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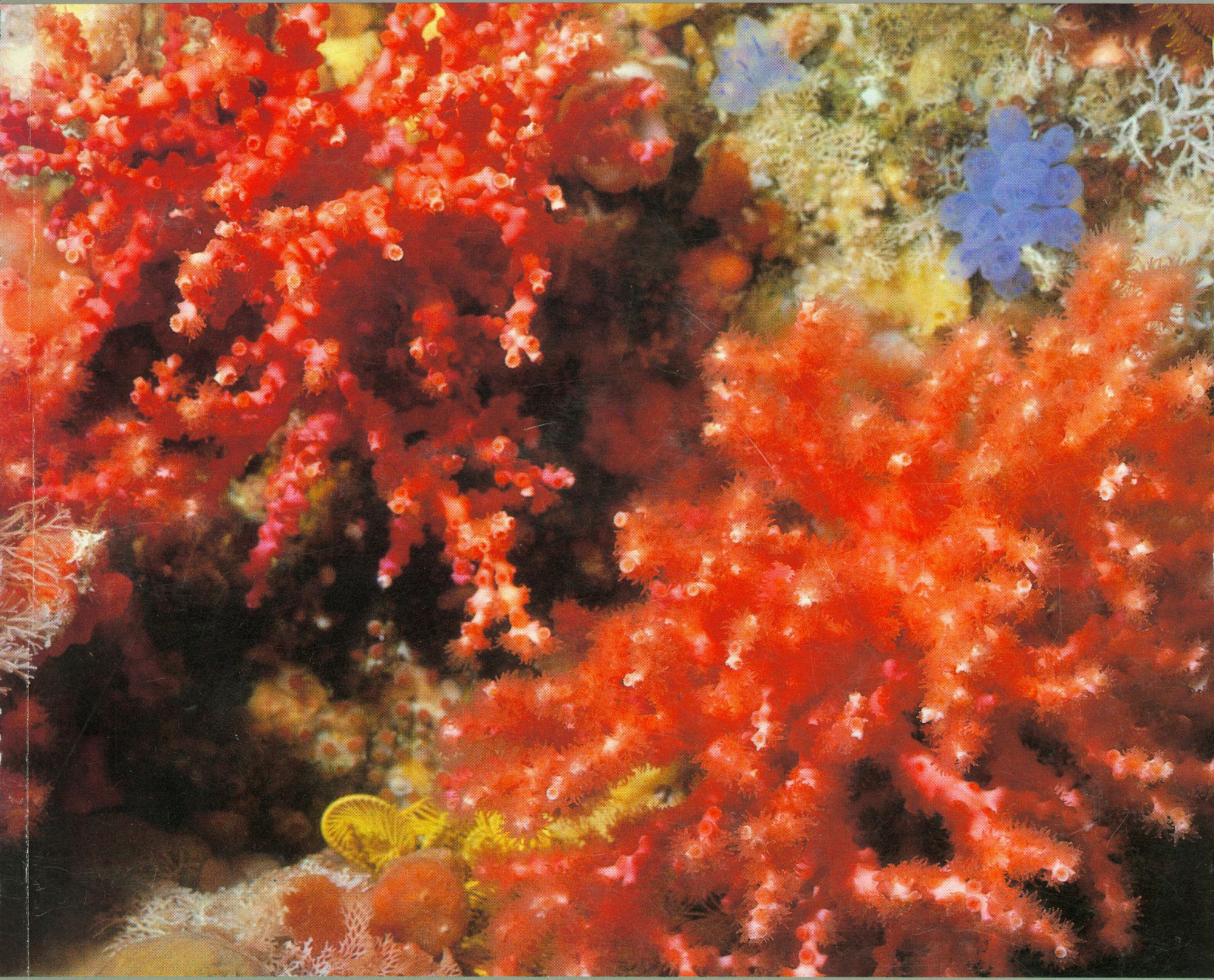

The Marine Fauna of New Zealand:

Scleractinia (Cnidaria : Anthozoa)

Stephen D. Cairns

New Zealand Oceanographic Institute Memoir 103

FRONTISPIECE:
Top left: Habitat of *Oculina virgosa* Squires, Three Kings Islands. Photo: Roger V. Grace
Top right: *Monomyces rubrum* (Quoy & Gaimard), Poor Knights Islands. Photo: Linda Grace
Bottom: *Culicia rubeola* (Quoy & Gaimard), Mimiwhangata. Photo: Roger V. Grace

COVER PHOTO: *Oculina virgosa* Squires, Three Kings Islands. Photo: Roger V. Grace.

NATIONAL INSTITUTE OF
WATER AND ATMOSPHERIC RESEARCH (NIWA)

The Marine Fauna of New Zealand: Scleractinia (Cnidaria : Anthozoa)

by

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Washington, D.C.

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"The living coral fauna of New Zealand is of the poorest kind as far as we know it. One species of *Flabellum* and one or two *Astrangiaceae* are all that are known."
(Tenison-Woods 1880: 1–2)

"The scleractinian corals of New Zealand have received so little attention that they have remained one of the larger unknown quantities of modern coral faunas."
(Ralph & Squires 1962: 1)

The Marine Fauna of New Zealand: Scleractinia (Cnidaria : Anthozoa)

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ABSTRACT

A total of 105 species of azooxanthellate Scleractinia are reported from the New Zealand region, defined as 24° to 57°30'S and 157°E to 167°W. Three new genera (*Pedicellocyathus, Temnotrochus, Falcatoflabellum*), 21 new species, and one new subspecies are described, and 71 new records for this region are reported. This revision is based on an examination of previously unexamined corals from approximately 804 stations, derived primarily from the collections of the New Zealand Oceanographic Institute and the Museum of New Zealand.

The New Zealand azooxanthellate Scleractinia are primarily (57%) tropical Indo-West Pacific in affinity, the species having varying degrees of southward extension into the region; 33°S is the southern limit for many species and is chosen herein to be the southern limit of the tropical/subtropical azooxanthellate province. There also appears to be a small, relatively shallow-water, warm-temperate (Auckland Province) group of endemic species; a group that is restricted to cold-temperate latitudes; and one species, *Flabellum impensum,* that has its northern limit in the New Zealand region in an otherwise Antarctic distribution. Six azooxanthellate species are reported from off Lord Howe Island, 18 from off Norfolk Island, and 10 from the Colville Ridge, all three regions containing primarily tropical and eurythermic tropical species. Most (82%) of the 56 azooxanthellate species known from off the Kermadec Islands are also tropical or eurythermic tropical; the remaining 10 species are found in warm- to cold-temperate regions to the south. Although 41 of the 105 species occur at shelf depths (0–200 m), most (80%) of the New Zealand azooxanthellate Scleractinia occur on the upper slope (200–1000 m), the deepest record being that of *Fungiacyathus marenzelleri* at 4954 m.

Keywords: Scleractinia, classification, distribution, new species, new genera, marine fauna, New Zealand, zoogeography.

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INTRODUCTION

Despite the impression given in the epigraph of a sparse and poorly known coral fauna, the New Zealand region fauna is now known to be quite a diverse one with at least 105 azooxanthellate species, which includes about 15% of the known azooxanthellate species worldwide. The paucity of shallow-water corals off New Zealand led to the statement (*see* Epigraph) of Tenison-Woods (1880) that corals are rare off New Zealand, but azooxanthellate corals abound in deeper waters, especially the upper slope, a fact only gradually revealed by deep-sea exploration: viz. *Gazelle* (Studer 1878); *Challenger* (Moseley 1881); *Terra Nova* (Gardiner 1929); and *Discovery* (Gardiner 1939) expeditions.

Only the azooxanthellate Scleractinia of the New Zealand region are discussed in this account, i.e., those species that lack algal symbionts. Being ecologically defined, the azooxanthellate corals are a polyphyletic group occurring in four of the five scleractinian suborders, but include all of the species that occur off New Zealand; however, the zooxanthellate (hermatypic or reef) corals that occur in the northern New Zealand region off Lord Howe, Norfolk, and the Kermadec Islands are not included in this account.

Azooxanthellate Scleractinia occur from the Arctic Circle to off continental Antarctica, and, although often referred to as "deep-water corals", occur from 0–6328 m, being commonest on the upper slope (200–1000 m). Scleractinia are exclusively sessile, benthic organisms, with an aragonitic calcium carbonate corallum that is usually white, but may be mottled or streaked with black, brown, or pink pigment. Most azooxanthellate corals are solitary in growth mode (e.g., 83% of New Zealand species), but colonial azooxanthellate species also occur, both in shallow and deep water.

Previous Studies

Squires (1958), Ralph and Squires (1962), and Squires and Keyes (1967) all presented brief historical resumés of scleractinian species and their distribution in the New Zealand region. Table 1 also briefly summarises all reports of scleractinian corals from this region, including first occurrences of all species, senior synonyms, and, in some cases, names of the vessels from which the specimens were collected. Only the significant publications are discussed below, and those requiring clarification.

Not surprisingly, the first two species of Scleractinia reported from the New Zealand region were the common, colourful, shallow-water *Monomyces rubrum* and *Culicia rubeola* by Quoy and Gaimard (1833).

Milne Edwards and Haime (1848b) reported three species of *Coenopsammia* from "Nouvelle-Zélande (Quoy et Gaimard)": *C. coccinea*, *C. gaimardi*, and *C. urvillii*, which, according to Wells (1983), are all synonyms of *Tubastraea coccinea* Lesson, 1829. These records were perpetuated by Milne Edwards and Haime (1857) and Duncan (1870), but not by Hutton (1904) in his list of corals known from New Zealand. In a revealing paragraph, Tenison Woods (1878: 340) cited Captain Hutton, "the well known naturalist at Dunedin", as saying that these three species did not occur off New Zealand. Tenison Woods went on to say that many of the specimens collected by the *Astrolabe* were mixed and that "many tropical corals quoted by Messrs. Quoy and Gaimard as from Australia and New Zealand, really came from the Pacific Islands within the tropics. Certain it is that very few of the Australian or New Zealand habitats can be verified." Later, Squires (1958) and Ralph and Squires (1962) listed these records as erroneous for the New Zealand region. In fact, *Tubastraea* had never been collected subsequent to the 1848 report until Squires (1960b) reported *T. aurea* (another junior synonym of *T. coccinea*) from the Norfolk Island cable. But even this record is false — the two specimens in question have well-developed Pourtalès Plans and thus are more consistent with the genus *Cladopsammia* than *Tubastraea,* although the species identity is unknown.

Six species (Table 1) were added to the inventory of New Zealand corals by three dredge stations of the *Terra Nova,* as reported by Gardiner (1929). Not all of these records were originally identified to species level, but examination of Gardiner's specimens (now deposited at The Natural History Museum, London, formerly the BM(NH), British Museum (Natural History)) confirm the identification of six well-known species for this region.

In his thorough revision of the fossil corals of

Table 1. Chronology of knowledge of recent azooxanthellate Scleractinia of the New Zealand region (* denotes a significant paper).

*1833	Quoy & Gaimard	*Astrolabe*: first records of *Turbinolia (= Monomyces) rubra* n. sp. and *Dendrophyllia (= Culicia) rubeola* n.sp.
1848b	Milne Edwards & Haime	Erroneous reports of three species of *Coenopsammia (= Tubastraea)* from New Zealand.
1849	Milne Edwards & Haime	*Culicia smithii* n.sp. from New Zealand (doubtful record).
1862	Holdsworth	*Flabellum nobile* n.sp. (= *Monomyces rubrum*) from New Zealand.
1870	Duncan	Uncritical listing of 7 recent species from New Zealand.
1876	Duncan	*Conocyathus zelandiae* n.sp. from Cook Strait; not since recollected off New Zealand, but known elsewhere.
1878	Studer	S.M.S. *Gazelle*: *Flabellum latum* n. sp. and *F. gracile* n.sp. (both considered to be forms of *Monomyces rubrum*).
1879	Tenison Woods	*Cylicia huttoni* n. sp. (= *Culicia rubeola*) and *C. vacua* n.sp. (= *Monomyces rubrum*) from off New Zealand.
1881	Moseley	H.M.S. *Challenger*: dubious record of *Caryophyllia maculata (= Rhizosmilia maculata)* and *C. lamellifera* n.sp. from off the Kermadec Islands.
1904	Hutton	Uncritical list of 8 recent and 1 fossil species from New Zealand.
1906	Dennant	*Kionotrochus suteri* n. sp. from off Great Barrier Island.
*1929	Gardiner	*Terra Nova*: Seven deep-water species reported off Three Kings Islands: *Flabellum harmeri* n.sp (= *Monomyces rubrum*); *Gardineria* sp. (= *Crispatotrochus curvatus*); *Desmophyllum cristagalli (= D. dianthus); Caryophyllia profunda; Trochocyathus* sp. (= *Tethocyathus cylindraceus*); *Thecopsammia* sp. (= *Balanophyllia chnous*); and *Dendrophyllia (= Eguchipsammia) japonica*.
1937	Wells	Additional record of *Kionotrochus suteri* from Cuvier Island.
1939	Gardiner	*Discovery*: *Deltocyathus lens (= Peponocyathus dawsoni)* and *Sphenotrochus intermedius (= S. squiresi)* from off New Zealand.
1947	Powell	Two species listed in "Native Animals of New Zealand".
1948	Ralph	Additional records of *Caryophyllia profunda* and *Flabellum rugulosum (= Monomyces rubrum)*.
*1958	Squires	Uncritical listing of all recent corals reported from New Zealand coasts.
1958	Wells	*Stephanophyllia formosissima (= Letepsammia fissilis)* from off New Zealand.
1960a	Squires	Additional notes on *Kionotrochus suteri*, endemic to New Zealand.
1960b	Squires	First record of *Goniocorella dumosa* from New Zealand (off Norfolk Island).
1960c	Squires	Notes on fossil and Recent *Culicia rubeola*.
1962	Ralph & Squires	Five new records: *Oculina virgosa; Sphenotrochus* sp. B (= *S. ralphae*); *Stenocyathus decamera* n.sp. (= *S. vermiformis*); *Flabellum deludens (= F. apertum)*; and *F. knoxi* n.sp.
*1963	Squires	Monograph of *Flabellum (= Monomyces) rubrum*.
1964a	Squires	Additional records of *Caryophyllia profunda, Goniocorella dumosa*, and *Flabellum knoxi* from off Chatham Islands.
1964b	Squires	Seven species reported off northeastern New Zealand, including new records of: *Ceratotrochus (= Labyrinthocyathus) limatulus* n.sp. and *Flabellum aotearoa*.
1965	Squires	Deep-water coral coppices reported from Campbell Plateau and Chatham Rise.
1965	Squires & Ralph	New records of *Flabellum lowekeyesi* n.sp. and *Stephanocyathus* sp. (= *S. platypus*).
*1967	Squires & Keyes	NZOI: New records of *Madrepora vitiae (= M. oculata), Dendrophyllia palita* n.sp. (= *D. alcocki*), and *Notocyathus orientalis (= Peponocyathus dawsoni)*.
1968	Morton & Miller	Colour illustrations of *Culicia rubeola* and *Flabellum (= Monomyces) rubrum*.
1969	Squires	Nine species mapped and discussed from the New Zealand region, including new records of *Solenosmilia variabilis* and *Flabellum impensum*.

1974c	Zibrowius	Notes on *Dendrophyllia palita (= D. alcocki).*
1976	Grace & Grace	*Culicia rubeola* and *Flabellum (= Monomyces) rubrum* off Great Mercury Island.
1982	Brook *et al.*	*Sphenotrochus ralphae* off Rakitu Island.
1982	Brook	Four shallow-water species off Rakitu Island.
*1982	Cairns	R.V. *Eltanin*: 13 species reported from Subantarctic New Zealand, including 4 new records: *Aulocyathus recidivus, Enallopsammia marenzelleri, E. rostrata,* and *Fungiacyathus fragilis.*
1984	Hayward *et al.*	*Sphenotrochus ralphae* off Chickens Islands.
1985	Hayward *et al.*	Three shallow-water species off Broken Islands.
1988	Cairns	Notes on *Kionotrochus suteri.*
1989a	Cairns	*Javania* sp. (= *J. pachytheca*) and *Truncatoguynia* sp. (= *T. irregularis*) reported from off Kermadec Islands.
1992	Stolarski	Notes on *Kionotrochus suteri.*

New Zealand, Squires (1958) also listed all previous records of recent Scleractinia in an appendix, listing 26 taxa, 18 of which he considered valid. No new records of recent Scleractinia were included in his paper, but he did provide a brief history of recent corals known from New Zealand waters. Except for an addendum by Squires (1962a), the fossil corals have not been subsequently revised and thus Squires' (1958) revision serves as the fossil counterpart to this paper.

The revision of the extant scleractinian corals of New Zealand by Ralph and Squires (1962) was the first of two revisions of the recent corals of this region. They included three new species and five new records for the region (*see* Table 1). Their material drew from many sources, most now deposited at the Auckland Institute and Museum, and some at the Museum of New Zealand (MoNZ).

Although it deals with only one species, Squires' (1963) monograph of the New Zealand endemic *Flabellum (=Monomyces) rubrum* is a classic for the New Zealand region, including an extensive, annotated synonymy; a description of morphological variation of corallum and polyp; and a discussion of its ecology, distribution, and fossil record.

The second major revision of the scleractinian fauna of the New Zealand region was that of Squires and Keyes (1967), who based their paper primarily on the NZOI collections (station series A–C). They reported, illustrated, and keyed 25 recent species and discussed three other records that they considered of doubtful authenticity: *Trochocyathus* sp. of Gardiner (1929); *Gardineria* sp. of Gardiner (1929); and *Conocyathus zelandiae* Duncan, 1876. Of this number, three were new species, and three were new records for the region (*see* Table 1), *F. raukawaensis* n. sp. having previously been reported as *F. deludens* by Ralph and Squires (1962). Most of their specimens are deposited at NZOI but some are at MoNZ.

In a revision of the Antarctic and Subantarctic fauna, I reported 13 species from Subantarctic New Zealand waters, including four new records for the region (Cairns 1982) .

A tabulation of all species previously reported from the New Zealand region (Table 2) yields 34 species of azooxanthellate Scleractinia. Seventy-one additional species are included herein, resulting in a total of 105 species for this region.

Table 2. Distribution patterns and depth ranges of New Zealand azooxanthellate Scleractinia.

Species	TROPICAL 1	WARM TEMPERATE 2	Cold Temperate 3	4	5	6	7	SUBANTARCTIC 8	Elsewhere	PATTERN OF DISTRIBUTION	Depth (m) in the region
Fungiacyathus (F.) stephanus	K	x	x						Indo-West Pacific	1C	1442–1705
F. (F.) fragilis		x	x					x	N. Atlantic, C. Pacific	1D	1029–1693
F. (F.) pusillus pacificus	NTC									2C	350–988
F. (B.) marenzelleri		x	x						Cosmopolitan	1C	1760–4954
F. (B.) margaretae	C									2C	635–673
F. (B.) turbinolioides		x							W. Pacific	1B	600–751
Letepsammia superstes	K								Japan	3B	200–710
L. fissilis		x								2A	106–206
L. formosissima	NK								Indo-West Pacific	1A	290–378
Stephanophyllia complicata	NT	x							Indo-West Pacific	1A	319–1137
Culicia rubeola		x	x							2D	0–82
Oculina virgosa		x								2A	29–388
Madrepora oculata	TK	x	x					x	Cosmopolitan	1D	*149–946
Anthemiphyllia dentata	NTK								Indo-West Pacific	1A	280–570
Caryophyllia (C.) rugosa	LNK								Indo-West Pacific	1A	142-508
C. (C.) hawaiiensis	LNK								C. and W. Pacific	1A	126-279
C. (C.) quadragenaria		x	x			x			W. Pacific	1D	77-198
C. (C.) profunda		x	x	x		x		x	S. Indian Ocean	3A	*20-1300
C. (C.) atlantica	T			x		x	x		E. Atlantic, W. Pacific	1D	1004-1474
C. (C.) ralphae	L								Chesterfield Is.	2C	315-360
C. (C.) diomedeae	CK	x	x			x			Widespread	1C	660-1200
C. (C.) japonica		x	x	x			x		NW Pacific	3B	106-946
C. (C.) lamellifera	LNK								?SW Indian Ocean	2C	89-1152
C. (C.) elongata	TK	x							Indo-West Pacific	1B	165-590
C. (C.) scobinosa	LC								Indo-West Pacific	1A	784-1276
C. (C.) ambrosia	C	x	x						Widespread	1C	701-1180
C. (P.) compressa	K	x							Off Japan	3B	402-757
Coenocyathus brooki	K									2C	7-95
Crispatotrochus curvatus		x	x							2D	1373-2505
C. rugosa	LK									2C	142-508
Labyrinthocyathus limatulus	LNK	x								2B	20-508
L. sp.			x		x					2E	665-1000
Polycyathus norfolkensis	N									2C	10-20
Trochocyathus rhombo-columna	LTK								Indo-West Pacific	1A	419-530
T. maculatus	LK									2C	100-183
T. gordoni	K									2C	398-710
T. cepulla	NK								New Caledonia	2C	398-449
T. hastatus	K								Tuvalu	1A	460-710
Tethocyathus cylindraceus		x	?						W. Atlantic	1B	5-327

Species	TROPICAL	WARM TEMPERATE	Cold Temperate					SUBANTARCTIC	Elsewhere	PATTERN OF DISTRIBUTION	Depth (m) in the region
	1	2	3	4	5	6	7	8			
T. virgatus	TCK								W. Pacific	1A	142-530
Stephanocyathus (S.) platypus		x	x	x			x		Temp. SW Pacific	3A	561-1168
S. (A.) spiniger	LNK	x							Indo-West Pacific	1B	174-590
S. (O.) weberianus	L								W. Pacific	1A	1045
S. (O.) coronatus	NTC								W. Atlantic	1A	646-1276
Vaughnella oreophila	NC								W. Pacific	1A	646-757
V. multipalifera	K	x								2B	1357-1450
Bourneotrochus stellulatus	LNK								W. Pacific	1A	326-710
Deltocyathus ornatus	N								W. Pacific	1A	280-390
D. formosus	NK									2C	142-565
Conotrochus brunneus	LTK								Indo-West Pacific	1A	486-1051
Aulocyathus recidivus	TK	x	x		x			x	Temp. Indo-West Pacific	3B	245-1137
Dasmosmilia lymani		x							Atlantic	1B	633-1002
Desmophyllum dianthus	NTK	x	x	x	x	x	x	x	Cosmopolitan	1D	25-1750
Thalamophyllia tenuescens	LK								W. Pacific	1A	200-315
Hoplangia durotrix		x							E. Atlantic	3B	7-110
Goniocorella dumosa	N	x	x	x		x	x		Indo-West Pacific	1D	88-1488
Anomocora cf.fecunda	NK	x							Central Pacific	1B	145-388
Solenosmilia variabilis	TK	x	x	x		x	x	x	Cosmopolitan	1D	509-1260
Conocyathus zelandiae			?						Indian Ocean, Australia	-	?
Alatotrochus rubescens	N								W. Pacific	1A	449-751
Sphenotrochus ralphae		x								2A	7-104
S. squiresi		x								2A	66-318
Kionotrochus suteri		x								2A	46-622
Cryptotrochus venustus	T								W. Pacific	1A	1137
Peponocyathus dawsoni	T	x	x	x		x				2D	87-988
Tropidocyathus pileus	N								Indo-West Pacific	1A	319
Notocyathus conicus	NK								W. Pacific	1A	402-710
Thrypticotrochus multilobatus	NK	x							Indo-West Pacific	1B	95-440
Pedicellocyathus keyesi		x								2A	70-194
Truncatoguynia irregularis	NK								W. Pacific	1A	133-248
Stenocyathus vermiformis	TK	x	x	x	x	x	x	x	Cosmopolitan	1D	*30-805
Temnotrochus kermadecensis	K									2C	366-402
Flabellum (F.) knoxi			x	x		x	x	x		2E	160-1167
F. (F.) angiostomum	NT								W. Australia	1A	540-640
F. (F.) impensum							x		Off Antarctica	4	1165-2100
F. (U.) lowekeyesi	LK	x	x	x		x	x		SWIndian Ocean, Tasmania	3A	381-1064
F. (U.) messum	K								Indo-West Pacific	1A	800–1035
F. (U.) aotearoa	LNK	x							Chesterfield Is	2B	130-565
F. (U.) hoffmeisteri	CK								Temp. SE Australia	3A	440–646
F. (U.) apertum apertum			x	x	x	x	x	x	Subantarctic	3A	322-1575

Species	TROPICAL 1	WARM TEMPERATE 2	Cold Temperate 3	Cold Temperate 4	Cold Temperate 5	Cold Temperate 6	Cold Temperate 7	SUBANTARCTIC 8	Elsewhere	PATTERN OF DISTRIBUTION	Depth (m) in the region
Monomyces rubrum		x	x							2D	
- typical form											0-201
- forma *nobile*											70-410
- forma *latum*											1-163
Polymyces wellsi	K	x	x						Pacific	1B	355-1165
Rhizotrochus flabelliformis	LNK	x							W. Pacific	1B	228-419
Gardineria hawaiiensis	NTK	x							W. Pacific	1B	142-602
G. sp.	LN								Chesterfield Is	2C	291-378
Javania lamprotichum	K								Central Pacific	1A	465-710
J. pachytheca	LK	x							Chesterfield Is	2B	360-1045
Truncatoflabellum pari-pavoninum	K								Indo-West Pacific	1A	1035-1450
T. dens	NK								W. Pacific	1A	320-555
T. phoenix	K								off Japan	3B	145-179
T. arcuatum		x								2B	350-364
Placotrochides scaphula			x						Indo-West Pacific	1C	665
Falcatoflabellum raoulensis	K									2C	366-402
Balanophyllia chnous		x								2A	140-549
B. gigas		x	x						W. Pacific	1C	148-640
B. crassitheca	LNK	x								2B	190-508
Endopachys grayi	NK	x							Indo-Pacific	1B	95-143
Eguchipsammia gaditana	NTK	x							Cosmopolitan	1B	57-988
E. fistula	K								Indo-West Pacific	1A	325
E. japonica	NTK	x	x	x					W. Pacific	1C	142-785
Cladopsammia eguchii	K								Pacific	1A	7
Dendrophyllia arbuscula	NK								W. Pacific	1A	202-259
D. alcocki	LNTK	x	x		x				Indo-West Pacific	1C	*118-570
Enallopsammia rostrata	NTCK	x	x	x			x	x	Cosmopolitan	1D	110-1276
E. cf. *marenzelleri*								x	Indo-West Pacific, NE Atlantic	1D	333-371
	76	52	31	14	6	12	12	11			

1 Tropical/Subtropical Region: Lord Howe Island and Seamount Chain (L); Norfolk Island and Ridge north of 33°S (N); Three Kings Ridge north of 33°S (T); Colville Ridge (C); Kermadec Islands and Ridge north of 33°S (K)
2 Warm Temperate Region: Auckland province
3 Cold Temperate Cookian Province: southern North Island and South Island
4 Cold Temperate Cookian Province: Chatham Islands and Chatham Rise
5 Cold Temperate Antipodean Province: Macquarie Ridge north of 50°S
6 Cold Temperate Antipodean Province: Campbell Plateau
7 Cold Temperate Antipodean Province: Bounty Plateau
8 Subantarctic Region: southern Macquarie Ridge south of 50°S and Hjort Seamount
* Shallow depths occur only in fiord localities

MATERIALS AND METHODS

Material

This study is based on the examination of previously unstudied material from eight institutional sources, herein listed in order of decreasing size of the contribution: NZOI* (a rich source of thousands of specimens from 557 stations primarily from the collections made using the R.V. *Tangaroa*, cruise series D–Z; MoNZ (numerous specimens from 118 stations from R.V. *Tangaroa* cruise series O, P, and R (1978–1981) and earlier collections made by the R.V. *Alert* (1957) and R.V. *Acheron* (1972–1978); AIM (several hundred specimens from throughout the New Zealand region, including collections of Fred Brook from Kermadec, Norfolk, and Three Kings Islands); AUM (deep-water corals from 24 New Zealand localities); AMS (deep-sea corals from nine stations of the R.V. *Franklin* from seamounts in the Tasman Sea and Lord Howe Seamount Chain); Institute of Geological and Nuclear Sciences (IGNS), formerly the N.Z. Geological Survey (NZGS) (15 lots of relatively shallow-water corals from coastal New Zealand); Portobello Marine Biological Station of the University of Otago (nine lots of deep-water corals from canyons off Dunedin); Otago University Department of Geology (three lots of deep-water coral). Based on these specimens, additional records of 103 of the 105 azooxanthellate New Zealand species are reported and illustrated. *Conocyathus zelandiae* has never been collected from New Zealand subsequent to its original description in 1876, but is described and illustrated based on Australian specimens. Likewise, *Enallopsammia marenzelleri* has not been recollected since it was reported from the Macquarie Ridge by Cairns (1982).

In addition to these unstudied collections, previously reported specimens from the following museums were re-examined: AIM (Squires 1960b, 1964b; Ralph & Squires 1962), AMS (Bourne 1903), BM(NH) (Duncan 1876; Moseley 1881; Gardiner 1929, 1939; Gardiner & Waugh 1938; Squires 1962b); MoNZ (Ralph & Squires 1962 (part); Squires & Ralph 1965 (part)); NZGS (Tenison Woods 1880; Squires 1958, 1965; Squires & Keyes 1967); USNM (Squires 1958 (part), 1964a (part), 1969; Squires & Ralph 1962 (part); Cairns 1982, 1988, 1989a); ZMA (Alcock 1902b, c); ZMB (Studer 1878). Type material of 78 of the 105 New Zealand species was examined, as well as the types of at least seven junior synonyms.

* For explanation of abbreviations, see p. 15

Methods

It was attempted to provide complete species synonymies, at least regarding records from the New Zealand region, but it is acknowledged that various checklists and smaller publications may have been overlooked. The original description and other significant references outside the New Zealand region are also included in the synonymies, the latter often being a key to the extended synonymy (chresonomy) (*sensu* Smith & Smith 1972) of the species. Efforts were made to examine as many types as possible and to verify as many of the previously published records as possible (*see* Material), but when specimens were unavailable for study and the published accounts unclear, the synonymic entries and corresponding distribution records are queried.

Most of the 105 species included in the revision are described or diagnosed, all but two based on new materal (*see* Material); however, if a species has recently been described and/or the new records do not add to a previous description, then only a reference to a complete description is given. Conventional scleractinian terminology is used in describing coralla (*see* Wells 1956; Cairns 1981, 1989a). One new term introduced in this paper is the **calicular lancet**, which is a group of three or more septa that project well beyond the calicular edge as rectangular or triangular apices, producing a serrate to lacerate calicular edge.

It is important to document which specimens were actually seen by the author of a systematic paper and where those specimens are deposited. Therefore, I have segregated the Material Examined sections into New Records and Previous Records: the former lists previously unreported specimens, the latter lists specimens that have been cited in previous publications. A third category is added some species named Reference Material, for specimens examined of closely related but not conspecific species. Each Material Examined section begins with a station number, followed by the number of specimens in the lot, and finally the catalogue number and/or museum of deposition.

A detailed map of the geographic range and a bathymetric range within the New Zealand region is given for most species, as well as its extended geographic and bathymetric ranges outside the region.

Holotypes and paratypes of all new species described herein are deposited at the USNM, NZOI, MoNZ, AMS, or AIM, as indicated in the text. An effort was made to list the museums of deposition and type localities for all senior and junior synonyms of all species.

The scanning electron photomicrographs were taken by the author on a Cambridge Stereoscan 100. In some cases in which specimens lacked sufficient contrast for conventional photography, the speci-men was dyed dark red and coated with a thin layer of sublimed ammonium chloride.

The following abbreviations are used in the text.

Museums

AIM Auckland Institute and Museum, Auckland (coral catalog numbers prefaced with "AK").

AMS Australian Museum, Sydney.

AUM Auckland University Museum, Geology Department; prefix for specimens held in that collection is AU.

BM(NH) British Museum (Natural History), London; now The Natural History Museum.

IGNS Institute of Geological and Nuclear Sciences

IOM Institute of Oceanology, Moscow.

MCZ Museum of Comparative Zoology, Harvard University, Cambridge.

MNHNP Muséum National d'Histoire Naturelle, Paris.

MNW Naturhistorisches Museum, Wien.

MoNZ Museum of New Zealand Te Papa Tonga-rewa (coral catalogue numbers pre-faced with "CO").

NMV National Museum of Victoria, Melbourne.

NZGS New Zealand Geological Survey (now Institute of Geological and Nuclear Sciences, IGNS).

NZOI New Zealand Oceanographic Institute, Wellington.

SAM South Australian Museum, Adelaide.

TIUS Institute of Geology and Paleontology, Tohoku (Imperial) University, Sendai, Japan.

USNM United States National Museum, Washington, DC; now the National Museum of Natural History.

ZMA Zoologische Museum, Amsterdam.

ZMB Zoologisches Museum, Berlin.

Other Abbreviations

GCD Greater calicular diameter of corallum.

GCD:LCD Ratio of greater calicular diameter to lesser calicular diameter of corallum.

D:H Ratio of diameter to height of corallum.

H:D Ratio of height to diameter of corallum.

LCD Lesser calicular diameter of corallum.

LEL:H Ratio of lateral edge length to height of corallum (*see* Cairns 1989b).

PD:GCD Ratio of pedicel diameter to greater calicular diameter.

SCI Septal concavity index: ratio of distance from thecal edge to point of greatest septal inflection to length of thecal face along that septum.

SSI Septal sinuosity index: ratio of amplitude of lower inner edge of a major septum to thickness of that septum (*see* Cairns 1989b).

Sx, Cx, Px, CSx Cycle of septa, costae, pali, or costosepta, respectively, designated by numerical subscript.

Sx > Sy In the context of a septal formula, septa of cycle x are wider than those of cycle y.

LIST OF STATIONS
NZOI (New Zealand Oceanographic Institute)

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
A502	41°30.0'	174°32.8'E	457	14.10.59
A904	44°15.2'	179°35.4'E	1108	12.9.63
A910	43°04.0'	178°39.0'W	549	13.9.63
B152	39°26.8'	176°56.7'W	4	25.7.57
B473	43°20.0'	169°47.0'E	215	3–4.6.61
B476	43°59.7'	168°17.2'E	144	4.6.61
B482	46°08.8'	166°06.0'E	88	5–6.6.61
B487	46°16.0'	166°03.0'E	196	6.6.61
B489	46°39.0'	166°09.5'E	198	7.6.61
B490	45°44.3'	166°44.8'E	148	8.6.61
B544	42°40.0'	173°39.0'E	128	4.10.62
B554	44°00.0'	172°58.2'E	81	6.10.62
B653	39°20.0'	173°42.0'E	79	23.10.62
B808	39°29.5'	173°48.0'E	55	18.3.63
C344	37°58.6'	174°34.4'E	55	26.10.59
C399	41°35.0'	174°45.7'E	468	3.5.60
C509	40°39.0'	177°03.5'E	201	20.6.60
C510	40°36.0'	177°02.0'E	384	"
C527	32°30.0'	179°12.0'W	508	18.9.60
C530	30°38.0'	178°31.0'W	183	19.9.60
C531	29°14.4'	178°02.0'W	179	"
C640	39°17.0'	171°53.0'E	364	28.5.61
C642	39°15.5'	171°52.5'E	354	"
C690	42°33.2'	173°33.8'E	119	18.6.61
C703	42°42.0'	173°37.8'E	184	19.6.61
C748	36°00.0'	173°32.2'E	135	16.2.62
C752	35°19.0'	172°57.5'E	131	17.2.62
C758	34°40.0'	172°14.5'E	203	"
C764	34°08.5'	172°08.5'E	66	19.2.62
C766	34°18.2'	172°48.8'E	75	"
C769	34°40.1'	173°11.2'E	77	20.2.62
C771	34°40.0'	173°27.0'E	192	"
C774	35°09.8'	174°14.4'E	78	"
C776	35°20.0'	174°25.8'E	77	"
C778	35°19.8'	174°47.6'E	187	"
C780	35°59.8'	174°47.4'E	75	21.2.62
C781	36.00'0'	175°20.8'E	93	"
C782	35°59.7'	175°36.7'E	134	"
C793	36°39.9'	175°02.0'E	132	23.2.62
C804	37°39.8'	177°43.6'E	77	24.2.62
C814	37°40.0'	178°56.4'E	194	25.2.62
C821	38°40.0'	178°21.5'E	32	26.2.62
C910	41°13.0'	173°52.7'E	24	8.2.63
D5	56°40.6'	158°45.5'E	1280	19.4.63
D6	55°29.0'	158°31.5'E	415	20.4.63
D39	50°58.0'	165°45.0'E	549	7.5.63
D74	50°55.7'	165°54.8'E	168	12.8.63
D87	49°56.0'	171°50.0'E	483	14.5.63

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
D136	48°33.5'	169°10.0'E	713	12.1.64
D149	49°10.5'	166°51.0'E	454	14.1.64
D159	49°01.0'	164°30.0'E	741	17.1.64
D166	49°49.0'	163°51.0'E	668	19.1.64
D173	50°53.0'	166°32.0'E	141	21.1.64
D224	40°47.0'	169°41.0'E	903	27.9.64
D225	40°27.0'	169°05.0'E	940	"
D226	39°54.0'	168°40.0'E	823	27–28.9.64
D227	39°50.0'	169°43.0'E	752	28.9.64
D228	39°08.0'	170°19.0'E	662	"
D230	38°10.0'	170°21.0'E	861	29.9.64
D231	37°53.0'	169°45.0'E	774	"
D235	39°43.0'	167°56.0'E	792	30.9.64
D242	38°00.0'	169°03.0'E	337	2.10.64
D244	39°31.0'	171°00.0'E	838	3.10.64
D424	41°05.0'	178°00.0'E	1558	14.3.65
D836	37°34.0'	179°22.0'E	1395	6.3.69
D871	43°20.0'	178°40.0'W	420	24.3.69
D876	43°20.0'	176°50.0'W	148	25.3.69
D888	44°15.0'	176°45.0'W	98	27.3.69
D899	44°23.0'	176°49.0'W	345	29.3.69
D904	43°58.5'	78°40.0'W	459	30.3.69
E74	44°00.0'	176°40.0'E	547	23.3.64
E75	44°00.0'	177°25.0'E	715	"
E79	43°05.0'	178°00.0'E	371	24.3.64
E121	43°15.0'	175°40.0'W	693	14.10.64
E123	43°45.0'	175°30.0'W	492	"
E148	44°30.0'	177°45.0'W	880	17.10.64
E254	34°35.0'	172°25.0'E	126	6.4.65
E255	34°39.0'	172°25.0'E	154	"
E256	34°39.0'	172°20.0'E	157	"
E258	34°39.0'	172°10.0'E	380	"
E261	34°35.0'	172°15.0'E	161	"
E274	34°30.0'	172°05.0'E	318	7.4.65
E275	34°25.0'	171°45.0'E	600	"
E278	34°25.0'	172°15.0'E	141	"
E283	34°25.0'	172°35.0'E	79	8.4.65
E291	34°15.0'	171°50.0'E	410	"
E302	34°06.7'	172°10.0'E	132	9.4.65
E313	34°05.0'	171°55.0'E	732	10.4.65
E319	33°56.0'	172°17.0'E	104	11.4.65
E340	34°05.0'	172°40.0'E	102	12.4.65
E348	34°37.0'	173°20.0'E	150	13.4.65
E349	34°37.0'	173°15.0'E	121	"
E351	34°37.0'	173°06.0'E	62	"
E356	34°34.0'	173°05.0'E	68	14.4.65
E358	34°34.0'	173°15.0'E	143	"
E359	34°34.0'	173°20.0'E	172	"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
E364	34°30.0'	173°05.0'E	73	14.4.65
E368	34°25.0'	173°07.5'E	126	"
E370	34°25.0'	173°10.0'E	146	15.4.65
E374	34°20.0'	173°00.0'E	117	"
E378	34°20.0'	172°55.0'E	102	"
E387	34°15.5'	172°47.5'E	88	16.4.65
E389	34°01.5'	172°43.5'E	155	"
E390	34°07.6'	172°45.0'E	102	"
E391	34°12.6'	172°45.0'E	95	"
E393	34°20.0'	172°45.0'E	70	"
E399	46°00.0'	171°33.0'E	1222	6.10.65
E400	46°00.0'	171°02.0'E	622–768	7.10.65
E405	47°20.0'	169°55.0'E	1004	9.10.65
E410	46°40.0'	170°44.6'E	1086	10.10.65
E413	45°12.0'	171°44.0'E	594	11.10.65
E421	44°00.0'	175°00.0'E	494	15.10.65
E422	44°15.0'	175°00.0'E	615	"
E423	44°18.0'	174°31.0'E	640	"
E424	44°40.0'	172°38.0'E	293	16.10.65
E428	44°16.0'	174°00.0'E	646	17.10.65
E434	43°30.0'	174°30.0'E	556	18.10.65
E436	43°15.0'	174°00.0'E	695	"
E636	37°28.5'	177°13.0'E	190	10.10.66
E707	40°10.3'	177°18.3'E	951–834	21.3.67
E712	39°20.0'	178°15.8'E	772–717	22.3.67
E713	39°20.8'	178°17.0'E	935–858	"
E714	39°19.6'	178°21.2'E	1284–1249	"
E715	38°40.0'	178°29.3'E	322	23.3.67
E717	38°42.0'	178°33.3'E	828–839	"
E718	38°41.0'	178°40.0'E	1041–1019	"
E719	38°46.0'	178°48.0'E	913–750	"
E720	37°33.0'	178°35.0'E	256–252	24.3.67
E725	37°20.5'	178.00.5'E	1004–942	"
E731	37°23.5'	177°12.0'E	602–503	25.3.67
E749	40°47.0'	176°57.0'E	913–997	29.3.67
E751	41°39.7'	175°15.0'E	300–399	30.3.67
E752	41°40.7'	175°15.4'E	618–596	"
E753	41°46.2'	175°15.0'E	1074–1227	"
E755	42°00.5'	174°25.4'E	247–276	"
E756	42°01.8'	174°26.5'E	885–969	"
E757	42°03.2'	174°27.2'E	1081–1125	"
E772	42°00.0'	170°16.0'E	748	14–15.10.67
E773	42°00.0'	169°54.0'E	968	15.10.67
E774	42°00.0'	169°15.0'E	1168	"
E783	43°23.0'	168°36.5'E	966	16–17.10.67
E784	43°23.0'	168°05.0'E	1221–1213	17.10.67
E792	44°40.0'	167°33.5'E	213–123	19.10.67
E793	44°40.0'	167°32.0'E	243–253	"
E796	45°20.0'	166°45.5'E	251–226	20.10.67
E797	45°20.0'	166°44.7'E	471–421	"
E800	45°20.5'	166°41.5'E	1003–993	"
E801	45°53.5'	166°07.0'E	983–888	"
E803	45°57.0'	166°09.0'E	534–514	21.10.67
E804	45°58.5'	166°18.5'E	183	"
E821	46°43.5'	165°46.5'E	549	23.10.67

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
E825	46°39.5'	166°40.5'E	914	24.10.67
E826	46°37.5'	166°44.2'E	823	"
E830	47°21.0'	167°00.0'E	682–619	25.10.67
E840	33°52.0'	172°16.0'E	757–729	16.3.68
E841	33°53.0'	172°17.0'E	479–428	"
E846	34°96.5'	171°57.5'E	417–343	"
E848	33°59.0'	171°40.0'E	250	17.3.68
E849	33°55.0'	171°32.0'E	216	"
E850	33°49.0'	171°19.0'E	509–515	"
E852	33°38.0'	170°55.0'E	1024–1049	"
E855	33°10.0'	169°56.0'E	736–710	"
E859	32°01.0'	168°03.0'E	484–486	18.3.68
E860	32°21.0'	167°41.0'E	1246–1258	"
E864	32°36.0'	167°36.0'E	130	19.3.68
E865	32°41.0'	167°36.0'E	168	"
E868	33°51.0'	167°20.0'E	751–762	"
E869	33°58.0'	167°45.0'E	1705–1685	"
E870	34°05.0'	168°10.0'E	1488–1556	20.3.68
E873	34°37.0'	171°52.0'E	974–961	21.3.68
E876	34°39.0'	172°14.0'E	216–247	"
E879	35°19.0'	172°25.0'E	768–786	22.3.68
E880	35°20.0'	172°20.0'E	1029–1074	"
E883	36°00.0'	172°52.0'E	999–1046	23.3.68
E884	35°59.0'	173°10.0'E	701–689	"
E889	36°48.0'	173°40.0'E	727–729	"
E890	36°40.0'	173°34.0'E	1014	23–24.3.68
E894	37°20.0'	173°57.0'E	728–708	24.3.68
E899	38°00.0'	173°47.0'E	729–715	25.3.68
E902	37°34.0'	172°05.0'E	1064–1066	26.3.68
E908	38°38.0'	172°41.0'E	256–336	28.3.68
F10	38°43.0'	172°35.0'E	333	30.10.64
F75	35°30.0'	174°43.0'E	121	12.11.64
F81	49°32.0'	167°01.0'E	401	14.1.65
F90	49°30.5'	167°40.0'E	601	16.1.65
F100	49°02.0'	168°53.5'E	733–746	18.1.65
F110	48°07.0'	174°02.0'E	1167	21.1.65
F112	48°08.0'	175°56.0'E	1427–1481	22.1.65
F123	47°38.0'	178°57.0'W	1280	27.1.65
F128	49°09.0'	177°18.0'E	978	28.1.65
F135	50°58.0'	173°57.0'E	832	30.1.65
F136	51°20.0'	172°42.0'E	547	"
F143	53°05.5'	170°13.0'E	380	1.2.65
F144	53°29.0'	178°56.0'E	596	"
F146	53°00.0'	172°45.0'E	435	"
F147	52°21.0'	173°09.0'E	611	"
F319	19°51.0'	157°43.8'W	847–940	27.5.65
F750	44°15.0'	175°26.0'E	594	17.8.66
F753	44°45.0'	174°30.0'E	763–854	18.8.66
F762	41°00.0'	176°30.0'E	304–326	21.8.66
F764	41°05.0'	176°37.5'E	999–1030	"
F767	41°30.8'	176°07.0'E	1205–1293	"
F797	37°25.7'	177°11.0'E	348	7.9.66
F868	37°28.5'	179°03.5'E	808–924	2.10.68
F872	37°20.6'	178°11.2'E	878–832	3.10.68
F873	37°19.5'	178°11.0'E	1050–1053	"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
F874	37°18.0'	178°11.0'E	1357	3.10.68
F877	37°31.0'	177°32.0'E	783–728	"
F878	37°28.5'	177°31.5'E	997–942	"
F896	36°40.5'	176°19.2'E	909–814	6.10.68
F898	36°13.0'	176°10.0'E	263–260	8.10.68
F900	36°13.0'	176°23.0'E	754–721	9.10.68
F909	35°06.4'	175°11.0'E	1002–1030	10.10.68
F911	34°38.0'	174°36.0'E	1295–1412	11.10.68
F913	34°43.5'	174°31.5'E	743	"
F915	34°58.7'	174°18.0'E	251–265	"
F916	34°38.5'	173°28.0'E	249–241	12.10.68
F923	34°07.5'	172°46.7'E	143–216	13.10.68
F924	34°07.5'	172°47.0'E	315–439	"
F928	34°06.2'	172°06.8'E	388–406	14.10.68
F933	34°24.0'	173°10.3'E	252–249	15.10.68
G1	32°35.0'	167°23.0'E	138	14.9.66
G3	26°25.0'	167°15.0'E	710	27.9.66
G32	43°44.0'	176°29.0'E	402	23.2.67
G33	43°40.0'	177°00.0'E	457	"
G38	43°37.0'	179°29.5'E	415	24.2.67
G172	43°39.0'	179°28.0'W	373	17.1.68
G177	43°47.0'	179°28.0'W	315	"
G184	44°06.0'	179°25.0'W	344	"
G197	43°46.0'	179°44.0'W	377	18.1.68
G198	43°48.0'	179°44.0'W	366	19.1.68
G200	43°54.0'	179°44.0'W	395	"
G208	43°30.0'	179°56.0'E	413	"
G223	43°44.0'	179°50.0'E	421	21.1.68
G230	43°33.0'	179°43.0'E	410	"
G233	43°32.0'	179°36.0'E	412	"
G240	43°40.0'	179°36.0'E	424	22.1.68
G244	43°36.0'	179°30.0'E	406	"
G245	43°35.0'	179°31.0'E	421	"
G254	43°35.0'	179°29.0'E	417	23.1.68
G255	43°39.0'	179°29.0'E	424	"
G258	43°34.0'	179°22.0'E	402	"
G259	43°33.0'	179°22.0'E	419	"
G262	43°30.0'	179°22.0'E	412	"
G273	43°30.0'	179°15.0'E	410	24.1.68
G276	43°35.0'	179°15.0'E	413	"
G278	43°40.0'	179°15.0'E	413	"
G279	43°39.0'	179°07.0'E	426	"
G291	43°42.0'	179°01.0'E	402	25.1.68
G292	43°42.0'	179°48.0'E	454	"
G293	43°40.0'	179°28.0'E	421	"
G303	43°04.0'	179°20.0'W	311	26.1.68
G329	44°06.0'	179°00.0'W	417	1.2.68
G344	43°44.0'	178°52.0'W	402	2.2.68
G371	43°33.0'	177°50.0'W	388	5.2.68
G398	43°25.0'	178°17.0'W	424	7.2.68
G651	44°00.0'	174°31.0'E	572	17.1.70
G665	44°43.0'	172°40.0'E	934	18.1.70
G666	44°52.2'	172°20.2'E	1015	18–19.1.70
G667	44°57.0'	172°05.0'E	872	19.1.70
G688	46°10.0'	171°00.2'E	731	20.1.70

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
G697	46°19.5'	170°42.0'E	528	21.1.70
G701	46°20.0'	171°30.0'E	1400	22.1.70
G703	46°20.0'	172°04.0'E	1480	23.1.70
G817	33°00.9'	162°56.6'E	815	14.2.71
G818	33°00.0'	162°48.5'E	791	"
G819	32°57.6'	162°35.3'E	782	"
G820	33°09.0'	162°36.0'E	793	15.2.71
G821	33°18.5'	162°35.5'E	791	"
G822	33°20.4'	162°49.2'E	815	"
G823	33°10.4'	162°59.2'E	798	"
G824	33°10.4'	162°59.2'E	807	"
G825	33°20.9'	162°59.5'E	829	15–16.2.71
G885	47°54.3'	179°53.1'E	210–240	13.12.70
G888	48°16.0'	177°50.4'E	1020	14.12.70
G893	49°37.0'	178°19.0'E	570	16.12.70
G937	49°41.3'	167°16.5'E	520	16.1.71
G938	49°33.9'	166°44.5'E	490	17.1.71
G941	39.59.7'	178°08.0'E	665–690	17.5.73
G947	40°13.8'	177°20.0'E	1491–1423	30.5.73
G955	42°40.5'	174°45.5'E	1195–1147	3.6.73
H636	43°26.4'	179°34.9'E	395	10.3.75
H914	43°29.4'	177°55.5'W	358	11.8.75
H923	43°29.0'	179°32.2'E	395	13.8.75
H939	43°40.9'	179°29.8'E	431	14.8.75
H942	43°43.8'	179°28.2'E	46	"
H945	43°19.4'	179°29.2'E	405	15.8.75
I14	35°35.9'	174°40.0'E	103	4.5.75
I15	35°24.6	174°28.0'E	68–71	"
I19	35°25.2'	175°00.4'E	270–276	5.5.75
I21	35°24.2'	175°25.8'E	690	"
I25	35°11.1'	175°06.1'E	675	6.5.75
I34	35°00.0'	175°13.0'E	578	7.5.75
I47	36°00.0'	174°39.9'E	48–46	9.5.75
I50	36.00.2'	175°13.2'E	92	10.5.75
I52	36°11.2'	75°13.5'E	63–66	"
I53	36°12.1'	174°55.0'E	56–54	11.5.75
I56	36°23.0'	175°13.1'E	50–46	"
I63	36°11.3'	176°23.0'E	585–400	12.5.75
I64	36°12.0'	176°11.8'E	335–247	"
I71	29°09.8'	168°02.1'E	57	20.7.75
I76	28°45.0'	167°45.1'E	259–190	"
I86	29°29.9'	167°50.5'E	280–350	23.7.75
I87	29°25.0'	167°50.0'E	89–170	"
I91	29°24.8'	168°10.0'E	342–360	"
I92	29°24.8'	168°13.2'E	570–578	"
I94	29°20.2'	168°10.8'E	308	"
I96	32°10.8'	167°21.2'E	356	25.7.75
I97	32°22.9'	167°28.2'E	540–544	"
I343	34°46.4'	173°23.7'E	< 30	17.11.77
I345	34°40.4'	173°31.0'E	182–227	"
I352	34°39.0'	174°04.2'E	840–815	19.11.77
I353	34°45.4'	174°04.1'E	530	"
I356	34°52.4'	174°05.7'E	269–275	"
I363	34°50.2'	174°00.2'E	227–224	20.11.77
I366	34°42.3'	174°17.6'E	705–684	"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
I370	34°10.6'	172°46.5'E	94	23.11.77
I371	34°11.6'	72°49.5'E	118–120	"
I374	34°32.3'	173°30.3'E	232–240	"
I375	34.32.7'	173°30.9'E	–	"
I661	43°50.2'	179°05.8'W	375	11.3.79
I664	47°39.8'	179°27.8'W	595	12.3.79
I666	47°47.5'	178°59.5'W	1165	13.3.79
I667	47°45.6'	179°17.0'W	648	"
I669	47°49.0'	179°45.7'W	355	"
I671	48°00.0'	180°00.0'E	280	"
I674	48°00.4'	179°10.5'W	750	14.3.79
I676	48°09.8'	179°20.0'W	810	"
I684	48°20.0'	179°29.0'W	705	15–16.3.79
I685	48°19.5'	179°29.5'W	722	16.3.79
I686	48°30.5'	179°45.0'W	710	"
I689	48°51.5'	178°41.5'E	808	17.3.79
I694	49°30.0'	178°45.0'E	1004	18.3.79
I698	48°20.0'	178°30.0'E	726	19.3.79
I699	48°16.0'	179°00.0'E	532	"
I702	48°10.0'	178°44.5'E	545	20–21.3.79
I703	48°10.9'	178°15.9'E	875	21.3.79
I704	48°00.0'	178°29.0'E	475	"
I707	47°20.0'	179°30.0'E	552	22.3.79
I715	47°05.0'	178°15.0'E	623	23.3.79
I716	44°00.0'	176°13.9'E	500	25.3.79
I721	44°07.4'	175°46.2'E	540	26.3.79
I735	24°42.0'	159°34.8'E	360	11.5.79
I741	22°43.0'	159°16.0'E	328	12.5.79
I743	22°34.2'	159°09.4'E	291–298	"
I745	22°06.8'	159°06.3'E	1300–1560	"
J55	44°05.5'	176°12.0'E	198	17.5.70
J58	43°31.0'	179°09.5'E	512	20.5.70
J59	43°51.0'	179°25.0'E	309	"
J362	32°32.7'	166°26.5'E	1030	25.8.73
J485	50°38.0'	167°38.0'E	320–365	7.12.73
J657	37°28.2'	179°03.2'E	695–726	4.9.74
J658	36°00.6'	179°12.8'E	2515–2505	"
J659	35°00.6'	179°15.1'E	695–689	5.9.74
J660	35°02.0'	179°15.9'E	803–788	"
J667	36°37.5'	178°19.3'E	2431	5–6.9.74
J672	36°26.5'	175°46.0'E	25–32	7.9.74
J674	36°41.8'	175°55.2'E	3–33	"
J676	37°22.5'	177°11.7'E	341–333	8.9.74
J678	37°24.7'	177°12.0'E	352–350	"
J679	37°21.1'	177°11.8'E	316–328	"
J680	37°25.8'	177°11.8'E	328–352	"
J683	37°20.7'	177°06.8'E	388–400	"
J686	37°16.2'	176°51.2'E	194–219	"
J699	37°33.2'	176°59.2'E	174–248	10.9.74
J705	37°16.0'	176°51.0'E	190	11.9.74
J709	37°15.2'	176°50.0'E	328–406	"
J710	37°15.1'	176°50.1'E	195–208	"
J711	37°15.0'	176°50.0'E	366–472	"
J715	36°04.3'	178°00.8'E	683–693	12.9.74
J716	36°04.2'	178°00.6'E	785–990	"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
J951	35°02.0'	172°52.7'E	52	18.6.81
J953	34°39.6'	172°13.1'E	270–260	"
J954	34°38.0'	172°13.5'E	204–192	"
J959	34°25.3'	173°08.8'E	140–210	19.6.81
J966	34°51.9'	173°51.7'E	120	20.6.81
J969	35°08.8'	174°21.1'E	70–106	21.6.81
J970	35°08.6'	174°21.1'E	86–91	"
J971	35°25.3'	174°58.9'E	246	22.6.81
J976	35°44.7'	175°29.6'E	155–225	"
K527	41°10.4'	173°10.0'E	-	24.7.72
K795	33°02.6'	179°34.6'W	350	18.7.74
K800	29°11.9'	177°50.8'W	670–778	22.7.74
K803	29°16.0'	177°50.3'W	190–140	"
K804	29°14.8'	177°49.6'W	590–490	"
K805	29°10.7'	177°47.4'W	1142–1156	22–23.7.74
K806	28°30.7'	177°49.3'W	1165–1185	23.7.74
K818	29°13.3'	177°56.4'W	95–116	24.7.74
K819	29°13.2'	177°56.3'W	100–140	"
K820	29°13.3'	177°59.8'W	95–122	"
K823	29°18.5'	177°56.2'W	202–131	25.7.74
K825	28°47.8'	177°47.8'W	145	"
K826	28°48.0'	177°48.0'W	142	"
K828	28°35.4'	177°50.7'W	440	26.7.74
K828A	28°35.4'	177°50.7'W	508–510	"
K829	29°13.0'	177°52.4'W	565–635	"
K830	29°11.5'	177°53.0'W	545–590	26–27.7.74
K838	30°15.8'	178°23.7'W	200	28.7.74
K839	30°15.4'	178°24.0'W	290	"
K840	30°17.6'	178°25.3'W	398–412	"
K842	30°10.2'	178°35.9'W	325–370	29.7.74
K843	30°10.5'	178°34.5'W	254–260	"
K844	30°11.2'	178°33.8'W	290	"
K846	30°13.1'	178°32.0'W	610–640	"
K851	30°33.3'	178°31.8'W	106–104	30.7.74
K857	30.33.8'	178°30.6'W	165–180	"
K858	30°34.2'	178°29.8'W	465–501	"
K859	30°34.9'	178°28.2'W	405–443	"
K860	30°35.8'	178°25.7'W	605–720	"
K867	31°21.4'	178°50.6'W	190–240	1.8.74
K868	31°21.5'	178°51.4'W	335	"
K870	31°21.2'	178°44.5'W	510–610	2.8.74
K872	31°20.4'	178°49.2'W	280–235	"
K873	37°34.0'	179°22.0'W	1270–1280	3.8.74
M763	44°36.2'	167°49.7'E	27	29.3.81
M773	44°37.1'	167°51.5'E	25	30.3.81
M774	44°40.0'	167°54.6'E	30	"
M775	44°38.9'	67°55.2'E	20	"
M776	44°39.5'	167°54.2'E	15	"
M779	44°36.0'	167°49.4'E	30	31.3.81
M782	44°40.0'	167°55.0'E	22	1.4.81
M793	44°36.0'	167°49.4'E	30	7.4.81
N369	34°24.6'	172°26.3'E	101	10.12.74
N897	32°20.7'	179°03.8'W	424–426	22.2.77
O841	45°20.8'	167°02.4'E	0–35	26.2.85
O849	45°16.0'	167°00.1'E	0–35	28.2.85

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
O852	45°15.6'	167°09.4'E	0–35	1.3.85
P1	32°35.4'	167°32.0'E	122	24.1.77
P2	32°35.7'	167°31.7'E	122	"
P5	32°36.4'	167°30.6'E	126	25.1.77
P8	32°40.8'	167°26.8'E	757–660	"
P10	32°40.0'	167°28.4'E	378–352	"
P13	32°10.5'	167°21.2'E	449–442	"
P14	31°47.2'	167°51.6'E	319–316	"
P16	29°36.3'	168°05.0'E	310	26.1.77
P17	9°35.5'	168°04.0'E	248–225	"
P27	28°54.6'	167°44.2'E	390–402	27.1.77
P34	28°57.8'	167°45.8'E	370	28.1.77
P35	28°57.9'	167°45.5'E	392–423	"
P48	28°42.8'	167°54.6'E	279–186	30.1.77
P57	33°15.0'	169°59.0'E	563–614	4.2.77
P64	34°52.5'	172°34.4'E	155–163	7.2.77
P68	38°39.0'	172°38.2'E	313–557	9.2.77
P85	31°38.4'	159°09.5'E	430–465	28.5.77
P115	31°25.9'	159°02.2'E	183–179	31.5.77
P120	35°45.7'	165°04.1'E	950	3.6.77
P842	32°34.4'	156°17.3'E	285–290	28.11.79
P846	31°00.1'	153°18.3'E	350–375	3.12.79
P925	27°59.6'	155°37.5'E	420	11.12.79
P939	41°20.4'	166°54.8'E	1760–1799	22.4.80
P942	41°00.6'	169°06.0'E	914	24.4.80
P944	27°20.8'	179°20.9'W	673–670	31.5.80
P945	26°42.9'	179°20.0'W	1276–1384	1.6.80
P946	25°59.1'	179°18.1'W	660	"
P947	25°13.7'	179°04.1'W	646–547	"
P966	23°29.8'	176°34.6'W	635–695	10.6.80
Q1	43°49.7'	179°00.0'W	470	12.3.78
Q2	43°36.8'	178°43.7'W	400	"
Q6	44°09.4'	179°35.6'W	468	14.3.78
Q7	44°06.2'	179°33.8'W	408	14–15.3.78
Q8	44°02.2'	179°20.3'W	305	15.3.78
Q11	43°44.1'	179°31.6'W	300	"
Q13	43°27.6'	179°46.9'W	415	"
Q16	43°59.4'	179°15.6'W	215	16.3.78
Q19B	44°02.0'	179°17.2'W	285	"
Q20	44°09.6'	179°14.2'W	320	17–18.3.78
Q24	44°29.7'	176°33.7'W	320–300	22.3.78
Q25	44°26.2'	176°38.4'W	360	"
Q31	44°15.8'	176°54.8'W	340–315	23.3.78
Q38	44°24.8'	176°43.6'W	345	23–24.3.78
Q39	44°26.0'	176°37.0'W	255	24.3.78
Q40	44°29.5'	176°32.5'W	345–380	"
Q46	33°07.4'	156°10.1'E	148	24.5.78
Q68	29°14.0'	159°00.0'E	1045–1212	1.6.78
Q70	26°59.7'	159°18.9'E	376–427	2.6.78
Q83	33°00.2'	163°01.2'E	816–841	7.6.78
Q84	32°59.4'	163°08.7'E	830	"
Q102	45°38.8'	166°53.3'E	0–40	8.11.78
Q105	44°38.1'	167°52.8'E	0–30	9.11.78
Q174	41°37.9'	175°12.8'E	44	17.12.78
Q338	44°00.7'	176°04.9'E	480	13.11.79
Q340	44°06.1'	176°11.7'E	435	13.11.79
Q341	44°07.1'	176°19.2'E	264	14.11.79
Q343	44°07.8'	175°47.8'E	500	"
Q738	44°37.3'	167°51.7'E	30	11.7.82
Q741	44°37.8'	167°51.7'E	30	13.7.82
Q743	44°57.6'	167°27.0'E	37	14.7.82
Q874	12°22.3'	178°32.5'W	1000	23.10.83
R437	39°35.1'	178°25.1'E	800	16.6.90
R438	39°26.0'	78°20.3'E	1010	"
R439	39°26.8'	178°20.0'E	1000	"
S6	42°35.9'	170°39.7'E	201	11.9.78
S8	42°38.0'	170°36.0'E	120	"
S22	50°39.0'	167°39.6'E	400	17.9.78
S25	50°41.8'	167°40.6'E	339	"
S27	50°41.3'	167°37.5'E	335	18.9.78
S28	50°41.1'	167°44.0'E	375	"
S29	50°40.7'	167°41.1'E	300	"
S30	50°41.0'	167°40.8'E	265	"
S42	53°15.6'	169°30.5'E	480	21.9.78
S43	53°29.1'	170°04.2'E	693	"
S46	53°59.8'	171°13.2'E	1075	"
S48	53°30.6'	172°24.0'E	625	22.9.78
S52	52°47.0'	172°54.0'E	494	23.9.78
S53	53°00.7'	172°59.9'E	450	"
S67	48°05.9'	179°55.2'E	380	26.9.78
S72	48°06.5'	178°46.8'E	420	27.9.78
S99	51°57.8'	174°48.0'E	1750–1800	27.11.78
S122	43°35.5'	175°57.3'E	322	20.10.79
S125	43°32.1'	175°58.5'E	365	"
S126	43°33.4'	175°58.6'E	322	"
S127	43°35.4'	175°57.3'E	322	"
S130	43°34.0'	175°57.7'E	335	21.10.79
S142	44°30.9'	174°52.5'E	715	24.10.79
S152	45°52.3'	174°04.9'E	1676	26.10.79
S154	45°24.2'	173°59.8'E	1373	27.10.79
S157	44°10.5'	173°29.9'E	160	28.10.79
S159	44°19.3'	173°35.5'E	525	"
S160	44°13.9'	173°39.5'E	550	"
S166	44°25.4'	174°07.4'E	720	29.10.79
S168	44°10.6'	174°23.3'E	594	"
S173	43°59.4'	174°02.0'E	486	30.10.79
S174	44°06.5'	173°54.1'E	518	"
S181	43°26.7'	173°30.0'E	392–260	31.10.79
S216	42°40.9'	173°39.2'E	200	4.11.79
S222	42°28.3'	173°40.2'E	600–180	5.11.79
S248	44°36.1'	167°49.2'E	30	19.2.80
S251	45°10.9'	167°07.4'E	20	20.2.80
S257	45°17.0'	167°00.6'E	37	21.2.80
S260	45°29.4'	167°05.1'E	33	22.2.80
S562	35°49.2'	172°54.0'E	600–505	5.8.83
S565	29°18.5'	169°46.7'E	1350–830	12.8.83
S571	30°47.3'	172°45.2'E	509–480	15.8.83
S572	30°45.5'	172°47.7'E	530–403	"
S573	30°29.7'	172°42.3'E	975–840	"
T7	44°06.5'	176°06.5'E	315	7.3.81

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
T8	44°19.4'	176°14.0'E	480–520	7.3.81
T32	48°23.6'	179°42.6'W	668	13.3.81
T38	49°04.6'	178°58.2'E	740	13–14.3.81
T48	49°18.6'	177°54.7'E	990	15.3.81
T88	44°02.0'	174°46.6'E	500	31.3.81
T109	39°45.8'	178°14.1'E	288–350	24.4.81
T182	18°57.9'	159°44.0'W	375–672	14.9.81
T214	30°40.9'	178°25.5'W	565	18.3.82
T217	30°44.0'	178°38.1'W	492	"
T225	29°13.1'	177°53.5'W	472	21.3.82
T226	28°33.0'	177°50.0'W	800–930	22.3.82
T233	29°13.0'	178°00.0'W	100	"
T235	30°19.3'	178°21.0'W	510–445	23.3.82
T241	30.05.0'	178°25.1'W	1087	23–24.3.82
T243	30.05'0'	178°15.0'W	1035	24.3.82
T244	30.05.2'	178°10.2'W	1450	"
T247	30°14.0'	178°27.0'W	15	"
T256	30°31.0'	178°39.0'W	710–725	27.3.82
T257	31°09.7'	178°40.0'W	890	28.3.82
T259	31°09.8'	178°30.0'W	1310–1254	"
U197	34°09.8'	163°36.7'E	1186	25.9.82
U198	34°59.3'	162°11.2'E	1573	26.9.82
U203	35°33.2'	159°05.8'E	4919–4912	29.9.82
U204	35°29.7'	157°28.0'E	4570–4675	30.9.82
U208	34°13.8'	151°29.1'E	498–466	5.10.82
U224	36°55.7'	159°31.5'E	4954–4961	15.10.82
U325	10°52.4'	165°58.6'W	1585–1446	21.4.86
U345	14°56.1'	172°15.3'W	1972–2166	26.4.86
U351	18°39.1'	172°12.2'W	996–976	29.4.86
U568	35°08.4'	169°28.4'E	867–865	3.2.88
U573	33°33.1'	170°06.4'E	1260	4.2.88
U574	33°19.6'	170°06.9'E	570–580	"
U582	31°52.0'	172°26.0'E	1058–988	5.2.88
U584	31°26.3'	172°35.6'E	1137–1150	6.2.88
U591	30°51.0'	172°48.0'E	486	7.2.88
U592	30°41.3'	172°54.0'E	1067–1058	"
U594	30°20.1'	172°59.6'E	406	"
U595	30°21.5'	173°08.7'E	1474–1365	"
U599	30°43.0'	173°16.0'E	640–590	8.2.88
U602	31°30.6'	172°50.9'E	1216–1385	9.2.88
V365	43°44.9'	179°00.4'W	399	8.9.89
V372	43°20.2'	178°58.8'E	415–409	13.9.89
V373	43°35.5'	178°59.5'E	385	"
V386	44°05.3'	177°00.1'E	665	16.9.89
V387	43°49.6'	176°59.8'E	498–497	"
V388	43°34.8'	176°59.9'E	331–328	"
X121	37°24.7'	177°11.7'E	340	23.11.89
X122	37°25.1'	177°11.1'E	365	24.11.89
X138	37°15.0'	176°50.4'E	355–265	27.11.89
X152	36°09.7'	176°48.4'E	940–820	28.11.89
X182	36°48.2'	177°28.3'E	1035–925	3.12.89
X221	37°20.2'	177°06.0'E	405–300	7.12.89
Z2098	28°39.5'	173°01.0'E	850	4.9.67
Z2997	26°57.0'	168°10.2'E	1329	-
Z3907	43°41.8'	179°55.1'E	387	-
Z3909	43°42.2'	179°58.0'E	388	-
Z3911	43°38.1'	178°09.2'E	376	-
Z3924	43°33.0'	179°39.0'E	402	-
Z3925	43°24.0'	179°22.5'E	394	-
Z3928	43°34.3'	179°37.6'E	399	-
Z3934	43°33.3'	179°39.4'E	400	-
Z3936	43°33.2'	179°40.1'E	389	-
Z3939	43°32.2'	179°40.0'E	391	-
Z3943	43°33.4'	179°40.1'E	388	-
Z3947	43°33.1'	179°39.9'E	389	-
Z3948	43°33.2'	179°39.9'E	390	-
Z3950	43°32.9'	179°43.6'E	393	-

MoNZ Stations (BS)

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
BS208	37°22.5'	176°22'E	207-219	27.2.57
BS300	41°30'	174°54'E	603	6.9.72
BS302	Antipodes Is		81	21.11.72
BS307	Raoul I., Kermadecs		110-146	4.4.73
BS309	Raoul I., Kermadecs		165-220	"
BS310	Raoul I., Kermadecs		155-165	"
BS313	NW end of Raoul I.		146-201	5.4.73
BS314	39°22'	171°50'E	236	
BS327	Bay of Islands		7	7.12.73
BS329	off Moturoa, Bay of Islands		31	8.12.273
BS335	Bay of Islands		37-40	10.12.73
BS342	Bay of Islands		46-55	14.12.73
BS346	off Motuwhekeke I., Bay of Islands		22-31	"
BS353	37°30'	179°22'E	1134-1207	7.2.74
BS362	36°01'	174°43'E	59	13.2.74
BS363	35°58.5'	174°44'E	62	"
BS369	35°32'	174°41'E	110-113	15.2.74
BS370	35°29'	174°44'E	110	15.2.74
BS372	35°22'	174°43'E	146	"
BS380	35°10.5'	174°10'E	37	16.2.74
BS391	34°01'	172°07'E	622	18.2.74
BS392	34°08'	172°11'E	102	"
BS394	34°11'	172°10'E	91	19.2.74
BS395	34°10'	172°12'E	252	"
BS396	34°13'	172°11.5'E	256	"
BS401	34°22'	173°03'E	121	"
BS402	34°26'	173°14'E	146	20.2.74
BS415	Bay in Stephenson's I., opposite Whangaroa Heads		22-24	23.2.74
BS434	4.1 km off Fleetwood Bluff, Raoul I.		135	25.10.75
BS437	5.6 km off Fleetwood Bluff, Raoul		154	"
BS438	3.9 km off Nugent I., Raoul I.		146-165	28.10.75
BS441	3.7 km off Nugent I., Raoul I.366-402			"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
BS442	5.0 km off Nugent I., Raoul I.		512-549	28.10.75
BS480	41°26'	174°47'E	99-106	29.2.76
BS559	43°14'	173°39'E	512-1006	27.9.76
BS560	42°35'	173°41'E	640	28.9.76
BS570	29°14'	177°50'W	135-146	10.9.76
BS571	29°19'	177°54'W	219-274	"
BS581	29°14'	177°53'W	530-567	13.9.76
BS630	42°36'	170°40'E	300	13.4.78
BS631(P441)	34°24.0'	172°16.8'E	120	20.6.78
BS632(P449)	34°20.0'	172°30.0'E	100	"
BS633(P461)	34°20'	171°48'E	440	21.6.78
BS634(P465)	34°17'	171°45'E	427	"
BS635(P475)	33°59.2'	172°13.6'E	155	23.6.78
BS636(P476)	34°01.8'	172°12.9'E	508	"
BS637(P485)	4°05.5'	172°24.6'E	200	24.6.78
BS638(P487)	34°14.2'	172°32.4'E	100	"
BS639(P515)	33°58.0'	172°30.6'E	550	25.6.78
BS641(P571)	34°02.0'	171°48.4'E	188	29.6.78
BS642(P574)	34°06.5'	172°04.7'E	310	"
BS649(R7)	42°29.2'	176°06.3'E	1262	11.1.79
BS654(R12)	43°02.6'	175°24.2'E	253	12.1.79
BS665(R23)	42°16.3'	174°20.8'E	860	14.1.79
BS668(R26)	41°52.1'	174°43.2'E	454	"
BS672(R30)	41°31.4'	174°52.6'E	533	15.1.79
BS682(R40)	37°35.0'	178°43.0'E	129	17.1.79
BS697(R55)	37°25.2'	177°11.8'E	318	19.1.79
BS707(R65)	37°24.0'	177°06.5'E	740	"
BS709(R67)	37°21.5'	177°06.0'E	283	"
BS715(R73)	37°17.0'	176°51.0'E	251	20.1.79
BS718(R76)	37°29.1'	176°54.7'E	248	"
BS723(R81)	37°35.9'	176°59.5'E	179	"
BS724(R82)	37°37.5'	176°59.9'E	129	20.1.79
BS732(R90)	37°46.5'	176°38.5'E	39	21.1.79
BS733(R91)	37°43.4'	176°38.5'E	59	"
BS734(R92)	37°39.4'	176°34.4'E	82	"
BS742(R100)	37°22.0'	176°28.5'E	448	22.1.79
BS744(R102)	37°18.9'	176°16.2'E	59	"
BS747(R105)	37°16.7'	176°17.5'E	104	"
BS748(R106)	37°15.2'	176°14.5'E	188	"
BS753(R111)	37°07.8'	176°18.7'E	463	23.1.79
BS756(R114)	37°00.8'	176°12.3'E	178	"
BS757(R115)	37°00.2'	176°14.8'E	304	"
BS761(R119)	37.22.0'	176°40.0'E	616	24.1.79
BS762(R120)	37°29.0'	176°32.0'E	818	"
BS763(R121)	37°30.8'	176°32.3'E	755	"
BS768(R126)	37°33.1'	178°49.5'E	94	25.1.79
BS770(R128)	37°33.4'	178°48.3'E	106	"
BS771(R129)	39°15.4'	178°19.3'E	413	26.1.79
BS806(O550)	35°54'	172°12'E	543-597	11.1.81
BS807(O551)	35°10.4'	172°35.4'E	110-146	"
BS812(O556)	35°37.6'	172°36.5'E	657	"
BS819(O564)	37°06.6'	173°54.1'E	952	12.1.81
BS830(O575)	39°52.8'	177°36.5'	785-882	21.1.81
BS831(O576)	38°39'	178°41'E	725-755	"
BS833(O578)	37°38'	178°56'E	143-153	22.1.81
BS842(O588)	37°17.4'	176°53.6'E	292-337	23.1.81
BS843(O589)	37°15'	176°51'E	163-407	"
BS844(O590)	37°11'	176°39'E	685-705	"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
BS846(O592)				
	37°04'	176°27'E	807-872	23.1.81
BS849(O595)				
	37°00'	176°13'E	202-207	24.1.81
BS856(O602)				
	35°35'	175°46'E	327-329	"
BS866(O612)				
	34°43'	173°32'E	163-168	27.1.81
BS878(O624)				
	34°25.7'	173°12.8'E	207-221	"
BS881(O627)				
	34°20'	173°06'E	163-168	"
BS882(O628)				
	32°32'	167°30'E	113-118	29.1.81
BS883(O629)				
	32°32'	167°31'E	113	"
BS884(O630)				
	32°33'	167°29'E	133	"
BS888(O634)				
	32°39'	167°40'E	357-487	"
BS889(O635)				
	32°41'	167°38'E	206-296	30.1.81
BS891(O637)				
	32°39'	167°32'E	133	"
BS893(O639)				
	33°59.9'	171°45.3'E	186-196	31.1.81
BS895(O641)				
	34°02'	171°44'E	246-291	"
BS896(O642)				
	34°01'	171°45'E	201-216	"
BS897(O643)				
	34°02'	171°46'E	206-221	"
BS898(O644)				
	34°01'	171°44'E	206-211	"
BS899(O645)				
	34°00'	171°47'E	143-163	"
BS902(O648)				
	34°10.5'	172°11.4'E	153	1.2.81
BS904(O650)				
	33°57.0'	172°19.0'E	128	"
BS905(O651)				
	33°57.4'	172°19.4'E	123-128	"
BS906(O652)				
	34°15'	172°14'E	173-178	2.2.81
BS907(O653)				
	43°17'	172°16'E	123-133	"
BS909(O655)				
	34°16'	172°15'E	138-143	"
BS910(O656)				
	34°19'	172°18'E	88-93	"
BS911(O657)				
	34°20.2'	172°21.8'E	121	"
BS912(O658)				
	34°22.8'	172°24.6'E	121	"

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
BS913(O659)				
	34°25.0'	172°27.8'E	78	2.2.81

Miscellaneous Vessels

(AIM, AMS, AUM, BM, MoNZ, Portobello, USNM)

Albatross :				
3708	35°02'N	138°46'E	110-128	8.5.1900
4894	32°33'N	128°32'E	174	9.8.1906
Alexander Nesmeyanov:				
N17-6	32°15'	179°10'E	900-950	Dec 1989
N17-15	32°15'	179°10'E	760-830	Dec 1989
Alpha Helix:				
79-M14	11°33.5'	135°52.5'E	22	-
79-M15	11°31.5'	135°48.8'E	24	-
Azuchi Maru:				
96	44°17.8'	177°30.6'W	512	-
Belinda:				
	44°10.6'	147°10.1'E	1051-1100	-
Challenger:				
170	29°55'	178°14'W	?1152	14.7.1874
Chatham:				
4	43°14'	176°11'W	366	23.1.54
34	44°04'	175°23.5'W	238	1954
Cordilla:				
	42°50'	177°41'W	763-775	13.8.89
Eltanin:				
370	53°54'	64°36'W	104-115	12.12.62
1403	41°42'	175°29'E	946-951	31.1.65
1712	38°24'	178°53'W	1354-1995	28.5.66
1718	38°27'	168°07'W	531-659	13.7.66
1850	49°40'	178°53'E	103	2.1.67
1983	47°11'	147°47'E	1028-1034	24.2.67
Franklin:				
6/88/4	10°34'	144°13'E	815-825	20.8.88
6/88/5	10°37.2'	144°22.0'E	990-1053	21.8.88
5/89/4	36°43.1'	156°13.3'E	143	1.5.89
5/89/5	33°14'	156°10'E	132	"
5/89/10	30°48'	156°13'E	288	2.5.89
5/89/25	28°05.8'	163°06'E	1051	5.5.89
5/89/32	27°12.0'	160°37.8'E	1960	7.5.89
5/89/40	26°45.3'	159°31.0'E	315-360	8 .6.89
5/89/41	27°08.4'	158°15.2'E	2860	"
5/89/47	28°17.5'	158°37.9'E	419	10.5.89
Ikatere:				
B26	35°04'	174°23'E	185	-
J1/56/71				
	35°05'	172°27'E	274	-
J15/9/76				
	39°40'	169°45'E	712-740	-
J9/15/77				
	44°13.1'	173°51'E	610	-
JC10/57/71				
	47°09'	169°28.4'E	429-456	-

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
JC11/2/71				
	43°56'	174°35.8'E	585	-
JC19/9/84				
	40°06'	167°57.9'E	919-922	13.11.84
JC19/19/84				
	39°42.4'	168°07'E	748-780	15 .11.84
K1/24/81				
	40°46.1'	176°59.0'E	1010-1035	25.11.84
K1/25/81				
	40°13.3'	177°11.8'	555-585	25.11.81
KTN17/82				
	42°46.2	176°32.5'W	1100	-
KTN26/82				
	42°50'	176°08'W	1050	-
Private Collection:				
L892	N. of Curtis I., Kermadecs		30	13.10.85
L999	W. of Esperance Rock		22	1.9.88
L1050	W. of N. Meyer I., Raoul I.		12	1 .1.91
L1051	SW of Napier I., Raoul I.		36	1.6.91
L1056	34°11'	172°03.3'E	20	18.1.85
L1057	34°10.5'	172°02'E	37	1.2.85
L1413	N. of Macauley I., Kermadecs		20	1.6.92
L1630	W. side Meyer I., Raoul I.		7	1.1.91
L2633	34°08.2'	172°10.4'E	15	19 .1.85
L2641	34°11'	172°03.3'E	15-18	18.1.85
L2680	37°33.5'	178°18'E	10	25.1.85
L2712	36°37'	175°48'E	20	25.10.84
L2715	36°08'	175°30'E	53	2.1.81
L2925	35°54'	175°07'E	23	28 .10.84
L2926	36°15.5'	175°19.6'E	16	23.10.84
L2929	35°54'	175°07'E'E	30	3 .1.84
L3069	35°28.4'	174°43.5'E	5-7	27.8.84
L3071	35°28.4'	174°43.5'E	5-22	"
L4620	Duncombe Bay, Norfolk I.		10-12	1.11.89
L4621	Duncombe Bay, Norfolk I.		20	"
L4622	W. of Nepean, Norfolk I.		15	22.3.92
L4623	Organ Rock, Norfolk I.		15	1.11.89
L4721	W. of Cheeseman I., Kermadecs		26	1.9.88

Stn No.	Latitude (°S)	Longitude	Depth (m)	Date
L4722	W. of Esperance Rock Kermadecs		22	1.9.88
Lachlan :				
	37°39'	178°34'E	183	-
Matai :				
	36°47.4'	173°53.4'E	732	-
Munida:				
MU67/81	Sander's Canyon, Otago		512-533	-
MU73/124	Papanui Canyon, Otago		420	-
MU76/139				
	45°46'	171°03'E	660	-
Paterson :				
	36°18'	164°51'E	1000	July 1993
Poong San-1:				
	40°02'	168°58.4'E	795-887	-
San Manukau-1:				
	44°46'	176°15'W	1272-1322	20 .12.89
Slope:				
33	38°19.6'	149°24.3'E	930	-
Soela:				
1/82/59				
	33°09'	156°13'E	138-142	28.1.82
Terra Nova:				
91	off Great King, Three Kings Is.		549	26.7.1911
96	11 km east of North Cape		128	3.8.1911
TM (KT9292)YT1				
	30°14.8'N	130°46.1'E	80-88	16.2.92
Trinity II				
	37°05'	176°17'E	470-700	-
Tui:				
Rumble II				
	35°25'	178°48'E	1050	-
Rumble IV				
	36°06'	178°01'E	640	-
AU2/53				
	34°00'	171°55'E	805	-
AUZ40	29°24'	168°10'E	326	-
Volcanolog:				
64	35°26.3'	175°43'E	445	-
B30/20/1				
	Barrier Bank, N of Great Barrier Is		300-500	-
B30/28				
	Knight's Terrace, off Poor Knights Is		300-500	-

LIST OF SPECIES

Order SCLERACTINIA
Suborder FUNGIINA
Superfamily FUNGIOIDEA
Family FUNGIACYATHIDAE

Fungiacyathus (Fungiacyathus) stephanus (Alcock)
Fungiacyathus (Fungiacyathus) fragilis G.O. Sars
Fungiacyathus (Fungiacyathus) pusillus pacificus n.ssp.
Fungiacyathus (Bathyactis) marenzelleri (Vaughan)
Fungiacyathus (Bathyactis) margaretae n.sp.
Fungiacyathus (Bathyactis) turbinolioides Cairns

Family MICRABACIIDAE

Letepsammia superstes (Ortmann)
Letepsammia fissilis n.sp.
Letepsammia formosissima (Moseley)
Stephanophyllia complicata Moseley

Suborder FAVIINA
Superfamily FAVIOIDEA
Family RHIZANGIIDAE

Culicia rubeola (Quoy & Gaimard)

Family OCULINIDAE

Oculina virgosa Squires
Madrepora oculata Linnaeus

Family ANTHEMIPHYLLIIDAE

Anthemiphyllia dentata (Alcock)

Suborder CARYOPHYLLIINA
Superfamily CARYOPHYLLIOIDEA
Family CARYOPHYLLIIDAE

Caryophyllia (Caryophyllia) rugosa Moseley
Caryophyllia (Caryophyllia) hawaiiensis Vaughan
Caryophyllia (Caryophyllia) quadragenaria Alcock
Caryophyllia (Caryophyllia) profunda Moseley
Caryophyllia (Caryophyllia) atlantica (Duncan)
Caryophyllia (Caryophyllia) ralphae n.sp.
Caryophyllia (Caryophyllia) diomedeae Marenzeller
Caryophyllia (Caryophyllia) japonica Marenzeller
Caryophyllia (Caryophyllia) lamellifera Moseley
Caryophyllia (Caryophyllia) elongata Cairns
Caryophyllia (Caryophyllia) scobinosa Alcock
Caryophyllia (Caryophyllia) ambrosia Alcock
Caryophyllia (Premocyathus) compressa Yabe & Eguchi
Coenocyathus brooki n.sp.
Crispatotrochus curvatus n.sp.
Crispatotrochus rugosus n.sp.
Labyrinthocyathus limatulus (Squires)
Labyrinthocyathus sp.
Polycyathus norfolkensis n.sp.
Trochocyathus (Trochocyathus) rhombocolumna Alcock
Trochocyathus (Trochocyathus) maculatus n.sp.
Trochocyathus (Trochocyathus) gordoni n.sp.
Trochocyathus (Trochocyathus) cepulla n.sp.
Trochocyathus (Aplocyathus) hastatus Bourne
Tethocyathus cylindraceus (Pourtalès)
Tethocyathus virgatus (Alcock)
Stephanocyathus (Stephanocyathus) platypus (Moseley)
Stephanocyathus (Acinocyathus) spiniger (Marenzeller)
Stephanocyathus (Odontocyathus) weberianus (Alcock)
Stephanocyathus (Odontocyathus) coronatus (Pourtalès)
Vaughanella oreophila Keller
Vaughanella multipalifera n.sp.
Bourneotrochus stellulatus (Cairns)
Deltocyathus ornatus Gardiner
Deltocyathus formosus n.sp.
Conotrochus brunneus (Moseley)
Aulocyathus recidivus (Dennant)
Dasmosmilia lymani (Pourtalès)
Desmophyllum dianthus (Esper)
Thalamophyllia tenuescens (Gardiner)
Hoplangia durotrix Gosse
Goniocorella dumosa (Alcock)
Anomocora cf. *fecunda* (Pourtalès)
Solenosmilia variabilis Duncan

Family TURBINOLIIDAE

Conocyathus zelandiae Duncan
Alatotrochus rubescens (Moseley)
Sphenotrochus (Sphenotrochus) ralphae Squires
Sphenotrochus (Sphenotrochus) squiresi n.sp.
Kionotrochus suteri Dennant

Cryptotrochus venustus (Alcock)
Peponocyathus dawsoni n.sp.
Tropidocyathus pileus (Alcock)
Notocyathus conicus (Alcock)
Thrypticotrochus multilobatus Cairns

Superfamily FLABELLOIDEA
Family GUYNIIDAE

Pedicellocyathus keyesi n.gen., n.sp.
Truncatoguynia irregularis Cairns
Stenocyathus vermiformis (Pourtalès)
Temnotrochus kermadecensis n.gen., n.sp.

Family FLABELLIDAE

Flabellum (Flabellum) knoxi Ralph & Squires
Flabellum (Flabellum) angiostomum Folkeson
Flabellum (Flabellum) impensum Squires
Flabellum (Ulocyathus) lowekeyesi Squires & Ralph
Flabellum (Ulocyathus) messum Alcock
Flabellum (Ulocyathus) aotearoa Squires
Flabellum (Ulocyathus) hoffmeisteri Cairns & Parker
Flabellum (Ulocyathus) apertum apertum Moseley
Monomyces rubrum (Quoy & Gaimard)
Polymyces wellsi Cairns
Rhizotrochus flabelliformis Cairns
Gardineria hawaiiensis Vaughan
Gardineria sp.
Javania lamprotichum (Moseley)
Javania pachytheca n.sp.
Truncatoflabellum paripavoninum (Alcock)
Truncatoflabellum dens (Alcock)
Truncatoflabellum phoenix n.sp.
Truncatoflabellum arcuatum n.sp.
Placotrochides scaphula Alcock
Falcatoflabellum raoulensis n.gen., n.sp.

Suborder DENDROPHYLLIINA
Family DENDROPHYLLIIDAE

Balanophyllia chnous Squires
Balanophyllia gigas Moseley
Balanophyllia crassitheca n.sp.
Endopachys grayi Milne Edwards & Haime
Eguchipsammia gaditana (Duncan)
Eguchipsammia fistula (Alcock)
Eguchipsammia japonica (Rehberg)
Cladopsammia eguchii Wells
Dendrophyllia arbuscula Van der Horst
Dendrophyllia alcocki (Wells)
Enallopsammia rostrata (Pourtalès)
Enallopsammia cf. *marenzelleri* Zibrowius

ZOOGEOGRAPHY

Vaughan and Wells (1943: 88) made the brief statement that 10 (56%) of the 18 species of New Zealand Scleractinia then known were endemic, the other eight being related to a South Pacific fauna. Based on the slightly larger number of 21 species, Ralph and Squires (1962) suggested that the New Zealand coral fauna originated from pre-Pliocene relicts and a more recent invasion from the Indo-Pacific, and minimised the endemic nature of the fauna. Finally, based on 25 species, Squires and Keyes (1967) stated that 12 species (48%) were endemic, seven were autochthonous (traceable to forms from the New Zealand Neogene), and the remainder shared a relationship with South Pacific and Antarctic faunas, including two species with affinities to the Australian region. They also discussed five general patterns of distribution based on 17 of these 25 species. Their first general pattern (New Zealand endemic) corresponds to pattern 2D discussed below; their second pattern (warm-temperate shelf) corresponds to pattern 2A discussed below; their third pattern includes a miscellaneous group of three species; the fourth pattern groups four eurythermic tropical species (patterns 1B, C, D discussed below), and their fifth pattern also corresponds to two eurythermic tropical species (pattern 1D) and one widespread temperate species (pattern 3A).

The following analysis is based on 104 species, one species *(Conocyathus zelandiae)* remaining unclassified. It includes a much larger area than previous studies of the New Zealand region, defined as having latitudinal boundaries of 24° S and 57°30′ S and longitudinal borders of 157° E to 167° W (the New Zealand region as defined and mapped by Carter (1980)).

Patterns of Distribution

Four general patterns of distribution (Tables 2 and 3) emerge from a study of the distribution patterns of the 104 azooxanthellate species in the New Zealand region, these patterns being in general

Table 3. Patterns of scleractinian distribution within the New Zealand region.

I. Cosmopolitan, Indo-West Pacific, or widespread in Pacific, with a southern range in New Zealand region extending to:	
A. Subtropics (no farther south than 33°S), including Wanganella Bank, Norfolk Ridge; Lord Howe Islands; northern Three Kings Ridge; Colville Ridge; Kermadec Islands ...	29 species
B. Warm-temperate Auckland Province (eurythermic tropical) ...	12 species
C. Cold-temperate region (southern North Island, South Island, Chatham Rise, Campbell and Bounty Plateaus, northern Macquarie Ridge), broad eurythermic tropical ...	8 species
D. Subantarctic (Macquarie Ridge south of 50°S, Hjort Seamount) ...	10 species
II. "Endemic", or thus far known only from:	
A. Warm-temperate Auckland Province ...	7 species
B. Auckland Province and subtropical ridges and islands to north of New Zealand ...	6 species
C. Subtropical ridges and islands north of 33°S (Lord Howe Island, Norfolk Ridge, Three Kings Ridge, Colville Ridge, and Kermadec Islands) ...	14 species
D. Temperate (warm and cold) New Zealand ...	4 species
E. Cold-temperate region ...	2 species
III. Widespread temperate species	
A. Restricted to southern temperate latitudes ...	5 species
B. Disjunct distribution off Japan or northeast Atlantic and New Zealand ...	6 species
IV. Antarctic ...	1 species

agreement with the horizontal distribution of shelf fauna proposed by Briggs (1974).

The commonest pattern of azooxanthellate coral distribution in the New Zealand region is that of species that are widespread in the tropical Indo-West Pacific (or even cosmopolitan) that have their southern limit in the Southwest Pacific in the New Zealand region. Also included in this group are four species (*Tethocyathus cylindraceus, Stephanocyathus coronatus, Dasmosmilia lymani, and Hoplangia duro-trix*) that are thus far known to occur only in the Atlantic Ocean and New Zealand region. This group (pattern 1 of Tables 2–3) consists of 59 species (57% of regional fauna) and can be further subdivided based on the degree of southward extension into the New Zealand region. For instance, 29 of these 59 species are found no farther south than 33°S (pattern 1A). Zooxanthellate corals are known from Lord Howe Island (Veron & Done 1979; Veron 1993: 65 species), Norfolk Island (Veron 1986; Veron, pers. comm., 1993: 5 species), and the Kermadec Islands (Vaughan 1917: 8 species), the latter assumed by some (e.g., Schiel, Kingsford & Choat 1986) to be subtropical. However, there are no islands or shallow banks in the New Zealand region between Esperance Rock (the southern limit of zooxanthellate corals, about 31°20'S) and Three Kings Islands (about 34°), where no zooxanthellate corals are known to occur. But, because 13 of the 29 species having pattern 1A have their southernmost occurrences at 33°S, often at Wanganella Bank on the southern Norfolk Ridge, this latitude was chosen as the boundary between the subtropics and warm-temperate upper slope (200-1000 m) region of New Zealand. It is interesting to note that the northern limit of reef corals in the northwest Atlantic is 34–35°N (MacIntyre 1970) and the northern limit of reef corals in the northwest Pacific is 34°30'N (Veron 1992). Latitude 33°S is also considered to be the northern limit of the warm-temperate upper-slope Auckland Province.

A second distributional pattern (pattern 1B) consists of 12 species that are widespread in the tropics but also extend into the warm-temperate region of New Zealand — the Auckland Province. Briggs (1974) defined this region to include the northern half of North Island from East Cape and 38–39° S on the west coast. He referred to species having this kind of distribution as eurythermic tropical.

A third distributional pattern (pattern 1C) consists of eight species termed "broad eurythermic tropical" by Briggs (1974), including species that are widespread in the tropics but also extend into cold-temperate regions. In New Zealand, the cold-temperate region is defined by Briggs (1974) to include the North Island south of the warm-temperate boundary, South Island, Chatham Rise, Bounty and Campbell Plateaus, and northern Macquarie Ridge north of 50°S. Three of these eight species are cosmopolitan in distribution.

A final, fourth category of widespread species (pattern 1D) is a derivative of the third, consisting of ten species that extend even farther south into Subantarctic waters of the Macquarie Ridge (south of 50°S) and Hjort Seamount. Seven of these ten species have cosmopolitan or near-cosmopolitan distributions. Squires and Keyes' (1967: fig. 4) fourth general pattern of distribution corresponds to patterns 1C–D discussed above.

A second group of distributional patterns comprises those species that are "endemic" or at least so far known only from a restricted geographic range. Seven species (pattern 2A) occur only in the warm-temperate Auckland Province. Because the bathymetric ranges of these species are fairly shallow (i.e., mostly 50–300 m), most of these species may in fact be endemic to this province. This pattern corresponds to Squires and Keyes' (1967: fig. 2) second general pattern of distribution.

A second pattern of "endemics" (pattern 2B) consists of six species that are known only from the warm-temperate region of New Zealand and the subtropical ridges and islands to the north, of which two species also occur as far north as the Chesterfield Islands. The depth ranges of these species are considerably deeper than those of pattern 2A, i.e., none shallower than 130 m, and most ranging from 500–1000 m. For this reason it is likely that these species may eventually be found to be eurythermic tropical species with broader distributions in the upper-slope tropical region (i.e., pattern 1A).

A third category of "endemics" (pattern 2C) consists of 14 species known only from the subtropical ridges (Norfolk, Colville, Kermadec, and Three Kings north of 33°S) and islands (Lord Howe, Norfolk, and Kermadecs) north of New Zealand, of which two species also extend to the Chesterfield Islands. Like pattern 2B, the bathymetric ranges of these species are relatively deep (primarily 300–800 m) and it is likely that at least some of these species will be found to occur more widely in tropical regions (i.e., pattern 1A).

A fourth category of "endemics" (pattern 2D) consists of four species known only from off both warm- and cold-temperate New Zealand. Whereas the two shallow-water species, *Culicia rubeola* and

Monomyces rubrum, are probably endemic to New Zealand, the two other species, *Crispatotrochus curvatus* (1375–2505 m) and *Peponocyathus dawsoni* (87–988 m) are predicted to be found either to the north of New Zealand or in other temperate areas. *Monomyces rubrum* characterised Squires and Keyes' (1967: fig. 1) first general pattern of distribution, that species apparently being the only species in their group.

Two species are known only from the cold-temperate region of New Zealand (pattern 2E): *Flabellum knoxi* and *Labyrinthocyathus* sp. A. *Flabellum knoxi* is widespread and common in this region and serves as a reliable indicator of the cold-temperate upper slope New Zealand region.

A third group of distributional patterns includes widespread temperate patterns. Pattern 3A consists of five upper-slope species that occur in the temperate region of the southern Indian Ocean and/or Australia as well as in the temperate region of New Zealand. Two species (*Flabellum hoffmeisteri* and *Stephanocyathus platypus*) are known only off Australia and New Zealand, and constitute the only (1.9%) unique affinity between the species of these two regions.

Pattern 3B consists of five species known from off temperate Japan as well as temperate to subtropical New Zealand, and one species (*Hoplangia durotrix*) is known only from the temperate northeastern Atlantic and warm-temperate New Zealand. These unusual disjunct distributions may eventually be found to be artefacts of collecting or, possibly the result of species introductions (e.g., *H. durotrix*). If found to be more widely distributed, these patterns might change to 1A, B, C or even 1D.

Category 4 consists of only one species, *Flabellum impensum*, that is Antarctic in distribution with an apparent northern range in the deep water of the cold-temperate Bounty Plateau.

To summarise, a majority (57%) of the 104 azooxanthellate coral species that occur in the New Zealand region represent the southern limit of more widespread tropical or eurythermic tropical species. Some endemic species do seem to occur in the warm-temperate Auckland province (pattern 2A), off New Zealand (pattern 2D), and in the cold-temperate region (pattern 2E), but those known only from the subtropical islands and ridges north of New Zealand (pattern 2C) may well have extended distributions into the tropics. Eleven species (11%) are known from more widespread temperate regions (patterns 3A–B) and one species is Antarctic in affinity (pattern 4).

Briggs (1974: 373) suggested that the horizontal distribution of upper-slope (200–1000 m) faunas "closely follows that of the shelf". Azooxanthellate Scleractinia (and Stylasteridae) are good tests for this theory in that most (i.e., 80%) New Zealand azooxanthellate Scleractinia occur in the upper-slope realm (see below). In general, the distribution of deep-water azooxanthellate Scleractinia (Cairns, 1979, 1982, 1994) have been found to be con-sistent with the generally accepted shallow-water regions and provinces, the New Zealand region being no exception. Consistent with Briggs' (1974) shelf regions and provinces, the corals of New Zealand show tropical, eurythermic tropical, and broad eurythermic tropical components, warm-temperate endemics, and cold-temperate endemics. I diverge from Briggs only in the interpretation of the Kermadec Islands (*see* below).

Regional Affinities

Although 22 azooxanthellate species are known from the Lord Howe Seamount Chain (Table 2), only six are known from off Lord Howe Island or Balls Pyramid. Half of these six species are tropical or eurythermic tropical species (patterns 1A–C), two are known only from the subtropical ridges and islands north of New Zéaland (pattern 2C), and one species, *Balanophyllia crassitheca*, is known from the subtropical New Zealand region as well as the warm-temperate Auckland Province (pattern 2B).

Seventeen of the 36 (Table 2) azooxanthellate species that occur on the Norfolk Ridge also occur off Norfolk Island. Their affinities are primarily tropical (pattern 1A, 9 species) to eurythermic tropical (patterns 1B–D, 5 species). Also, two species are thus far known only from the New Zealand subtropics (pattern 2C) and two species are known from the subtropics and warm-temperate Auckland Province (pattern 2B).

Of the ten species that occur on the Colville Ridge, seven are widespread tropical (pattern 1A) or eurythermic tropical (patterns 1C–D), two are known only from the subtropical ridges north of New Zealand (pattern 2C), and one species, *Flabellum hoffmeisteri,* occurs off cold-temperate south-eastern Australia and Tasmania (pattern 3A).

The zoogeographic affinities of the Kermadec Islands/Ridge have been debated with mixed opinion, perhaps depending on the animal group being analysed and the depth range being considered. Briggs (1974) considered the Kermadecs as a separate province in the warm-temperate region; from fish distributions Shiel *et al.*, (1986) considered the chain to be subtropical; and Gordon (1985), based on Bryozoa, suggested that they were transitional between the northern tropical and temperate neozelanic elements. The 56 species of azooxanthellate Scleractinia (Table 2) known from the Kermadec Ridge show a decided correlation with the tropical region — 19 species are widespread tropical species with their southern range in the Kermadecs (pattern 1A), another 18 species are eurythermic tropical (patterns 1B–D), and nine are known only from the subtropical region (north of 33°S) to the north of New Zealand (pattern 2C), of which three of the latter are known only from the Kermadec Islands. Thus, a total of 46 (82%) of the 56 Kermadec species have tropical or subtropical affinities. Four species (7%) occur in the warm-temperate Auckland Province as well as the subtropical ridges north of New Zealand (pattern 2B), giving support to Briggs' hypothesis of a warm-temperate affinity, and six species are widespread in cold-temperate regions having their northern extension or disjunct distribution in the Kermadec Islands (patterns 3A–B).

Of the 13 species that are known from the Chatham Rise (Table 2), eight are broad eurythermic tropical species (patterns 1C–D), one is endemic to the cold-temperate region of New Zealand, and four are more widely distributed primarily in the southern temperate regions (patterns 3A–B).

In summary, the ridges and islands north of New Zealand (Lord Howe and Norfolk Islands and ridges north of 33°S, Colville Ridge, Kermadec Islands and Ridge) show a strong tropical affinity (patterns 1A–D, 2C) and a very weak affinity to the warm-temperate Auckland province, the latter evidenced by a low number of species sharing pattern 2B.

Bathymetric Distribution

Forty-one (39%) of the 104 New Zealand species occur at shelf depths (0–200 m) within the New Zealand region (Table 2), 14 of which are accessibleby scuba (0–50 m), viz. *Culicia rubeola, Oculina virgosa, Coenocyathus brooki, Labyrinthocyathus limatulus, Polycyathus norfolkensis, Tethocyathus cylindraceus, Hoplangia durotrix, Sphenotrochus ralphae, Kionotrochus suteri, Monomyces rubrum, Cladopsammia eguchii, Caryophyllia profunda, Desmophyllum dianthus,* and *Stenocyathus vermiformis.* The last three species, however, as well as *Madrepora oculata, Aulocyathus recidivus,* and *Dendrophyllia alcocki* (Table 2), are found more commonly at upper-slope depths (200– 1000 m), occurring in shallow water only in the cool upwelled waters of Fiordland. Most (82 species or 80%) of the New Zealand species occur in the upper slope (200–1000 m) and 30 species (39%) occur in the lower-slope region (1000–3000 m). Only one species, *Fungiacyathus marenzelleri,* is known from the abyssal region, as deep as 4954 m west of the Lord Howe Rise. The percentages above exceed 100 because many species occur in more than one bathymetric region. *Conocyathus zelandiae* was not included in the bathymetric analysis, but would probably occur in the 0–100 m zone.

The 104 species (all but *Conocyathus zelandiae*) were scored for their occurrences in eight bathymetric zones: 0–100 m, 100–200 m, 200–400 m, 400–600 m, 600–800 m, 800–1000 m, 1000–2000 m, and 2000–5000 m. These zones were then clustered by UPGMA using NTSYS-PC, version 1.60 (1991). The most obvious result of this cluster analysis was the faunistic break between the species occurring from 0–400 m and those occurring deeper than 400 m, the similarity coefficient between these two clusters being only 0.265. Within the three shallower-water zones, those species occurring at 100–200 m have a strong affinity with those occurring at 200–400 m, whereas the species that occur at 0–100 m are somewhat independent, joining the 100–400 m cluster only at the 0.347 level. This faunistic break at 100 m was also noted by Squires and Keyes (1967: 36) in their bathymetric analysis of 23 New Zealand species.

MINERALOGY

In the context of a more comprehensive analysis of the mineralogy of the Scleractinia, the coralla of eight New Zealand species were analysed by X-ray diffraction to determine their calcium carbonate polymorph. All species consisted of 100% aragonite. The species tested were *Caryophyllia elongata, C. diomedeae, Flabellum aotearoa, Truncatoflabellum dens, Javania pachytheca, Falcatoflabellum raoulensis, Truncatoguynia irregularis,* and *Polymyces wellsi.* All recent Scleractinia thus far analysed have proven to be aragonitic (Filkorn, in press).

CLASSIFICATION

Order SCLERACTINIA
Suborder FUNGIINA
Superfamily FUNGIOIDEA Dana, 1846
Family FUNGIACYATHIDAE Chevalier, 1987

Fungiacyathus Sars, 1872

Corallum solitary, cupolate, and free; septotheca horizontal and usually quite fragile. Costae either thin serrate ridges or rounded and granular. Four or five cycles of septa; septal faces carinate, reflecting underlying trabeculae. All septa attached to their adjacent septa with synapticular plates. Pali may be present; columella spongy.

Key to the six species of *Fungiacyathus* known from the New Zealand Region

1 Five cycles of septa (96 septa) *F. (Fungiacyathus)* 2
Four cycles of septa (48 septa) *F. (Bathyactis)* 4

2 Septal and costal edges straight; numerous trabecular spines on inner septal edges .... *F. pusillus pacificus*
Septal and costal edges sinuous (corrugated); no trabecular spines 3

3 Small P2 present; septal lobes quite tall .... *F. stephanus*
P2 absent; septal lobes not tall .... *F. fragilis*

4 Costae rounded and granular; intercostal furrows deep near calicular edges (as in a turbinoliid); coralla small (≤ 11 mm GCD) .... *F. turbinolioides*
Costae ridged and serrate or granular; intercostal regions shallow; adult coralla 18–40 mm in diameter 3

5 Base flat; all costae serrate ridges; trabecular ridges sparse and widely spaced (about 1.0–1.75 mm apart); diameter up to 40 mm .... *F. marenzelleri*
Base highly concave; C1–3 rounded and granular; trabecular ridges numerous and closely spaced (about every 0.4 mm apart); diameter up to 18 mm .... *F. margaretae*

Fungiacyathus (Fungiacyathus) Sars, 1872

Fungiacyathus having 96 septa (5 cycles).

Type Species: *Fungiacyathus fragilis* Sars, 1872, by monotypy.

Remarks: Six species are known in the nominate subgenus, including one exclusively fossil species (*F. euaensis* Wells, 1977, Eocene of Tonga) and one as yet undescribed species (*F.* sp. A of Cairns, 1994, North Pacific). The other four are *F. pusillus* (Pourtalès, 1868; *F. fragilis* Sars, 1872, *F. stephanus* (Alcock, 1893), and *F. paliferus* (Alcock, 1902). The recent species occur worldwide at 99–2200 m.

Fungiacyathus (F.) stephanus (Alcock, 1893)
(Plate 1, a-c)

Bathyactis stephanus Alcock, 1893: 149, pl. 5, figs 12, 12a.
Bathyactis stephana: Alcock 1898: 28–29, pl. 3, figs 5, 5a.
Fungiacyathus (F.) stephanus: Cairns 1989a: 7–9, pl. 1, figs a-k, pl. 2, figs a-b (synonymy); Cairns & Keller 1993: 230; Cairns 1994: 37, pl. 13, figs g-i.

Material Examined: New Records: NZOI Stn E774, 1, USNM 93983; Stn E784, 2, NZOI; Stn E869, 1, USNM 93984; Stn F911, 1, NZOI; Stn K805, 1, NZOI; Stn U197, 3, USNM 93985. Previous Records: *See* Cairns (1989a: 8).

Distribution: New Zealand region: Lord Howe Rise; Norfolk Ridge; Kermadec Ridge; Challenger Plateau; east of North Cape (Map 1); 1142–1705 m. Elsewhere: southwest Indian Ocean; Gulf of Aden; Bay of Bengal; off Japan; Philippines; Indonesia; 245–2000 m.

Types: The holotype is presumed to be deposited at the Indian Museum, Calcutta.

Type Locality: *Investigator* Stn 133, 15°43'30 N, 81°19'30 E (off Krishna Delta, Bay of Bengal), 1240 m.

Remarks: Complete descriptions and synonymies of this species are given by Cairns (1989a, 1994) in the context of revisions of the Philippine and North Pacific Scleractinia, respectively. The records reported herein represent a southern range extension for the species and the first record from the New Zealand region. The largest New Zealand specimen (NZOI Stn U197) is 39.5 mm in calicular diameter and 17.2 mm in height, which is thought to be about the maximum size for the typical (concave base) form of the species.

Fungiacyathus stephanus is quite similar to *F. fragilis* and is compared to that species in that account. It is distinguished from other species in the subgenus by having extremely tall septal lobes, a broad marginal shelf, and highly corrugated septa.

Fungiacyathus (F.) fragilis G. O. Sars, 1872
(Plate 1, d, f)

Fungiacyathus fragilis Sars, 1872: 58, pl. 5, figs 24–32; Zibrowius 1980: 23–24, pl. 5, figs A–J (synonymy); Cairns 1982: 7, pl. 1, figs 3–7 (synonymy).
Bathyactis hawaiiensis Vaughan, 1907: 145–147, pl. 27, figs 1, 1a.
Not *Fungiacyathus symmetricus fragilis* Keller, 1976: 41–43 (junior homonym).

MATERIAL EXAMINED: New Record: NZOI Stn E880, 2 fragments, USNM 93975. Previous Records: Specimens reported by Cairns (1982): *Eltanin* Stn 1412 and 1846; holotype of *B. hawaiiensis*.

DISTRIBUTION: New Zealand region: off west coast of New Zealand (rare) and Macquarie Ridge (Map 1); 1029–1693 m. Elsewhere: North Atlantic; Hawaiian Islands; 285–2200 m.

TYPES: One syntype of *F. fragilis* is known to be deposited at the Oslo Museum (B626). The holotype of *B. hawaiiensis* is deposited at the USNM (20834).

TYPE LOCALITIES: *F. fragilis*: "Skraaven in Lofoten" (Norway), 549 m. *B. hawaiiensis*: *Albatross* Stn 4125, between Oahu and Kauai, Hawaiian Islands, 1761–2056 m.

REMARKS: Nothing can be added to the descriptions of this species previously given by Zibrowius (1980) and Cairns (1982). The largest New Zealand specimen examined (*Eltanin* Stn 1846) is 25.6 mm in diameter. It is quite similar to *F. stephanus*, the only other species in the subgenus to attain a large calicular diameter. In fact, damaged and/or juvenile specimens of the two species are difficult to distinguish; however, adult *F. fragilis* differs by lacking P2, lacking a marginal shelf, and by having much lower septal lobes.

Fungiacyathus (F.) pusillus pacificus n. subsp.
(Plate 1, g-i, l)

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: Known only from the New Zealand region on the Norfolk, Three Kings, and southern Colville Ridges (Map 13); 350–988 m.

DESCRIPTION: Holotype 17.5 mm in diameter and 8.8 mm in height; largest specimen (NZOI Stn I97) 21.4 mm in diameter. D:H of most well-preserved specimens about 2. Base flat to slightly concave. Costae straight, finely serrate ridges, appearing as beaded in centre of worn coralla. Intercostal width near calice edge 2–4 times width of a costa. Corallum white.

Septa hexamerally arranged in 5 complete (96 septa) cycles, even in coralla as small as 9.0 mm diameter. S1 consist of 3 or 4 thick, ridged inner trabecular spines that are vertical to slightly incurved in shape. Peripheral to these spines is a tall septal lobe bearing 12–15 vertical serrate ridges on each face, the ridges alternating in position on either septal face. Peripheral to the tall lobe are 13–15 trabeculae that form a series of disjunct lobes, each composed of only 2 or 3 trabeculae. 11 or 12 synapticulae occur per S1, the largest usually the sixth from the centre. S2 consist of 5 or 6 inner trabecular spines, the inner 3 inclined toward the columella (the third being quite massive), the outer 2 or 3 smaller and inclined outward. Peripheral to these spines is a tall septal lobe similar in size and shape to that of the S1, but positioned slightly further from centre of fossa and inclined slightly outward (not vertical). Peripheral to the tall S2 lobe is a similar arrangement of 13–15 trabeculae that form smaller, disjunct lobes, as in the S1. S3 consist of 4 large inner trabecular spines, each spine consisting of 2 or 3 trabeculae, bordered by a septal lobe consisting of 7–9 ridges per face. S3 lobe positioned further outward from centre of calice than S2 lobe and orientated even more obliquely, its outer edge extending beyond the base. This overextension of the S3 lobes and the virtually vertical outer edges of all septa produces a slight marginal shelf encircling the corallum, quite similar to that seen in some species of *Stephanophyllia*. Outer edges of S3 consist of 7–9 trabeculae arranged in smaller lobes. S4 consist of 12–15 trabecular spines, some of them doubled into small lobes, but not united into a larger septal lobe. S5 consist of 5–7 slender trabecular spines. All septa are planar with straight edges, having no sinuousity or undulations. Only S1 are independent; pairs of S5 fuse to S4, pairs of S4 to S3, and pairs of S3 to S2, the inner edges of the S1–2 reaching the columella. No septal canopies are present. Columella papillose and indistinguishable from inner septal trabecular spines of S1-2.

TYPES: Holotype: NZOI Stn U599, NZOI H-621. Paratypes: NZOI Stn G3, 2, NZOI P-1000; Stn I96, 3, NZOI P-1001; Stn I97, 12, NZOI P-1002, 6, USNM 93974; Stn K795, 3, NZOI P-1003; Stn P10, 3, USNM 93973; Stn U582, 3, USNM 93972; Stn U591, 1, NZOI P-1004; Stn U599, 7, NZOI P-1005, 5, USNM 93971.

TYPE LOCALITY: 30°43'S, 173°16'E (northern Three Kings Ridge), 590–640 m.

ETYMOLOGY: The subspecies name *pacificus* alludes to the larger-sized Pacific subspecies of the species.

REMARKS: *Fungiacyathus pusillus pacificus* is easily distinguished from *F. fragilis* and *F. stephanus* by its planar septa and solid corallum; it differs from *F. paliferus* in having serrate (not granular) costae, and in lacking P2; it differs from *Fungiacyathus* sp. A (*sensu* Cairns 1994) in lacking septal canopies and in having a papillose columella. But, *F. pusillus pacificus* is remarkably similar to the nominate subspecies (Pourtalès 1868), which is known only from the Caribbean at 285–439 m (*see* Cairns 1979), apparently differing only in size. The maximum known size for the Atlantic subspecies is 16.8 mm, that of the Pacific subspecies 21.4 mm. Correlated with the larger calicular diameter, *F. pusillus pacificus* also has better-developed and more numerous trabeculae per corresponding septal cycle.

Fungiacyathus (Bathyactis) Moseley, 1881

Fungiacyathus having 48 (four cycles) septa.

TYPE SPECIES: *Fungia symmetrica* Pourtalès, 1871, by monotypy.

REMARKS: Nineteen species are known in this subgenus (*see* Cairns 1989a, Filkorn in press), five of them exclusively fossil in occurrence. The remaining 14 species occur worldwide at depths of 183-6328 m.

Fungiacyathus (B.) marenzelleri (Vaughan, 1906) (Plate 1, j-k)

Bathyactis marenzelleri Vaughan, 1906a: 66–67, pl. 4, figs 1-1b.

Fungiacyathus marenzelleri: Cairns 1979: 35–37, pl. 2, figs 8-9, pl. 3, figs 3, 8 (synonymy); Zibrowius 1980: 24–25, pl. 6, figs A–M, pl. 7, figs A–K (synonymy); Cairns 1982: 5–7, pl. 1, figs 1–2, 8 (synonymy); 1994: 15–16, pl. 1, figs a-f (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn J667, 3, USNM 93976; Stn P939, 1, USNM 93978; Stn U203, 8, USNM 93977; Stn U204, 1, NZOI; Stn U224, 15, NZOI. Previous Records: Type series of *B. marenzelleri*.

DISTRIBUTION: New Zealand region: abyssal plain south of Lord Howe Island; Bellona Trough; Raukumara Plain (Map 1); 1760–4954 m. Elsewhere: virtually cosmopolitan, including amphi-Atlantic, amphi-Pacific, Subantarctic, and off continental Antarctica (Cairns 1994); 300–6328 m.

TYPES: The holotype is deposited at the USNM (47415) and three paratypes are at the MCZ.

TYPE LOCALITY: *Albatross* Stn 4721, 8°07.5' S, 104°10.5' W (off Peru), 3820 m.

REMARKS: Because of its widespread distribution, *F. marenzelleri* has been adequately described and figured before (see synonymy) and will therefore not be redescribed here. It differs from the other species in its subgenus by having a relatively large corallum, straight septal edges, and relatively few, widely spaced trabecular ridges. A large, well-preserved New Zealand specimen (NZOI Stn J667, Plate 1, j, k) is 34.7 mm in diameter, but even larger coralla up to 40 mm GCD have been reported (Cairns 1989a). *Fungiacyathus marenzelleri* is the deepest-living coral known, and represents the deepest record of a scleractinian from the New Zealand region.

Fungiacyathus (B.) margaretae n. sp. (Plate 2, a-c)

MATERIAL EXAMINED: Types, q.v.

DISTRIBUTION: Known only from the northern Colville Ridge (Map 20); 635–673 m.

DESCRIPTION: Holotype 16.3 mm in calicular diameter and 8.3 mm in height; largest specimen (NZOI Stn P944) 18.3 mm in diameter. Base highly concave, the outer septal edges extending as much as 2 mm beyond basal perimeter. C4 consist of narrow, serrate ridges, but C1–3 are wider (about 0.35 mm) and rounded, bearing small, rounded granules. CS1–3 develop small (1.1 mm), downward projecting spurs at calicular edge. Corallum white.

Septa hexamerally arranged in four complete cycles. S1 consist of 2 or 3 inner trabecular spines bordered by a highly exsert septal lobe that bears 16–23 closely spaced, vertical, serrate ridges, these ridges becom-ing horizontally oriented near calicular edge. S2 less exsert, consisting of 3 or 4 inner trabecular spines, bordered by a slightly smaller lobe consisting of 10–13 trabecular ridges. S3 about two-thirds width of an S3 and consist of a lobe of 8 or 9 projecting trabecular spines, each pair of S3 solidly fused to their common S2 by an imperforate canopy. S4 about two-thirds width of an S3 and also consist of 8 or 9 projecting trabecular spines, each pair of S4 solidly fused to their common S3 through an imperforate canopy. Both S1 and S2 extend from columella to calicular edge, the S1 being the only independent septa. Septa are planar with straight inner edges. Synapticular plates solid, 7 or 8 per S1 or S2, the sixth from the columella being the tallest, rising well above the adjacent S4. Columella a central, circular plate 2.5–3.0 mm in diameter, often slightly concave and usually penetrated by various trabecular spines from the inner edges of the S1–2.

Types: Holotype: NZOI Stn P944, NZOI H-622. Paratypes: NZOI Stn P944, 1, USNM 93979; Stn P947, 2, NZOI P-1006; Stn P966, 1, USNM 93980.

Type Locality: 27°20.8′ S, 179°20.9′ W (Colville Ridge), 673 m.

Etymology: This species is named in honour of my wife.

Remarks: Among the 13 other recent species in this subgenus, *F. margaretae* is most similar to *F. granulosus* Cairns, 1989a (Philippines, 390–567 m), both species having granular costae and similarly shaped septal trabecular ridges. *Fungiacyathus margaretae* differs in having a highly concave base, costoseptal spurs, more exsert S1, more highly developed synapticular plates, and a smaller corallum.

Fungiacyathus (B.) turbinolioides Cairns, 1989
(Plate 2, d, e)

Fungiacyathus (B.) turbinolioides Cairns, 1989a: 12–13, pl. 6, figs a-g.

Material Examined: New Records: NZOI Stn E275, 1, NZOI; Stn E868, 1, USNM 93981; BS391, 6, MoNZ CO252, 3, USNM 93982; *Slope* Stn 33, 1, USNM, 2, NMV F67776. Previous Records: Type series.

Distribution: New Zealand region: southern Norfolk Ridge; off Three Kings Islands (Map 13); 600–751 m. Elsewhere: Celebes Sea; Formosa Strait; off Victoria (reported herein); 622–930 m.

Types: The holotype and 65 paratypes are deposited at the USNM; two paratypes are also deposited at the AMS.

Type Locality: *Albatross* Stn 5586, 4°06′50 N, 118°47′20 E (off Sabah, Celebes Sea), 635 m.

Remarks: *Fungiacyathus turbinolioides* was recently described and figured; nothing can be added to our knowledge of that species based on the worn New Zealand specimens except for the range extension. It is easily distinguished from other *Fungiacyathus* by its deep peripheral intercostal furrows that separate wide, granular costae, which makes it appear like a turbinoliid from a basal view. Other distinguishing characters include its robust compound trabecular spines; relatively few (3 or 4), low synapticular plates per S1 (barely visible in an intact corallum); and lack of septal canopies.

Family MICRABACIIDAE Vaughan, 1905

Letepsammia Yabe & Eguchi, 1932d

Corallum solitary, discoidal, and free; a small marginal shelf usually present. Costae thin and ser-rate, separated by wide, porous intercostal regions. Synapticulothecate, highly perforate septa alternat-ing in position with an equal number of costae. Columella spongy to papillose.

Type Species: *Stephanophyllia formosissima* Moseley, 1876, by original designation.

Remarks: Three species are currently recognised in this genus: *L. formosissima* (Moseley, 1876), *L. superstes* (Ortmann, 1888), and *L. fissilis* n. sp.

Letepsammia superstes (Ortmann, 1888)
(Plate 2, f-i)

Stephanophyllia superstes Ortmann, 1888: 160–161, pl. 6, fig. 5; Owens 1986b: 487.

Stephanophyllia (Letepsammia) japonica Yabe & Eguchi, 1932b: 443 (*nom. nud.*); 1934: 281, figs 1-3; 1942b: 139, 156–157, pl. 12, fig. 8.
Micrabacia japonica: Omura 1983: 119.
Stephanophyllia japonica: Zou 1988: 75, pl. 5, fig. 7.
Letepsammia formosissima forma *superstes*: Cairns 1994: 40–41, pl. 15, figs. c, f.

MATERIAL EXAMINED: New Records: NZOI Stn K795, 3, USNM 94080; Stn K828, 1, USNM 94081; Stn K838, 1, NZOI; Stn K840, 11, USNM 94082; Stn T256, 1, NZOI; BS441, 3, MoNZ CO226.

DISTRIBUTION: New Zealand region: Kermadec Ridge (Map 20); 200–710 m. Elsewhere: Sagami Bay, Japan, to off Hong Kong, South China Sea; 77–307 m (Cairns 1994).

DESCRIPTION: Corallum discoidal to patellate, some coralla having a flat base but most having a slightly conical base, the basal angle as low as 140°. Largest corallum examined (NZOI Stn K840) 19.7 in diameter and 7.4 mm in height. Costal ridges about 0.15 mm wide near calicular edge, separated by intercostal spaces about 2 times as wide. Each costa bears a uniserial row of small (0.10–0.15 mm in height), closely adjacent, blunt teeth, producing finely serrate costal edges. Costae project 0.5–0.7 mm beyond septal edge perimeter, producing a narrow marginal shelf. Regularly spaced cylindrical synapticulae unite each costa to its 2 adjacent septa, 25–36 synapticular bridges occurring per major septum (= corallum radius) depending on size of corallum. Synapticular bridges create a series of intercostal pores that increase in diameter from epicentre to calicular edge (e.g., 0.10–0.25 mm diameter range). Corallum white.

Septa invariably 96 in number, arranged in typical micrabaciid fashion. S1 independent and semicircular in profile, with an oblique inner edge that slopes toward the columella. S1 bear 16 or 17 slender trabecular spines, the innermost spines inclined toward columella. S2 bear about 13 trabecular spines, the innermost 3 spines quite robust, cylindrical, and finely granular. S3, prior to bifurcation, bear 2 or 3 massive (0.5 mm in diameter), cylindrical spines, which constitute the highest point of corallum. Remaining S3 trabecular spines are smaller diameter cylinders or flattened perpendicular to septal plane. Each pair of S3 solidly fuses to its common S2 near columella. All septa highly porous and solidly fused to one another by synapticular rods that are circular to slightly elliptical in cross section, which usually occur in oblique rows relatively high in corallum. Fossa shallow, containing an elliptical field of 11–18 slightly clavate granular papillae, all interconnected among their bases.

TYPES: The holotype of *S. superstes* is deposited at the Strasbourg Zoological Museum. Two syntypes of *S. japonica* are deposited at the TIUS (50236).

TYPE LOCALITIES: *S. superstes*: Sagami Bay. *S. japonica*: Pleistocene limestone of the Ryukyu Islands.

REMARKS: In my revision of the North Pacific Scleractinia (Cairns 1994), I referred to the Japanese populations of this species as *L. formosissima* forma *superstes*, the Japanese specimens described as differing from typical *L. fomosissima* in being smaller, having fewer septa, and having a papillose columella. Having seen additional specimens of this species from the New Zealand region I now believe this "form" to represent a distinct species, *L. superstes*. It differs from *L. formosissima* in having a smaller corallum (GCD max. 20 mm vs 47 mm for *L. formosissima*); having fewer septa (96 vs ≥120 for *L. formosissima*); having spinose, sloping inner S1 edges (those of *L. formosissima* are vertical and not spinose); having a flat-based to patellate corallum (coralla of *L. formosissima* are exclusively flat); and having a papillose columella (that of *L. formosissima* is spongy). Overall, *L. superstes* has a denser, more robust corallum and more closely spaced septa.

Letepsammia fissilis n. sp. (Plate 3, a-e)

?*Stephanophyllia formosissima*: Wells 1958: 263 (part: specimen from New Zealand); Ralph & Squires 1962: 16.
Letepsammia sp. Squires 1964b: 3; Squires & Keyes 1967: 21, pl. 4, fig. 1.

MATERIAL EXAMINED: Types, q.v.; specimens reported by Squires (1964b) as *Letepsammia* sp. (*Ikatere* Stn B23, B26, B27, and *Lachlan*, AIM).

DISTRIBUTION: Known only from New Zealand region from southernmost Norfolk Ridge; off Three Kings Islands; and off North Island from North Cape to East Cape (Map 10); 106–206 m.

DESCRIPTION: The typical shape of this species is a triangular wedge-shaped sector representing one-sixth (or 1 system minus enclosing S1) of a typical micrabaciid corallum. Its outer (calicular) edge is rounded and its two sides straight, making an inner angle of about 60°. In time, these wedges grow outward as well as generate additional septa, resulting in an increase in radius and edge angle. In only one case (NZOI Stn P5) was an entire circular corallum generated from an initial fragment, the calice being 12.5 mm in diameter. Most sectors appear to originate at a calicular radius of about 9 mm and a septal complement of 19. Multiplying 19 by 6 and adding 6 for the missing S1 yields a theoretical complement of 120 septa for an entire corallum. The holotype began from such a sector, but extended its radius to 12.1 mm and widened its calicular edge to encompass 31 septa. Regeneration of the original wedge-shaped corallum is most easily seen and illustrated in basal view (Plate 3, e) as discontinuities or irregular additions to the costal structure. Costae are typical for the genus, consisting of narrow (0.10–0.15 mm), finely granular costal ridges separated by rather wide (about 0.3 mm), porous intercostal regions. Virtually all specimens examined were worn, but it would appear that a low marginal shelf is present. Corallum white.

Most coralla contain 12–32 septa, the majority having 19, and only one (the complete but juvenile corallum from NZOI Stn P5) having 96 septa. Septal complements between 20–32 are the result of irregular additions by septal bifurcation of peripheral septa of the original wedge. Because fission appears to occur along the symmetry of the S1, these septa are lost in the process. S2 independent and unbranched, rather low in relief, and highly porous, bearing 20–25 trabecular spines that constitute its entire border. S3 bifurcate in micrabaciid fashion, being quite irregularly developed along edges of regenerating coralla. Synapticulae absent from septal faces, but do occur basally, linking septa to costae. This lack of septal synapticular reinforcement may predispose the corallum to splitting and explain the usual loss of the S1 and columella following fission.

Types: Holotype: BS881 (O627), MoNZ CO281. Para-types: NZOI Stn E256, 2, NZOI P-1007; Stn E261, 4, NZOI P-1008; Stn E359, 2, NZOI P-1009; Stn P5, 1, NZOI P-1010; BS770 (R128), 1, MoNZ CO308; BS833, 18, MoNZ CO287, 6, USNM 94085; BS881 (O627), 10, MoNZ CO281, 3, USNM 94086; BS897 (O643), 2, MoNZ CO223; *Ikatere* Stn B26, 6, USNM 81868; *Lachlan*, 10, USNM 81869.

Type Locality: 34°20′ S, 173°06′ E (off North Cape), 163–168 m.

Etymology: The species name *fissilis* (Latin *fissilis*, splittable) refers to the fragile nature of the corallum of this species, which often splits into six wedge-shaped fragments.

Remarks: *Letepsammia fissilis* is distinguished from its two congeners by its distinctive asexual form of reproduction and regeneration, mitigated by its lack of septal face synapticulae. Although an intact corallum would appear to consist of 120 septa, as in *L. formosissima*, it differs from that species in having a smaller but more robust corallum. Furthermore, *L. formosissima* occurs at a greater depth in the New Zealand region. *Letepsammia fissilis* is approximately the same size as *L. superstes*, but would appear to have more septa in the fully developed condition (120 vs 96) and a flat base. Furthermore, *L. superstes* is characteristic of deeper waters to the north of the range of *L. fissilis*.

Letepsammia formosissima (Moseley, 1876)
(Plate 3, f, g)

Stephanophyllia formosissima Moseley, 1876: 561–562.
Letepsammia formosissima: Owens, 1986b: 486–487; Cairns, 1989a: 15–18, pl. 6, fig. j, pl. 7, fig. g-i, pl. 8, figs a-d (synonymy); Cairns & Parker, 1992: 8–9, pl. 1, figs f, h; Not Cairns, 1994: 40–41, pl. 15, figs c, f (= *L. superstes*).

Material Examined: New Records: Stn K804, 5 (dead), NZOI; Stn K844, 1, NZOI; Stn P10, 6, USNM 94084; Stn P14, 5, USNM 49232; Stn T256, 1, NZOI; BS888 (O634), 1, MoNZ.

Distribution: New Zealand region: southern Norfolk Ridge, including Wanganella Bank; Kermadec Islands (off Raoul, Macauley, and Curtis) (Map 10); 290– 378 m. Elsewhere: Indo-West Pacific from south-west Indian Ocean to Hawaiian Islands and South China Sea; 97–457 m.

Diagnosis: Discoidal coralla up to 46.7 mm in diameter (NZOI Stn P10); base flat to slightly convex; D:H up to 4.9 in large specimens. Thin (0.06–0.07 mm), ridged costae bear very small teeth or short spines, producing a finely serrate edge; intercostal regions quite wide (3–6 times costal width) and porous, the synapticular bars connecting each costa to its 2 alternating, adjacent septa clearly visible in basal view through the intercostal region. Synapticulae circular in cross section and rather scarce, restricted to base and lower edges of septa. A low, marginal shelf up to 3 mm wide present on well-preserved specimens. Corallum white.

Septa arranged in typical micrabaciid fashion (Cairns 1989a: text-fig. 2), attaining 144 septa at a calicular diameter of 30-40 mm, but larger coralla of up to 46 mm diameter (MoNZ CO153) having up to 199 septa. S1 independent and unbranched, having a smooth upper, inner edge, but a spinose peripheral edge. S2 also unbranched but not independent, a pair of S3 fusing to each S2 near the columella. Each S3 bifurcates repeatedly, producing a majority of the septa. S1–2 primarily non-porous, except for attenuate region in vicinity of marginal shelf, where all septa are porous. S3 also porous to varying degrees at regions of septal bifurcation. Columella elongate, papillose, and often heavily fused.

TYPES: Five syntypes are deposited at the BM(NH).

TYPE LOCALITY: Philippines and Indonesia, 174–236 m.

REMARKS: *Letepsammia formosissima* is compared to the two other species in its genus in previous remarks, but it is most likely to be confused with *Rhombopsammia niphada* Owens, 1986a. *Letepsammia formosissima* differs from the latter in having porous S1 and no vepreculae and lacking septal canopies. Furthermore, *R. niphada* is more typical of deeper water (405–804 m) and is not yet known from the New Zealand region.

Stephanophyllia Michelin, 1841

Corallum solitary, discoidal, and free; a small marginal shelf may be present. Costae granular. Synapticulothecate, 96 imperforate septa alternate in position with costae, the septa and costae interconnected by elongate, bar-shaped synapticulae in base (fulturae) or septal face synapticulae circular to elliptical in cross section. Columella lamellar to papillose.

TYPE SPECIES: *Fungia elegans* Bronn, 1837, by original designation.

REMARKS: The generic synonymy is discussed in detail by Cairns (1989a) and the four species compared in a tabular key. The recognised species are *S. elegans* (Bronn, 1837) (Mio-Pliocene, Europe); *S. complicata* Moseley, 1876; *S. fungulus* Alcock, 1902b; and *S. neglecta* Boschma, 1923.

Stephanophyllia complicata Moseley, 1876

(Plates 3, h, 4, a-e)

Stephanophyllia complicata Moseley, 1876: 558–561, text-fig; 1881: 198–201, pl. 4, fig. 12, pl. 13, figs 3–5; Van der Horst 1926: 51; 1931: 11; Gardiner & Waugh 1939: 234; Pillai & Scheer 1976: 14; Cairns 1989a: 21, pl. 12, figs. a-b; Cairns & Keller 1993: 231–232.

MATERIAL EXAMINED: New Records: NZOI Stn I96, 1, NZOI; Stn P13, 1, NZOI; Stn P14, 1, USNM 94078; Stn U568, 1, NZOI; Stn U584, 11, USNM 94079; Stn U592, 1, NZOI. Previous Records: Syntypes of *S. complicata*; specimens reported by Van der Horst (1926, 1931).

DISTRIBUTION: New Zealand region: southern Norfolk Ridge; Three Kings Ridge (Map 10); 319–1137 m. Elsewhere: Indian Ocean (Saya de Malha Bank, Chagos and Maldive Archipelagos); Banda Sea; 229–236 m.

DESCRIPTION: Corallum up to 18 mm in diameter and 7.2 mm in height (NZOI Stn U584), with vertical outer edges and a flat to slightly convex base. Costae flat and relatively wide (about 0.20 mm at calicular edge), each separated by a porous intercostal space about same width. In large coralla each intercostal region is bridged at regular intervals by 20–22 synapticular bars, which produce the porous basal structure. Each costa bears a central row of granules (about 50 µm in diameter) for its innermost 3–4 mm, beyond which the granules slightly decrease in size and form 2 rows, 1 row on each edge of the costa, the central region being flat to slightly concave. At calicular edge costae often slightly upturned, bifid, and extend about 0.5 mm beyond septal perimeter, producing a small marginal shelf. Corallum white.

Septa invariably 96 in number arranged in typical micrabaciid fashion like that of *S. fungulus* (Cairns 1989a: text-fig. 3); however, in 2 specimens (figured syntype and 1 from NZOI Stn U584) pairs of very small septa appear to diverge from the outer edges of both S1 and S2. S1 independent, usually unbranched, and have an arched upper edge describing a half circle; a vertical, non-spinose inner edge that borders the columella; and a spinose upper outer edge that reflects the 18–21 trabecular spines that project from the septum. Trabecular spines gradually decrease in size away from the columella, each spine corresponding to a low, serrate ridge (vepreculum) on the septal face. S2 consist of 3 or 4 rather massive, inward-inclined trabecular spines, peripheral to which is a semicircular septal lobe composed of about 15 trabecular spines. S3 and its subsequent bifurcations also consist of trabecular spines, the innermost region of each S3 bearing 2 or 3 thick spines. Each pair of S3 strongly fused to its common S2 by their inner edges as well as by numerous synapticular bars. Synapticular bars solidly join all adjacent septa, particularly the S1 and its adjacent septa, the bars (fulturae) occurring from the base to quite high in the corallum. All septa imperforate; S1–2 planar and straight, whereas S3, because of their repeated bifurcations, appear to meander. Fossa shallow, containing a prominent, narrow (0.5 mm wide), lamellar columella, the summit of which is often divided into papillae or stout, lamellar segments.

TYPES: Two syntypes are deposited at the BM(NH) (1880.11.25.155A–B).

TYPE LOCALITY: *Challenger* Stn 192, 5°42′ S, 132°25′ E (off Kai Islands, Banda Sea), 236 m.

REMARKS: *Stephanophyllia complicata* differs from the two other recent species in the genus by having a relatively thin, lamellar columella and in having S1 with vertical, non-spinose inner septal edges. Also, *S. complicata* attains a larger size than the other species and has more widely spaced septa. *Stephanophyllia complicata* is further differentiated from *S. fungulus* by having a thinner base and synapticular bars that are circular in cross section, not as massive and elongate as those in *S. fungulus*.

Suborder FAVIINA
Superfamily FAVIOIDEA Gregory, 1900
Family RHIZANGIIDAE d'Orbigny, 1851

Culicia Dana, 1846

Corallum colonial (reptoid), consisting of short, cylindrical corallites linked together by stolons. Corallites epithecate, the epitheca often rising above upper, outer septal edges as a thin, continuous rim. S1 and often S2 lobate; higher cycle septa lobate to coarsely dentate. Paliform lobes often present; columella papillose.

TYPE SPECIES: *Culicia stellata* Dana, 1846, by subsequent designation (Wells 1936).

REMARKS: Approximately 15 species have been described in the genus *Culicia*, but, like for most other shallow-water azooxanthellate genera, a worldwide revision is needed to establish the valid species and their synonyms. Despite the report of at least four species of *Culicia* from New Zealand waters, it is suggested that only one species exists, *C. rubeola*, and that it may be endemic to this region.

Culicia rubeola (Quoy & Gaimard, 1833)
(Plates 4, g, h, 5, a-c)

Dendrophyllia rubeola Quoy & Gaimard, 1833: 197–198, pl. 15, figs 12–15; Dana 1846: 389.
Angia rubeola: Milne Edwards & Haime 1848c: pl. 7, figs 6, 6a; 1849: 176.
Cylicia rubeola: Milne Edwards & Haime 1857: 607–608; Not Tenison Woods 1878a: 324, 325 (= *C. hoffmeisteri*); ?Tate 1890: 173; Not Dennant 1904: 9 (= *C. australiensis*); Not Howchin 1909: 247 (= *C. hoffmeisteri*).
Cylicia huttoni Tenison Woods, 1879: 132, pl. 12, fig. 1; Hutton 1904: 315.
Not *Culicia rubeola*: Wells 1954: 464–465, pl. 185, figs 3–6.
Culicia rubeola: Squires 1960c: 6–7, figs 5–6; Ralph & Squires 1962: 4–5, pl. 1, figs 1–5; Squires 1964b: 3; Squires & Keyes 1967: 21, pl. 1, fig. 1; Morton & Miller 1968: 159–160, pl. 7, fig. 4; Grace & Grace 1976: 99; Dawson 1979: 28; Brook 1982: 168–169; Hayward, *et al.* 1985: 101.
Not *Culicia* sp. cf. *C. rubeola:* Cairns 1991a: 7.

MATERIAL EXAMINED: New Records: NZOI Stn C910, 1, NZOI; Stn M763, 3, NZOI; Stn M793, 20, USNM 94000; Stn S251, 3, NZOI; Doubtful Sound, 20–30 m, 2, USNM 76306; Ocean Beach, Kawhia, 20, AUM 12020; Rangaunu Harbour, 82 m, 6, AUM 147; Manukau Harbour on bivalve *Perna canaliculus*, 2, AUM 140, H1201; between Great and Little Barrier Islands, 77 m, 1, AIM. Previous Records: Some of the specimens reported by Ralph and Squires, 1962 (AIM); Squires, 1964b (AIM); and Squires and Keyes, 1967 (NZOI).

DISTRIBUTION: New Zealand region: Probably endemic to New Zealand region, off all coasts of North Island and off Fiordland (Map 6); 0–82 m.

DESCRIPTION: Colonies low and encrusting, formed by reptoid budding from short, flat stolons. If the substratum is smooth (e.g., a bivalve shell, Plate 4, g, h), a circular colony may develop, one of the larger known colonies (AUM 140) being 60 mm in diameter and consisting of about 200 corallites. In these circular colonies, corallites are relatively short (1.5–2.0 mm) and usually spaced less than 1 calicular diameter from each other, but rarely directly adjacent. The reptoid budding sequence can usually even be traced to a founder corallite, which is invariably ≤ 8 budding generations from colony edge. Corallites in centre of colony vertical, whereas peripheral corallites are usually inclined outward. But if the substratum is irregular or other organisms are competing from the same space, corallites are more irregular in arrangement, have longer stolons, and are often taller (up to 8 mm). Calices circular and 3.0–6.0 mm in diameter (although most corallites are 3.5–4.5 mm in diameter), larger corallites apparently associated with sheltered environments (Brook 1982). Coralla epithecate, bearing thin, horizontal thecal corrugations encircling each corallite. Occasionally vertical granular costae are detectable beneath the veil of epitheca, the epitheca rising above the level of the septa as a thin, entire (smooth), circular rim. Corallum white; polyps pink.

Septa hexamerally arranged in 4 cycles, the fourth cycle rarely complete (most corallites having 30–40 septa); however, one large corallite (GCD = 5.6, AU147) has 62 septa. Hexameral symmetry often difficult to determine because of unequal development of S4 within systems and the similarity of S2 to S1 in systems having pairs of S4. Often the 2 systems of a corallite on the leading edge of the colony are more developed, these 2 systems each having 2 pairs of S4, whereas the proximal systems will have only 1 pair or no S4. Each S1 has 1 or 2 narrow lobes on its upper margin adjacent to epitheca, then widens to a fuller primary septal lobe with a straight inner edge and 1 or 2 tall but narrow pali-form lobes adjacent to columella. S2 half to three-quarters width of an S1 and bear 5 or 6 rounded lobes, the innermost lobes similar in size and shape to P1. If a pair of S4 flanks an S3, the S3 is almost as wide as an S2, each S3 pair fusing with the inner edge of the common S2. Inner edges of these S3 composed of numerous slender, horizontally oriented lobes and several larger, inner paliform lobes. S3 unflanked by pairs of S4 are much smaller, about one-third width of an S2, and composed of numerous slender, horizontally oriented lobes. S4, if present, rudimentary. Fossa moderate to deep, containing a well-developed papillose columella composed of 5–10 slender, nongranular pillars that are indistinguishable in size (about 0.15 mm in diameter) and shape from inner paliform lobes (P1–3).

TYPES: The type specimen of *Dendrophyllia rubeola* was stated to be deposited at the Otago Museum by Ralph and Squires (1962: 5, pl. 1, fig. 5); however, this specimen could not be located there in 1991 and it is more likely that Quoy and Gaimard's type would be at the MNHNP. The holotype of *C. huttoni* was not traced, although the original description implies that it also was deposited in the Otago Museum, Dunedin.

TYPE LOCALITIES: *Dendrophyllia rubeola*: Tamise (= Thames) River, New Zealand; depth unknown. *Cylicia huttoni*: "on old metal near the slip at Wellington, therefore may have been introduced" (Tenison Woods 1879: 132).

REMARKS: No attempt was made to rigorously compare *C. rubeola* to the 12–14 other species in the genus, many of those species being known from few specimens and often from dubious localities. A revision of the genus is obviously needed. It is noted, however, that Wells' (1954) *C. rubeola* from the Marshall Islands and Cairns' (1991a) specimen from the Galápagos are not conspecific with the New Zealand *C. rubeola*, and that the New Zealand species is similar to *C. hoffmeisteri* Squires, 1966 (known from off southeastern Australia), but differs in aspects of septal dentition.

It should also be noted that a second species, *C. smithii* (Milne Edwards & Haime, 1849), has been reported from off New Zealand. Only one specimen is known, the reputed type illustrated by Ralph and Squires (1962: pl. 1, fig. 6) and Squires and Keyes (1967: pl. 1, fig. 1). This specimen appears to differ from *C. rubeola* in having very closely adjacent corallites (cerioid) and, according to Ralph and Squires (1962), its septa are not lobate at the epithecal wall. Squires and Keyes (1967) indicated some uncertainty about the legitimacy of this type specimen as well as the accuracy of its type locality. Because no additional specimens of this shallow-water species have been reported from off New Zealand since 1849, I strongly doubt that *C. smithii* occurs in New Zealand waters.

A third species, *Cylicia vacua* Tenison Woods, 1879, is synonymised with *Monomyces rubrum*.

Family OCULINIDAE Gray, 1847

Oculina Lamarck, 1816

Corallum colonial (arborescent), corallites formed by extratentacular, alternate budding; axial corallites absent. Coenosteum dense and costate or uniformly granular. Pali or paliform lobes present before all but last septal cycle, usually in 2 crowns. Columella papillose.

TYPE SPECIES: *Madrepora virginea* Lamarck, 1816 (= *Oculina diffusa* Lamarck, 1816), by subsequent designation (Milne Edwards & Haime 1850: xix).

REMARKS: Of the approximately 25 nominal species in the genus, probably only 4 or 5 appear to be valid species (Cairns 1991a). The genus includes both zooxanthellate and azooxanthellate species and is commonest in the western Atlantic.

Oculina virgosa Squires, 1958 (Plates 4, f, i, 5, c, d)

Oculina virgosa Squires, 1958: 39, pl. 5, figs 8–16, text-fig. 11; Ralph & Squires 1962: 5–6, pl. 1, fig. 7; Squires & Keyes 1967: 22, pl. 1, fig. 3; Cairns 1991a: 10; Grant-Mackie, 1993: 16, 17, 20.

MATERIAL EXAMINED: New Records: NZOI Stn F928, 5 branches, NZOI; Stn J969, NZOI; Stn J970, NZOI; BS895 (O641), 10 branches, MoNZ CO307 and 312; BS898 (O644), 1 colony, MoNZ CO290; BS899 (O645), 3 colonies, MoNZ CO166 and 299; BS907 (O653), MoNZ; BS910 (O656), 1 colony, MoNZ CO27; 5–6 km off North Cape, 40 m, 2 colonies, AUM 9129, H1200; *Elingamite* wreck, West King Island, 42–46 m, 3 colonies, AIM; off Poor Knights Island, 29 m, NZGS; Cape Karikari, Doubtless Bay, 49 m, NZGS. Previous Records: Specimens reported by Squires (1958) several of which are at the USNM; Ralph and Squires (1962); and Squires and Keyes (1967).

DISTRIBUTION: Known only from New Zealand region in a circumscribed area off northeast coast of North Island from Three Kings Islands to Poor Knights Island (Map 8); 29–388 m.

DESCRIPTION: Corallum sparsely and irregularly branched, one of the largest specimens examined (AU9129, Plate 4, f) 140 mm in height and 14 mm in basal branch diameter, having 13 terminal branches. Slender terminal branches bear distally inclined, sympodially arranged corallites, but intermediate to large-diameter branches bear perpendicularly oriented corallites that are uniformly distributed on all branch faces. Most corallites are exsert, as much as 3.0 mm; however, corallites on basal branches sometimes flush or even recessed into coenosteum. Calices circular, ranging from 2.5–4.5 mm in diameter. Costae conspicuous only near calice, where they are 0.22–0.31 mm wide and separated by shallow intercostal striae about 30 µm in width. Costae, as well as remaining coenosteum, covered with low, rounded granules 70–80 µm in diameter.

Septa predominantly hexamerally arranged in 4 complete cycles, one pair of S4 usually occurring in each of the 2 systems on the leading (distal) edge of each corallite, resulting in 28 septa (6:6:12:4). Occasionally, one system is without the S4 pair or a third system acquires a pair of S4, resulting in 26 or 30 septa, respectively. In about 10% of the corallites examined, septa are heptamerally arranged in 3 complete cycles (7:7:14), also resulting in 28 septa. S1 exsert (up to 0.8 mm) and rather narrow (0.7 mm), having straight, vertical, slightly dentate inner edges, each of which bears a narrow (0.15 mm wide) paliform lobe near the columella. S2 slightly less exsert and less wide (about three-quarters width) than an S1, each bearing a slightly wider (0.25– 0.30 mm) paliform lobe. S3 half to two-thirds width of an S2 and have dentate inner edges, unless flanked by a pair of S4, in which case they are as wide as an S2 and bear a paliform lobe of equal size and same relative position as a P2, the 2 paliform lobes within such a system being paired. The crown of 6 P1 lie low in the fossa directly adjacent to the columella; the 6–8 P2 form a second crown of lobes that rise higher in the fossa and are slightly more recessed from the columella than the P1. Columella papillose, composed of 2–4 granular pillars.

TYPES: The holotype and three paratypes are deposited at the NZGS, the holotype numbered CO1219.

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

REMARKS: Two exclusively fossil species of *Oculina* are known from New Zealand: *O. oamaruensis* Park, 1917 (middle Eocene to early Miocene) and *O. nefrens* Squires, 1958 (Cretaceous), and only one other recent Pacific species is known: *O. profunda* Cairns, 1991a (Galápagos and California, 119–578 m). *Oculina virgosa* is distinguished from these three species by its tendency to have 28 septa, either in an incomplete hexamerally arranged fourth cycle or a full heptamerally arranged three cycles. Squires' (1958: text-fig. 11) diagram of the septal plan of this species is incorrect, showing twice as many septa (56) as proper and thus also confusing the paliform lobe arrangement.

Madrepora Linnaeus, 1758

Corallum colonial (arborescent), corallites formed by extratentacular alternate budding; no axial corallites. Coenosteum dense and weakly costate or uniformly granular. P2 sometimes present. Columella papillose or absent.

TYPE SPECIES: *Madrepora oculata* Linnaeus, 1758, by subsequent designation (Verrill 1901).

REMARKS: Many species names have been attributed to the genus *Madrepora* (*see* Zibrowius 1974b); however, there are probably only three or four valid recent species, which includes the highly variable, cosmopolitan *M. oculata* Linnaeus, 1758. A discussion of its variation is found in Zibrowius (1980) and Cairns (1982, 1991a). Other distinctive species include: *M. carolina* (Pourtalès, 1871) and *M. kauaiensis* Vaughan, 1907.

Madrepora oculata Linnaeus, 1758
(Plates 5, e, f, 6, a, b)

Madrepora oculata Linnaeus, 1758: 798; Zibrowius 1974b: 762–766, pl. 2, figs 2-5 (synonymy); Cairns 1979: 39–42, pl. 3, fig. 2, pl. 4, fig. 5, pl. 5, figs 1–3 (synonymy); Zibrowius 1980: 36–40, pl. 13, figs A–P (synonymy); Cairns 1991a: 9–10, pl. 2, fig. j, pl. 3, figs a-d; 1994: 1819, pl. 3, figs. f-h (synonymy).
Madrepora vitiae Squires & Keyes, 1967: 22, pl. 1, figs 4–8; Dawson 1979: 29–30.

MATERIAL EXAMINED: New Records: typical (*vitiae*) form: NZOI Stn B490, USNM 88376; NZOI Stn C509, NZOI; Stn D6, NZOI; Stn D424 (dead), NZOI; Stn E908, NZOI; Stn F10, NZOI; Stn H222, NZOI; Stn H223, NZOI; Stn P68, NOZI; Stn S572, USNM 93989; Stn T235, NZOI; Stn T256, NZOI; *Volcanolog* Stn 64, AUM AU12299. Encrusting form: NZOI Stn K828, NZOI; Stn K840, NZOI; Stn K858, NZOI; Stn U591, USNM 93987; Stn U594, USNM 93988; Stn Z2098, NZOI; BS441, MoNZ CO256. Previous Records: Types of *M. vitiae*; specimens reported by Squires and Keyes (1967) and Cairns (1982).

DISTRIBUTION: New Zealand region: typical form: widespread from southern Macquarie Ridge to Kermadec and Three Kings Ridges (Map 2); 149–946 m, the shallowest records off Fiordland. Symbiotic form: Three Kings and Kermadec Ridges: 398–850 m. Elsewhere: cosmopolitan except for off continental Antarctic; 15–1500 m.

TYPES: The types of *M. oculata* are lost (Zibrowius 1980). The holotype and three paratypes of *M. vitiae* are deposited at the NZOI (H-17, P-18–20) (*see* Dawson 1979).

TYPE LOCALITIES: *M. oculata*: Tyrrhenian Sea and off Sicily, Mediterranean; depth unknown. *M. vitiae*: NZOI Stn B314, 39°22′ S, 171°50′ E (northwest of Cape Farewell), 230–251 m.

REMARKS: *Madrepora oculata* is a widespread and variable species that has been described and illustrated many times (*see* synonymy). Two forms of the species occur in the New Zealand region: forma *vitiae*, decribed as a new species by Squires and Keyes (1967) and the "symbiotic" form, so named because of its association with commensal poly-chaetes that form tube galls throughout the corallum. Forma *vitiae* consists of robust colonies with long sympodially budded branches that infrequently anastomose. Its coenosteum is white and faintly striate. Calices are 2.6–3.3 mm in diameter and septa are hexamerally arranged in three complete cycles (S1>S2>S3). P2 may or may not be present; the columella is rather small and papillose. The symbiotic form consists of small, bushy colonies that are penetrated by polychaete worm tubes. Its branches are relatively short and frequently anastomose. Its coenosteum is light brown and finely granular, not striate. Calices are smaller, only 1.9–2.2 mm in diameter, and septa are hexamerally arranged in three cycles (S1>S2>S3). P2 may or may not be present; columella papillose and rather large.

Family ANTHEMIPHYLLIIDAE Vaughan, 1907

Anthemiphyllia Pourtalès, 1878

Corallum solitary and patellate or bowl-shaped. Coralla begin attached to substratum but usually become free as an adult. Base porcellanous and/or costate, often showing a scar of attachment. Septotheca thick and dense. Septal edges dentate to coarsely lobate. Pali absent; columella papillose.

TYPE SPECIES: *Anthemiphyllia patera* Pourtalès, 1878, by monotypy.

REMARKS: *Anthemiphyllia* is the only genus in the Anthemiphylliidae; however, Best and Hoeksema (1987) consider it to be a faviid genus, with close affinities to *Indophyllia* Gerth, 1921. Six species are known in the genus: *A. patera* Pourtalès, 1878 (western Atlantic, 500–700 m); *A. dentata* (Alcock, 1902a); *A. pacifica* Vaughan, 1907 (off Hawaiian Islands, 205– 296 m); *A. patella* Gerth, 1923 (Tertiary, Java); *A. frusta* Cairns, 1994 (off Japan, 237–241 m); and an undescribed species (*A. dentata sensu* Cairns 1984) (off Hawaiian Islands, 369 m).

Anthemiphyllia dentata (Alcock, 1902)
(Plate 6, c-g)

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

Anthemiphyllia dentata: Wells 1958: 264, pl. 1, figs 8–11; Not Cairns 1984: 11, pl. 1, figs F–G (= undescribed species); Best & Hoeksema 1987: 398–399, figs 9a-c; Cairns & Parker 1992: 16–17, pl. 4, figs e-f (synonymy); Cairns 1994: 44–45, pl. 18, figs d-f (synonymy).

MATERIAL EXAMINED: New Records: NZOI Stn C527, 8, USNM 93990; Stn I92, 1, NZOI; Stn K828, 2, USNM 93991; Stn K840, 3, NZOI; Stn K842, 1 attached form, USNM 93992; Stn K858, 2, NZOI; Stn K872, 1 attached form, USNM 93993; Stn P10, 4, NZOI; Stn T217, 5, USNM 93994; Stn U591, 1, USNM 93995; Stn U594, 2, NZOI; BS441, 16, MoNZ CO226 and 234, 6, USNM 94357.

DISTRIBUTION: New Zealand region: ridges north of New Zealand, including southern Norfolk, Three Kings, and Kermadec Ridges (Map 14); 280–570 m. Elsewhere: Arabian Sea; Maldives; Sulu and Banda Seas; off Japan; off southeast Australia and Tasmania; 50–560 m.

DESCRIPTION: Corallum shaped as a shallow bowl, the largest specimen examined (NZOI Stn T217) 21.9 mm in diameter and 11.4 mm in height. Most coralla are free, but often display a circular scar or irregularity 4–6 mm in diameter at centre of base. Several specimens, including all juvenile specimens and 2 adults from NZOI Stn K842 and K872, are firmly attached to the substratum by a region 4–6 mm in diameter. It is believed that free coralla result when specimens originally attach to a small and/or unconsolidated substratum; attached coralla persist if the substratum is large and solid. Central basal region often smooth, even porcellanous, but toward basal perimeter discrete, rounded costae 0.8–1.0 mm wide occur, separated by narrow (0.2 mm) intercostal furrows that become increasingly deep towards basal edge. Occasionally very thin ridges bisect each intercostal furrow. Costae very finely granular, 6 or 7 granules occurring across the width of a costa, each granules about 50 µm in diameter. Corallum white.

Septa hexamerally arranged in 5 cycles, the last cycle usually incomplete, the most common septal complement being 60, achieved by having one pair of S5 in each system. In some coralla, 2 pairs of S5 occur in a system, but invariably within the same half-system. S1–2 quite thick (up to 1 mm) and bear 7–11 septal lobes, the number dependent on the calicular radius. Innermost septal lobes cylindrical (0.3–0.4 mm in diameter), but become increasingly wider and thicker toward calicular edge such that outermost lobes are quite coarse (up to 1 mm wide) and have blunt tips. S1–2 have straight inner edges and highly granular faces, especially the faces of the prominent septal lobes. S2 only slightly less exsert and less wide than the S1. S3 almost as wide as the S2 (reaching almost to columella), but only half as thick. S3 bear 12–16 tall, cyclindrical teeth, the tallest being near the calicular edge. Unflanked S4 and all S5 about half width of an S3 and bear 10–12 tall, laciniate teeth, each about 0.3 mm in diameter. Fossa shallow, containing a granular, papillose columella, the elements about 0.5 mm in diameter, and indistinguishable from inner teeth of S1–2.

TYPES: Seven syntypes of *D. dentatus* are deposited at the ZMA (Coel. 716–718) (Van Soest 1979).

TYPE LOCALITY: *Siboga* Stns 95, 98, and 100, Sulu Sea; 350–522 m.

REMARKS: The New Zealand specimens reported herein differ slightly from those reported from the Indian Ocean (Cairns & Keller 1993), Australia (Cairns & Parker 1992), and the Sulu Sea (Alcock 1902a) in having smaller, bowl-shaped coralla. Specimens from other regions are usually larger and flatter, and, being larger, have more septal spines/lobes per septum. The S1–2 septal lobes of the New Zealand specimens are, in general, fewer in number and coarser in shape than those from other regions, but there appears to be great variation in this character, even among specimens from the same station. *Anthemiphyllia dentata* is distinguished from other species in the genus by having up to 5 cycles of septa and relatively large coralla, most other species having smaller coralla and only 4 cycles of septa. The New Zealand specimens are similar to the unique specimen reported as *A. dentata* by Cairns (1984), both taxa having bowl-shaped coralla of about the same size and 60 septa, but the Hawaiian specimen is distinguished by its distinctive S1 lobation.

Suborder CARYOPHYLLIINA
Superfamily CARYOPHYLLIOIDEA Dana, 1846
Farmily CARYOPHYLLIIDAE Dana, 1846

Caryophyllia Lamarck, 1816

Corallum solitary; attached (subcylindrical, ceratoid, trochoid) or free (cornute). Calice circular, elliptical, or compressed; thecal edge spines present on species having compressed coralla. Septal symmetry variable, but hexameral symmetry with 4 cycles of septa most common. One crown of pali present before penultimate or (rarely) antipenulti-