacific *Caryophyllia*, by having a fine, transversely ridged, brown-striped theca. The species is more fully described by CAIRNS (1995), who also compared it to the other two congeners that have transversely ridged theca: *C. rugosa* and *C. corrugata*. CAIRNS (1995) noted variation in septal symmetry (12-14 primary septa) and relative width of the  $S_4$  and  $S_3$  ( $S_4$  being wider, as in the holotype, or narrower than  $S_3$ , as in most other specimens). The four specimens reported above all have 48 septa arranged as:  $S_{1-2} > S_3 > S_4$ . However, three other specimens from MUSORSTOM 8 stns 1018, 1023, 1091, and 1095 (not reported above), are only tentatively assigned to this species. They differ from the typical form in lacking transverse thecal ridges and in having  $S_4$  that are equal to or slightly wider than their  $S_3$ , as in the holotype. It is possible that both of these characters may be found to constitute intraspecific variation for some species.

DISTRIBUTION. — Wallis and Futuna region: Futuna; Field Bank; 400-516 m. Vanuatu region: Malakula; 180-210 m. Elsewhere: Philippines; Indonesia; Kermadec and Norfolk Ridges; Taupo Tablemount; 89-1152 m (CAIRNS & ZIBROWIUS, 1997).

### *Caryophyllia (C.) scobinosa* Alcock, 1902

*Caryophyllia scobinosa* Alcock, v\*1902: 8, pl. 1, figs 2, 2a. — CAIRNS, 1995: 52-53, pl. 10, figs g-i, pl. 11, figs a-c, map 16 (synonymy). — CAIRNS & ZIBROWIUS, 1997: 94.  
Not *Caryophyllia scobinosa* - WELLS, v.1984: 207-209, figs 2 (1-4) [= *Asterosmilia* sp. cf. *A. marchadi* (Chevalier, 1966)].

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 552, 1 (MNHN). — Stn 565, 1 (MNHN). — Stn 635, 2 (USNM 98601).

Vanuatu. MUSORSTOM 8: stn 992, 2 (MNHN). — Stn 1034, 11 (MNHN). — Stn 1035, 7 (USNM 98602). — Stn 1074, 2 (MNHN).

TYPE LOCALITY. — "Siboga" stns 45 and 102: Flores and Sulu Seas, 535-794 m.

REMARKS. — This species was redescribed and figured by CAIRNS (1995). It is distinguished from the other unattached cornute species known from this region, *C. ambrosia*, by having a much smaller, and more slender corallum (GCD < 16 mm); and only 48 septa and 12 pali.

DISTRIBUTION. — Wallis and Futuna region: Combe, Tuscarora, and Rotumah Banks; 715-900 m. Vanuatu region: Erromango, Efaté, and Espiritu Santo; 750-775 m. Elsewhere: Indo-West Pacific from southwest Indian Ocean to Japan and Tonga; 353-1276 m (CAIRNS & ZIBROWIUS, 1997).

### *Caryophyllia (C.) ambrosia* Alcock, 1898

*Caryophyllia ambrosia* Alcock, v\*1898: 12, pl. 1, figs 1, 1a. — ZIBROWIUS, v.1980: 63-65, pl. 25, figs A-K (synonymy). — CAIRNS, 1994: 48, pl. 21, figs d-h; 1995: 53-54, pl. 11, figs d-e, map 7. — CAIRNS & ZIBROWIUS, 1997: 95-96.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 564, 2 (MNHN). — Stn 565, 2 (MNHN). — Stn 598, 1 (USNM 98599). — Stn 635, 2 (USNM 98600). — Stn 636, 4 (MNHN).

TYPE LOCALITY. — "Investigator" stns 104 and 176: Laccadive Sea, Arabian Sea, 1829-1957 m.

REMARKS. — The regional variation of corallum size and number of septa was discussed by CAIRNS (1994, 1995), who also provided descriptions and illustrations of the species. The specimens reported above have 14-22 (mode = 16) primary septa and 56-88 (mode = 64) total septa, which allies them most closely with northern Indian Ocean populations. Populations to the north (Japan), west (Indonesia), and south (New Zealand), usually have more septa, e.g., 18-30 primary septa or a total of 72-120 septa.

DISTRIBUTION. — Wallis and Futuna region: Tuscarora, Field, and Rotumah Banks; 700-1015 m. Elsewhere: Amphi-Atlantic; Indo-West Pacific, including Japan and New Zealand; 311-2670 m (CAIRNS & ZIBROWIUS, 1997).

Subgenus *CARYOPHYLLIA* (*ACANTHOCYATHUS*) H. Milne Edwards & Haime, 1848

*Caryophyllia* (*A.*) *grayi* (H. Milne Edwards & Haime, 1848)

*Acanthocyathus grayi* H. Milne Edwards & Haime, \*1848a: 293, pl. 9, figs 2, 2a. — UMBGROVE, 1950: 641-642, pl. 81, figs 27-32 (synonymy). — WELLS, v.1984: 209, pl. 2, figs 5-9.

*Caryophyllia* (*A.*) *grayi* - CAIRNS, 1994: 49, pl. 21, figs i-k (synonymy); 1998: 377. — CAIRNS & ZIBROWIUS, 1997: 97-98, figs 7 c, f, i.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 496, 1 (USNM 98598). — Stn 499, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 1001, 1 (MNHN). — Stn 1002, 1 (USNM 98597). — Stn 1004, 2 (USNM 98596). — Stn 1065, 1 (MNHN). — Stn 1069, 1 (MNHN). — Stn 1070, 2 (MNHN). — Stn 1071, 2 (MNHN). — Stn 1086, 4 (MNHN). — Stn 1103, 3 (MNHN). — Stn 1134, 1 (USNM 98595).

USGS (*Late Pleistocene of Kere River, Espiritu Santo*): stn 25715, 4 (USNM 71844, 71846, 78610), WELLS, 1984; Stn SM242, 129a and 129b, 4 (USNM 71845 and 73963), WELLS, 1984.

TYPE LOCALITY. — Unknown.

REMARKS. — The species is characterised as having a compressed, ceratoid corallum, with a narrow pedicel and rounded thecal edges, each of which bears several thecal spines that are circular in cross section. Costae are rounded, not ridged, and the theca is often reddish brown. Septa are usually arranged: 14:14:28, resulting in 56 septa and 14 pali, but large coralla have 16 and even 18 primary septa, resulting in up to 72 septa (CAIRNS, 1995). The species was redescribed and figured by CAIRNS (1995) and CAIRNS and ZIBROWIUS (1997), the latter including a key and discussion of most of the species in this subgenus.

DISTRIBUTION. — Wallis and Futuna region: Futuna; 290-300 m. Vanuatu region: Erromango, Malakula, and Espiritu Santo (also Late Pleistocene, WELLS, 1984); 125-360 m. Elsewhere: Indo-West Pacific from South Africa to Japan; 37-490 m (CAIRNS & ZIBROWIUS, 1997).

Genus *CRISPATOTROCHUS* Tenison Woods, 1878

*Crispatotrochus rubescens* (Moseley, 1881)

*Cyathoceras rubescens* Moseley, \*1881: 157, pl. 2, figs 8a-c. — Cairns, 1984: 15.

*Cyathoceras tydemani* Alcock, v\*1902a: 93-94; v.1902c: 14, pl. 1, figs 7, 7a.

*Cyathoceras diomedae* Vaughan, v\*1907: 77-78, pl. 7, figs 1-2.

*Crispatotrochus rubescens* - CAIRNS, 1994: 51, pl. 22, figs g-h (synonymy). — CAIRNS & ZIBROWIUS, 1997: 103-104, figs 10 a-c.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 502, 1 (USNM 98585). — Stn 507, 2 (MNHN). — Stn 511, 1 (MNHN). — Stn 523, 1 (MNHN). — Stn 585, 5 (MNHN). — Stn 604, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 983, 1 (USNM 98584).

TYPE LOCALITY. — "Challenger" stn 192: 5°49'15"S, 132°14'15"E (Kai Islands, Banda Sea), 236 m.

REMARKS. — This species was recently redescribed and figured by CAIRNS (1994).

DISTRIBUTION. — Wallis and Futuna; 420-516. Vanuatu region: Tanna; 475-480 m. Elsewhere: western and central Pacific: Japan; South China Sea; Philippines; Indonesia; Hawaiian and Christmas Islands; 110-634 m (CAIRNS & ZIBROWIUS, 1997).

*Crispatotrochus rugosus* Cairns, 1995

Figs 6 a-b

*Crispatotrochus rugosus* Cairns, \*1995: 57, pl. 13, figs a-b, map 16; 1998: 378. — CAIRNS & ZIBROWIUS, 1997: 104.

MATERIAL EXAMINED. — **Wallis and Futuna region.** MUSORSTOM 7: stn 511, 1 (MNHN). — Stn 523, 1 (MNHN). — Stn 542, 1 (MNHN). — Stn 584, 2 (USNM 98586). — Stn 589, 1 (MNHN). — Stn 610, 1 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 977, 3 (MNHN). — Stn 988, 8 (USNM 98589). — Stn 1015, 3 (USNM 98590). — Stn 1018, 6 (USNM 98587). — Stn 1030, 2 (MNHN). — Stn 1043, 1 (MNHN). — Stn 1095, 2 (MNHN). — Stn 1106, 1 (USNM 98588).

TYPE LOCALITY. — NZOI stn Q70: 26°59.7'S, 159°18.9'E (Lord Howe Seamount Chain), 376 m.

REMARKS. — *Crispatotrochus rugosus* is distinguished from the other 10-12 species in the genus by having fine, transverse thecal ridges, and  $S_1$  that are larger than the  $S_2$ . All but one of the specimens reported above are consistent with the type series, having 48 septa arranged in 4 cycles. However, the specimen from MUSORSTOM 8 stn 1043 (Figs 6 a-b) is considerably larger (CD = 29.2 x 18.3 mm, height = 37.1 mm) and has a fifth cycle of septa, although missing 4 pairs of  $S_5$  (88 septa). This large specimen is similar to the fragmented specimen reported by CAIRNS and ZIBROWIUS (1997) that had an estimated GCD of 32 mm.

Corallum pigmentation is variable, including uniformly white, uniformly brownish-black, and white with brown longitudinal stripes corresponding to the  $C_{1-2}$  near the calicular edge. One specimen from MUSORSTOM 8 stn 988 contains an acrothoracican cirripede boring in its pedicel.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Combe and Field Banks; 286-455 m. Vanuatu region: Tanna, Efaté, Epi, and Espiritu Santo; 190-410 m. Elsewhere: Kermadec Islands; Lord Howe Seamount Chain; Philippines; Malaysia; Western Australia; 142-508 m (CAIRNS & ZIBROWIUS, 1997).

Genus *LABYRINTHOCYATHUS* Cairns, 1979

*Labyrinthocyathus limatulus* (Squires, 1964)

*Ceratotrochus* (*Ceratotrochus*) *limatulus* Squires, v\*1964: 3-5, pl. 1, figs 5-9. — SQUIRES & KEYES, v.1967: 24, pl. 2, figs 9-10.

*Labyrinthocyathus limatulus* - CAIRNS, 1979: 70; 1995: 58, pl. 13, figs c-f, map 17.

MATERIAL EXAMINED. — **Vanuatu.** MUSORSTOM 8: stn 988, 3: 2 (MNHN), 1 (USNM 98592).

TYPE LOCALITY. — 7.2 km northeast of the Alderman Islands, Coromandel Peninsula, North Island, New Zealand, 102 m.

REMARKS. — This is the only species in the genus to have a transversely ridged theca, the ridging becoming less apparent toward the calicular edge. It is more fully described by CAIRNS (1995). This is the first record of *L. limatulus* outside the New Zealand region.

DISTRIBUTION. — Vanuatu region: Tanna; 372-466 m. Elsewhere: northern New Zealand region; Lord Howe Seamount Chain; 20-508 m (CAIRNS, 1995).

Genus *OXYSMILIA* Duchassaing, 1870*Oxysmilium circularis* Cairns, 1998

Figs 6 g-h, 7 a

*Oxysmilium circularis* Cairns, \*1998: 378, figs 2 i-k.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 977, 1 (MNHN). — Stn 983, 2 (USNM 98624). — Stn 1030, 2 (MNHN).

Kermadec Islands. NZOI: stn K830, 1 (USNM 99293). — Stn K858, 1 (USNM 99294).

TYPE LOCALITY. — "Soela" stn 02/82/16: 18°41'S, 117°54'E (off Port Hedland, Western Australia), 200-204 m.

REMARKS. — A characteristic of this species is the irregularity of S<sub>5</sub> pair insertion, some half-systems within the same specimen having a full two pairs of S<sub>5</sub>, some only one pair, and some no S<sub>5</sub>. A redescription of the species is not included here since it was so recently described. A specimen from MUSORSTOM 8 stn 983 is the largest known, measuring 29.8 x 27.9 mm in CD and 41.0 mm in height.

DISTRIBUTION. — Vanuatu region: Tanna and Efaté; 190-475 m. Elsewhere: northwestern Western Australia; Kermadec Islands (Curtis and Raoul), reported herein; 201-545 m.

*Oxysmilium corrugata* sp. nov.

Figs 6g-h, 7a

MATERIAL EXAMINED/TYPES. — Vanuatu. MUSORSTOM 8: stn 1030, 11: holotype and 7 paratypes (MNHN), 3 (USNM 98625).

TYPE LOCALITY. — MUSORSTOM 8 stn 1030: 17°51'S, 168°30'E (Efaté), 180-190 m.

ETYMOLOGY. — The species name *corrugata* (Latin *corrugatus*, ridged) refers to the fine file-like, regularly corrugated thecal ridging.

DESCRIPTION. — Corallum straight and elongate-conical, with a slightly flared calice. Largest specimen (holotype) 11.0 x 9.6 mm in CD, 4.3 mm in PD, and 12.5 mm in height. Calice slightly elliptical: GCD:LCD = 1.07-1.14-1.27. Corallum firmly attached through a thick, robust pedicel: PD:GCD = 0.39-0.60-0.77. Theca uniformly covered with well-defined, thin-edged, transverse ridges, about 6 parallel ridges per mm. Whereas thecal ridges occasionally bifurcate and rejoin one another, they often run uninterrupted for the entire circumference of the pedicel. Ridges cover the entire thecal surface, from base to distal peripheral edges of septa, but are often encrusted toward the base by bryozoa, foraminifera, and sponges. Corallum white.

Septa hexamerally arranged in 4 complete cycles: S<sub>1</sub>>S<sub>2</sub>>S<sub>3</sub>>S<sub>4</sub> (48 septa), the complete fourth cycle attained at a GCD of 5.7 mm or less. S<sub>1</sub> about 2.4 mm exsert, thick, having straight axial edges that penetrate into the columella, and coarsely granular faces. S<sub>2</sub> similar to the S<sub>1</sub> but slightly less wide and less exsert. S<sub>3</sub> slightly less exsert, wide, and thick than S<sub>2</sub>. S<sub>4</sub> only slightly less exsert and wide as S<sub>3</sub>. Thus, there are four size classes of septa, but the differences in size are minimal. Fossa of moderate depth. Columella composed of 4-6 coarse, granular papillae, which in larger coralla fuse into a solid, elongate, massive structure. The linear shape of the columella is sometimes modified into a cross-shape by short symmetrical outpocketings of the columella into the two lateral septal systems.

REMARKS. — There are three other Recent species of *Oxysmilium*: *O. rotundifolia* (H. Milne Edwards & Haime, 1848); *O. circularis* Cairns, 1998; and *O. epithecata*. *O. corrugata* differs from the first two in having a smaller



corallum with fewer septa, a transversely ridged theca, and a better-developed columella. It is compared to *O. epithecata* in the account of that species (below).

DISTRIBUTION. — Vanuatu region: Efaté: 180-190 m.

*Oxysmia epithecata* sp. nov.

Figs 6 d-e, 7 b-g

MATERIAL EXAMINED/TYPES. — Wallis and Futuna region. MUSORSTOM 7: stn 496, 1 paratype (MNHN), SEM stub 873 (USNM 98626). — Stn 507, 2 paratypes (USNM 98627). — Stn 509, 1 paratype (USNM 98628). — Stn 511, 1 paratype (MNHN). — Stn 514, 6 paratypes (USNM 98629). — Stn 523, 2 paratypes (MNHN). — Stn 556, 1 paratype (MNHN). — Stn 605, 17 paratypes (USNM 98630). — Stn 610, 1 paratype (MNHN).

Vanuatu. MUSORSTOM 8: stn 959, 1 paratype (MNHN). — Stn 962, 1 paratype (MNHN). — Stn 1018, holotype (MNHN). — Stn 1023, 5 paratypes (MNHN). — Stn 1026, 1 paratype (MNHN). — Stn 1097, 7 paratypes (MNHN).

TYPE LOCALITY. — MUSORSTOM 8 stn 1018: 17°53'S, 168°25'W (Efaté), 300-301 m.

ETYMOLOGY. — The species name *epithecata* (Greek *epi*, on + *theke*, sheath) refers to the wrinkled epitheca that covers the lower corallum.

DESCRIPTION. — Corallum straight and elongate-conical, with a slightly flared calice. One to four coralla often originate from the dead calicular edge of a conspecific corallum, producing a small, bushy pseudocorallum (Fig. 7 b). Holotype 7.1 x 6.4 mm in CD, 3.3 mm in PD, and 10.7 mm in height; largest specimen (MUSORSTOM 8 stn 1026) 11.3 mm in GCD. Calice circular as juvenile, becoming elliptical with age (GCD:LCD = 1.07-1.34). Corallum firmly attached through a robust pedicel (PD:GCD = 0.33-0.46) and thin, expansive, encrusting base, the base often twice the diameter of the calice. Entire base and lower quarter to half of theca covered with fine transverse epithecal ridges, those ridges on the base (6 per mm) more widely spaced than those on the pedicel (13 per mm). As in *O. corrugata*, the ridges may run uninterrupted around the entire circumference of the pedicel or base, but, in general, are more irregular in arrangement and spacing. The ridges are about 10 µm wide and 30 µm tall (Figs 7 f-g). Proximal to the epithecal ridging, the upper 3/4 to half of the theca is costate, the C<sub>1-2</sub> usually slightly ridged; all costae granular. Corallum white.

Septa hexamerally arranged in 4 cycles, the fourth cycle complete only in the largest corallum: S<sub>1</sub>>S<sub>2</sub>>S<sub>3</sub>>S<sub>4</sub>. Coralla below 3.5 mm in GCD contain only 3 cycles of septa (24), whereas coralla with a GCD between 3.5 and 11.0 mm have an increasing number S<sub>4</sub>, the intermediate number of 36 septa being most common. The holotype has 44 septa. S<sub>1</sub> up to 1.3 mm exsert, having straight axial edges that reach the columella. S<sub>2</sub> slightly less exsert (about 0.9 mm), also having straight axial edges that reach the columella. S<sub>3</sub> less exsert than S<sub>2</sub> and well developed only in large coralla, where they are about half the width of an S<sub>2</sub>, their lower axial edges sometimes fusing to the adjacent S<sub>2</sub>. S<sub>4</sub> least exsert septa, only developed in largest of coralla; otherwise restricted to exsert lobes at the calicular edge. Fossa deep, usually containing a deep-seated papillose columella. Small coralla often have no columella, whereas most larger coralla have a small columella composed of several small fused papillae, and one specimen (MUSORSTOM 8 stn 1097) has a robust columella.

REMARKS. — *Oxysmia epithecata* is most similar to *O. corrugata*, both species being about the same size, having the same number of septal cycles, and having transverse thecal ridges. *O. epithecata* differs in having finer, irregular transverse ridges that are restricted to the lower corallum, and a granular costate upper theca; a less robust pedicel; less septa at a corresponding GCD; a deeper fossa; and a less developed columella.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Tuscarora Bank; 240-455 m. Vanuatu region: Anatom, Efaté, and Espiritu Santo; 288-437 m.

Genus *TROCHOCYATHUS* H. Milne Edwards & Haime, 1848Subgenus *TROCHOCYATHUS (TROCHOCYATHUS)* H. Milne Edwards & Haime, 1848*Trochocyathus (T.) vasiformis* Bourne, 1903

Figs 8 a-b, f

*Trochocyathus vasiformis* Bourne, v\*1903: 27-28, pl. 5, figs 6-7.

**MATERIAL EXAMINED.** — Wallis and Futuna region. MUSORSTOM 7: stn 522, 1 (MNHN). — Stn 527, 1 (MNHN). — Stn 535, 2 (MNHN). — Stn 609, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 959, 2 (USNM 98634). — Stn 973, 2 (USNM 98636). — Stn 977, 19 (MNHN), SEM stub 883 (USNM 98635). — Stn 978, 4 (MNHN). — Stn 983, 3 (MNHN). — Stn 1006, 1 (MNHN). — Stn 1011, 1 (MNHN). — Stn 1015, 1 (USNM 98633). — Stn 1019, 1 (MNHN). — Stn 1067, 8 (USNM 98632). — Stn 1072, 1 (MNHN). — Stn 1107, 1 (MNHN).

Indonesia (*Mollucas*). KARUBAR: stn 5, 2 (USNM 98637).

**TYPE LOCALITY.** — Tutanga, Funafuti, Tuvalu Islands, 366 m.

**DESCRIPTION.** — Corallum straight, elongate-conical (ceratoid), and attached through a robust pedicel (PD:GCD = 0.47-0.84) and an encrusting base. Largest specimen (MUSORSTOM 8 stn 977) 14.9 x 11.9 mm in CD and 25 mm in height. Calice elliptical: GCD:LCD = 1.11-1.35. Theca thick; costae usually low, rounded, and finely granular, but occasionally C<sub>1-2</sub> are slightly ridged. Theca and outer septa a light yellow-brown (beige), the pali and columella white; however, one specimen (MUSORSTOM 8 stn 1107) completely white.

Septa regularly hexamerally arranged in 4 complete cycles: S<sub>1-2</sub>>S<sub>3-4</sub> (48 septa). S<sub>1-2</sub> exsert (up to 2.5 mm), having straight axial edges each bordered by a small (0.4 mm wide) palus; however, the 2 P<sub>1</sub> aligned with the greater calicular axis (those before the principal septa) only about half width and not as exsert as the other P<sub>1-2</sub>. S<sub>3-4</sub> equal in width, about 3/4 that of the S<sub>1-2</sub>; although equal in width, S<sub>3</sub> slightly more exsert than S<sub>4</sub>. A single, well-defined, elliptical palar crown occurs in the fossa, composed of 12 P<sub>1-2</sub> and 12 P<sub>3</sub>, the P<sub>3</sub> 2-3 times the width (0.9-1.0 mm) of the P<sub>1-2</sub> and usually rising slightly higher in the fossa. A large P<sub>3</sub> alternates with each smaller P<sub>1-2</sub>, but axial edges of all pali are the same distance from the columella, which gives the impression of a single crown, even though the pali are of three size classes and heights. Each palus bears several prominent, finely dentate, obliquely-oriented menianes (Fig. 8f). Outer edges of P<sub>3</sub> quite broad, occupying not only space before the S<sub>3</sub> but the two adjacent S<sub>4</sub>. Fossa of moderate depth. Columella an elliptical field of 10-25 slender, foliaceous elements. Columellar elements often shaped as papillae that support several horizontal to slightly inclined, circular plates, the papillae passing through the centre of these platelets (Fig. 8f). The shape of the columellar elements is intermediate between the typical papillose elements characteristic of *Trochocyathus* and the twisted elements common to *Caryophyllia*.

**REMARKS.** — This is believed to be the first report of this species subsequent to its description, most of the specimens reported above collected in the same sector of the Pacific as the type locality (Funafuti), and at similar depths to the types. The species is distinctive in having prominent menianes on its pali, a beige corallum, and distinctively shaped columellar elements.

BOURNE (1903) stated in the original description that the smaller, worn syntype had only 42 septa, lacking 3 pairs of S<sub>4</sub>, but that specimen (BM 1903.12.1.5-6) actually has 44 septa, lacking pairs of S<sub>4</sub> only in half-systems II and IV, as counted from a principal septum.

Specimens from four stations contained coralla that were bored by acrothoracican cirripede Crustacea: MUSORSTOM 7 stn 609, MUSORSTOM 8 stns 959, 977, and 1011.

**DISTRIBUTION.** — Wallis and Futuna region: Wallis; Waterwitch Bank; 430-650 m. Vanuatu region: Anatom, Tanna, Erromango, Efaté, Malakula, and Espiritu Santo; 366-622 m. Elsewhere: Banda Sea (recorded herein); Funafuti; 323-366 m.

*Trochocyathus (T.) rhombocolumna* Alcock, 1902

*Trochocyathus rhombocolumna* Alcock, v\*1902a: 98; v.1902c: 16, pl. 2, fig. 12. — CAIRNS, 1995: 60-61, pl. 13, fig. 1, pl. 14, figs a-b, map 19 (synonymy). — CAIRNS & ZIBROWIUS, 1997: 106-107.  
*Paracyathus tenuicalyx* Vaughan, v\*1907: 69-70, pl. 6, figs 1a-b.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 977, 1 (MNHN). — Stn 1060, 1 (USNM 98631).

TYPE LOCALITY. — "Siboga" stn 95: 5°43.5'N, 119°40'E (Sulu Sea), 522 m.

REMARKS. — This relatively commonly collected species is distinguished by having a transversely ridged theca (basally); hexamerally symmetrical septa ( $S_1 > S_2 > S_4 > S_3$ ); three size classes of pali, the  $P_{2-3}$  of each system arranged in a distinctive chevron pattern; and robust columellar elements. It is more fully described and illustrated by CAIRNS (1995).

DISTRIBUTION. — Vanuatu region: Tanna and Malakula; 397-410 m. Elsewhere: Indo-West Pacific from southwestern Indian Ocean to Hawaiian Islands; 110-530 m (CAIRNS & ZIBROWIUS, 1997).

*Trochocyathus (T.) philippinensis* Semper, 1872

*Trochocyathus philippinensis* Semper, v\*1872: 253, pl. 20, fig. 16. — CAIRNS & ZIBROWIUS, 1997: 107-108, figs 10 d-e. — CAIRNS, 1998: 380.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 496, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 969, 2 (MNHN). — Stn 976, 23 (USNM 98678). — Stn 1070, 1 (MNHN). — Stn 1071, 1 (MNHN). — Stn 1086, 2 (MNHN).

TYPE LOCALITY. — Pandanon, Philippines, 27-54 m.

REMARKS. — *Trochocyathus philippinensis* is characterized as having a small straight, ceratoid corallum; a porcellaneous theca that is pigmented chocolate-brown near the calicular edge; and a hexamerall symmetry of  $S_{1-2} > S_{3-4}$ . Some specimens have several thecal edge spines or slightly more prominent edge costae. The species was more fully described and illustrated by CAIRNS & ZIBROWIUS (1997).

DISTRIBUTION. — Wallis and Futuna region: Futuna; 250-330 m. Vanuatu region: Anatom, Tanna, Espiritu Santo, and Malakula; 182-252 m. Elsewhere: Ryukyu Islands; South China Sea; Philippines; Indonesia; northwestern Australia; 54-268 m (CAIRNS & ZIBROWIUS, 1997).

*Trochocyathus (T.) maculatus* Cairns, 1995

*Trochocyathus maculatus* Cairns, \*1995: 61, pl. 14, figs c-d. — CAIRNS & ZIBROWIUS, 1997: 107.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 499, 2 (USNM 98641). — Stn 504, 11 (MNHN). — Stn 505, 1 (MNHN). — Stn 508, 3 (MNHN). — Stn 509, 3 (USNM 98639). — Stn 524, 4 (USNM 98640). — Stn 546, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 961, 1 (MNHN). — Stn 1021, 2 (MNHN). — Stn 1047, 1 (MNHN). — Stn 1077, 1 (MNHN).

TYPE LOCALITY. — NZOI stn P115: 31°25.9'S, 159°02.2'E (Lord Howe Island), 183 m.

REMARKS. — This species is distinguished from other *Trochocyathus* by having distinctively speckled (brown-black) theca and septa, and by having exothecal dissepiments that cover raised costae around its base, similar to the morphology of *Rhizosmilia*. It was fully described and figured by CAIRNS (1995).

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Combe Bank; 240-550 m. Vanuatu region: Anatom, Efaté, Epi, and Malakula; 110-486 m. Elsewhere: Philippines; Kermadec Islands; Lord Howe Islands; seamounts off eastern Australia; 92-183 m.

*Trochocyathus (T.) efateensis* sp. nov.

Figs 8 d-e

MATERIAL EXAMINED/TYPES. — Vanuatu. MUSORSTOM 8: stn 1019, 25: holotype and 19 paratypes (MNHN), 5 paratypes (USNM 98642). — Stn 1020, 1 paratype (MNHN). — Stn 1026, 1 paratype (MNHN).

TYPE LOCALITY. — MUSORSTOM 8 stn 1019: 17°38'S, 168°34'E (Efaté), 397-430 m.

ETYMOLOGY. — Although this species is not thought to be endemic to Efaté, it is named for the island of its type locality.

DESCRIPTION. — Corallum straight, elongate-conical, having a slightly flared calice, and attached through a slender (PD:GCD = 0.29-0.42), but solid, pedicel. Pedicel reinforced with layers of textura, which are usually subsequently encrusted by epizoid organisms. Calice strongly elliptical (GCD:LCD = 1.21-2.00), small coralla being closer to circular, larger coralla becoming more elongate, sometimes slightly constricted medially. The constriction is accentuated by an upward arching of the calicular edges as viewed from the side. Holotype 16.7 x 11.2 mm in CD, 5.7 mm in PD, and 21.6 mm in height; largest specimen (MUSORSTOM 8 stn 1028) 17.3 x 13.6 mm in CD. Costae broad, equal in width, and inconspicuous, covered with low, rounded granules. Corallum uniformly white.

Septa hexamerally arranged in 5 cycles, the fifth cycle never complete ( $S_{1-2} > S_3 > S_4 > S_5$ ). One specimen (MUSORSTOM 8 stn 1019) of 13.4 mm GCD contains only 4 cycles of septa (48), but all other coralla have between 1 and 10 pairs of  $S_5$ , resulting in 50-68 septa. The holotype contains 68 septa. Order of insertion of  $S_5$  pairs quite irregular, but  $S_5$  pairs tend to be more common in end systems; some systems may contain 3 pairs of  $S_5$  and other systems within the same corallum no  $S_5$ . All septa equally exsert (1.3-1.5 mm), having straight axial edges.  $S_{1-2}$  quite thick: 0.8-1.1 mm at their widest upper edges. The remaining three size classes of septa are less thick and progressively less wide, the  $S_5$  being about half the width of an  $S_{1-2}$ . All pali have straight, thin axial edges that border the columella, and broad, ridged peripheral edges that are separated from their corresponding septa by narrow slits. Distal edges of all pali bluntly pointed, not evenly rounded as in most species of the genus. The 12 slender (0.8 mm wide)  $P_{1-2}$  form an elliptical crown around the columella. The 12  $P_3$  are about twice the width and rise higher in the fossa than the  $P_{1-2}$ , but, since their axial edges are in the same position relative to the columella as those of the  $P_{1-2}$ , the  $P_3$  contribute to the same palar crown.  $P_4$  present only when pairs of  $S_5$  occur, these pali about the same width of a  $P_{1-2}$ , but recessed farther from the columella and positioned higher in the fossa. Fossa of moderate depth. Columella papillose, composed of 9-20 robust, irregularly-shaped, granular elements, in some coralla rhomboidal in cross section.

REMARKS. — Of the 29 Recent species in the nominate subgenus of *Trochocyathus*, *T. efateensis* is most similar to *T. caryophylloides* Alcock, 1902. Although both species may have 64 septa, *T. caryophylloides* achieves it by having 16 sectors (three size classes of septa and two size classes of pali), whereas *T. efateensis* retains a hexamerall symmetry and has four size classes of septa and three size classes of pali. *T. efateensis* is further differentiated by its thick  $S_{1-2}$ , equally exsert septa, highly elliptical calice, and arched upper thecal faces.

DISTRIBUTION. — Vanuatu region: Efaté; 391-437 m.

*Trochocyathus (T.) patelliformis* sp. nov.

Figs 8 g, 9 a-c

MATERIAL EXAMINED/TYPES. — Vanuatu. MUSORSTOM 8: stn 1111, 1 paratype (MNHN). Hawaiian Islands. HURL: stn P5-063, holotype (USNM 83026).

TYPE LOCALITY. — HURL stn P5-063: 20°35.8'N, 156°03.5'W (Alenuihaha Channel, Hawaiian Is.), 1020 m.

ETYMOLOGY. — The species name *patelliformis* (Latin *patella*, small pan + *forma*, shape) refers to the patelliform shape of the corallum, which in Scleractinia includes those species having a basal angle of 80°-160°.

DESCRIPTION. — Corallum short and patellate, the thecal edges diverging at about 120° from a massive basal attachment. Holotype 22.7 x 19.2 mm in CD, 9.0 mm in pedal attachment, and only 11.0 mm in height. Smaller paratype 10.9 mm in GCD. Costae well defined, rounded, and covered with fine, spiny granules. Intercostal grooves equal in width to costae on lower corallum, becoming wider and deeper near calicular edge. Corallum uniformly white.

Septa hexamerally arranged in 5 cycles, the fifth cycle incomplete ( $S_{1-2} > S_3 > S_4 > S_5$ ). The holotype contains 12 pairs of irregularly inserted  $S_5$ ; 5 half-systems having 2 pairs of  $S_5$ , 5 having no  $S_5$ , and 2 half-systems having 1 pair of  $S_5$ , for a total of 72 septa. The smaller paratype contains 8 pairs of incipient  $S_5$ , also irregularly distributed, or 64 septa.  $S_{1-2}$  highly exsert (up to 3.7 mm), having straight axial edges and granular faces.  $S_3$  less exsert (about 3.3 mm) and  $3/4$  width of  $S_{1-2}$ .  $S_4$  less exsert (about 2.7 mm) but almost as wide as the  $S_3$ .  $S_5$  about 1.3 mm exsert and  $3/4$  width of an  $S_4$ . Two size classes and 4 crowns of pali occur in the holotype. The 6  $S_1$  are quite large (2.2 mm wide), each having a straight axial edge that abuts the columella, but a moderately sinuous peripheral edge, separated from its corresponding septum by a small notch. Remaining pali ( $P_2$ - $P_4$ ) all about 1.7 mm wide, each cycle progressively more recessed from the columella and rising slightly higher in the fossa. Fossa shallow. Columella composed of several finely granulated massive papillae that are fused into an irregular, elongate mass.

REMARKS. — *Trochocyathus patelliformis* is unique among the approximately 29 Recent, valid species in the genus in having a patellate-shaped corallum, in having  $P_1$  that are significantly broader than the higher cycle pali, and in having finely spinose costae. The Hawaiian holotype was diagnosed as a potentially new species shortly after its collection in 1988 but put aside until more specimens might be collected. The Vanuatu paratype, while apparently a juvenile corallum, was collected from a similar depth range and is morphologically consistent with the holotype.

DISTRIBUTION. — Vanuatu region: Espiritu Santo; 1210-1250 m. Elsewhere: Hawaiian Islands; 1010 m.

#### *Trochocyathus (T.) semperi* Cairns & Zibrowius, 1997

*Trochocyathus (T.) semperi* Cairns & Zibrowius, \*1997: 108-109, figs 10g-h, 11f.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1103, 1 (MNHN).

TYPE LOCALITY. — CORINDON 2 stn 251: 0°53.7'S, 119°29.6'E (Makassar Strait), 65 m.

REMARKS. — This recently described species is distinguished from all others in the genus by having spatulate edge spines and decamerall septal symmetry (10:10:20, 40 septa).

DISTRIBUTION. — Vanuatu region: Espiritu Santo; 163-165 m. Elsewhere: Philippines; Indonesia; 38-245 m (CAIRNS & ZIBROWIUS, 1997).

#### *Trochocyathus (T.) cooperi* (Gardiner, 1905)

*Tropidocyathus cooperi* Gardiner, \*1905: 955, pl. 93, fig. 30.

*Trochocyathus cooperi* - CAIRNS, 1994: 54, pl. 23, figs f-g. — CAIRNS & ZIBROWIUS, 1997: 111, fig. 11e (synonymy).

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 961, 1 (MNHN). — Stn 1021, 1 (MNHN).

TYPE LOCALITY. — Kolumadulu and Suvadiva, Maldives Islands, 64-70 m.

REMARKS. — This is a very distinctive species, characterised by having transverse division, thecal edge crests, and usually a brown mottled pigmentation at the calicular edge. It is more fully described and illustrated by CAIRNS (1994).

DISTRIBUTION. — Vanuatu region: Anatom and Efaté; 101-124 m. Elsewhere: widespread from Maldivé Islands to northern Ryukyu Islands and the Marquesas; 25-100 m (CAIRNS & ZIBROWIUS, 1997).

*Trochocyathus (T.) discus* Cairns & Zibrowius, 1997

Figs 9 d-e, 18 a

*Trochocyathus (T.) discus* Cairns & Zibrowius, \*1997: 112, figs 11 g-h, 12 a-c.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: 539, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 958, 1 (MNHN). — Stn 1088, 3 cemented to a *Xenophora* gastropod shell (MNHN). — Stn 1089, 1 (MNHN). — Stn 1090, 1 (USNM 98643).

TYPE LOCALITY. — KARUBAR stn 3: 5°48'S, 132°12'E (Kai Islands, Banda Sea), 278-300 m.

REMARKS. — Little can be added to the original description except to note that the corallum from MUSORSTOM 8 stn 1089 (Figs 9 d-e) is the largest yet recorded: 11.3 x 9.3 mm in CD and 7.9 mm in height. The species is characterised by having a discoidal to bowl-shaped corallum; a flat base, the result of transverse division; four cycles of septa, the S<sub>4</sub> adjacent to the S<sub>1</sub> being wider than the S<sub>3</sub>; and having a reddish-brown pigment to the calicular edge.

DISTRIBUTION. — Wallis and Futuna region; Combe Bank; 700 m. Vanuatu region: Anatom and Espiritu Santo; 455-497. Elsewhere: Banda Sea; 240-278 m (CAIRNS & ZIBROWIUS, 1997).

Subgenus *TROCHOCYATHUS (APLOCYATHUS)* d'Orbigny, 1849

*Trochocyathus (A.) hastatus* Bourne, 1903

*Trochocyathus hastatus* Bourne, v\*1903: 29-32 (in part: pl. 5, figs 2-3; not pl. 6, figs 8-11, = *Bourneotrochus stellulatus* Cairns, \*1984). — CAIRNS, 1995: 63-64, pl. 15, figs c-h, map 21.  
*Stephanocyathus (Acinocyathus) hastatus* - WELLS, v.1984: 213.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 523, 1 (MNHN). — Stn 555, 1 (MNHN). — Stn 586, 1 (MNHN). — Stn 618, 1 (MNHN). — Stn 619, 2 (MNHN).

Vanuatu. MUSORSTOM 8: stn 959, 7 (MNHN). — Stn 963, 3 (USNM 98645). — Stn 977, 2 (USNM 98646). — Stn 1019, 2 (USNM 98644). — Stn 1020, 1 (MNHN).

TYPE LOCALITY. — Tutanga, Funafuti, Tuvalu, 366 m.

REMARKS. — *Trochocyathus hastatus* is compared to the other two Recent species in the subgenus in Table 5, and was redescribed and illustrated by CAIRNS (1995). It is easily distinguished from congenics by having hexamerl septal symmetry but only 5 costal spines. CAIRNS (1995) noted that the S<sub>1</sub> unaccompanied by a costal spine was always significantly smaller than the other S<sub>1</sub>; however, both this septum and the opposing principal S<sub>1</sub> (opposite to the first) are equally small, the 4 other lateral S<sub>1</sub> being significantly wider and more exsert.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Alofi; Tuscarora Bank; 435-540 m. Vanuatu region: Anatom and Efaté; 391-436 m. Elsewhere: Kermadec Islands; Funafuti; 366-710 m (CAIRNS, 1995).