NATIONAL INSTITUTE OF
WATER AND ATMOSPHERIC RESEARCH (NIWA)

The Marine Fauna of New Zealand:

Porifera: lithistid Demospongiae (Rock Sponges)

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Frontispiece:
Lithistid sponge *Aciculites pulchra* Dendy (Scleritodermidae), clearly indicated by the noduled surface, on the surface of a boulder at 120 m off the southern edge of a reef off Great Barrier Island. This photograph was taken from a Remote Operated Vehicle (ROV) during the Department of Conservation's Great Barrier Island Deep Reef Investigation in 2003.

Photo: Roger Grace, Department of Conservation, Auckland Conservancy.

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ABSTRACT

The lithistid Demospongiae fauna of New Zealand has been inventoried from existing and new collections, and is reviewed here and revised where necessary. Most of the 282 specimens examined were recorded from the largest collection of sponges in New Zealand, in the NIWA Invertebrate Collection, Wellington. Significant collections were also examined from the Museum of New Zealand Te Papa Tongarewa. The lithistid Demospongiae (formerly order Lithistida Schmidt, 1870) is represented in the New Zealand region by nine families, 18 genera (one of which is new to science), and 30 species (12 of which are new to science): Theonellidae (1 genus, 1 species), Phymatellidae (3 genera, 6 species), Corallistidae (3 genera, 7 species), Neopeltidae (4 genera, 4 species), Macandrewiidae (1 genus, 1 species), Pleromidae (1 genus, 3 species), Isoraphiniidae (1 genus, 1 species), Scleritodermiidae (3 genera, 5 species), and Azoriciidae (1 genus, 2 species). This work records the first lithistid species, *Neoschrammeniella antarctica* n. sp., known from polar regions, and provides the first record of the genus *Leiodermatium* further south than the Philippines. Two additional species of *Leiodermatium* described here are found only in the west-central Pacific and Micronesian deep waters, but are included for the sake of a complete review of the genus in the Pacific. New species of the previously monospecific phymatellid genera *Neoaulaxinia* and *Neosiphonia* are described, and a new corallistid genus, *Awhiowhio*, is recognised from New Zealand waters. All specimens were dredged from between 80 and 1700 m, but were commonest between 200 and 800 m. With the exception of one specimen from the eastern edge of the Challenger Plateau on New Zealand's west coast, and a new species from the Ross Sea, Antarctica, all were found north of the southern edge of the Chatham Rise and in New Zealand's northernmost waters. Known and new species are redescribed from representative New Zealand material and, in some cases, the characters used to define genera and species are redefined and clarified. In particular, ornamentation of the desma skeleton and morphology of the augmenting microscleres are emphasised for distinction at the species level.

Keywords: Porifera, lithistid Demospongiae, Lithistida, Theonellidae, Phymatellidae, Corallistidae, Neopeltidae, Macandrewiidae, Pleromidae, Isoraphiniidae, Scleritodermidae, Azoricidae, Desmanthidae, polyphyletic group, systematics, sponges,

INTRODUCTION

Lithistid demosponges are a polyphyletic group comprising 13 extant families; 36 genera are included in the most recent classification (Pisera & Lévi 2002a) but five genera remain of uncertain status. They differ from other demosponges in that the dominant structural spicules (desmas) are articulate, forming in most species a solid, rigid, heavily siliceous skeleton. These desmas are highly diverse morphologically; the overall architecture of the desma, the ornamentation of the desma surface, and the pattern of articulation with adjacent spicules, are diagnostically important (Schrammen 1910, see Kelly 2000a; Pisera & Lévi 2002a).

Lithistid sponges were traditionally placed in the single order Lithistida Schmidt, 1870 owing to the common possession of desmas, even though these display considerable morphological diversity. For some time, lithistids have been recognised as polyphyletic, with several points of origin within the Demospongiae (de Laubenfels 1936; Reid 1963, 1970; Kelly-Borges & Pomponi 1994; Pisera & Lévi 2002a). An indication of the polyphyletic nature of lithistid sponges is revealed in the wide range of microscleres and ectosomal megascleres, and desma axial geometries, which include tetraxial, monaxial, polyaxial, and anaxial forms.

Familial and ordinal affiliations of lithistids with each other and with non-desma-bearing sponges are uncommon but can be found in the megasclere and microsclere components of the skeleton (see Pisera & Lévi 2002a). The presence of triaene megascleres and asterose microscleres in some lithistid genera clearly indicates affinity with demosponge Astrophorida, and this has been supported by recent DNA studies (Kelly-Borges & Pomponi 1994; Chombard *et al*. 1998; McInerney *et al*. 1999). The exotylostyles of *Gastrophanella* are considered to demonstrate affinity with the non-lithistid demosponge order Hadromerida (Van Soest & Stentoft 1988).

A greater difficulty arises when taxa do not have accessory spicules, or the spicules that they have bear only superficial resemblance to those in non-lithistid demosponges. Species of *Aciculites*, for example, contain only acanthose anisostrongyles as accessory spicules, and *Leiodermatium* and *Vetulina* possess only desmas and diactines, and desmas, respectively. In all three taxa, molecular evidence was required to indicate their phylogenetic relationships (Kelly-Borges & Pomponi 1994).

The lithistid sponges are of interest to biomedical science because of the great variety of pharmaceutically relevant biological activities of their chemical extracts (see Pomponi 2001; Bewley *et al*. 1998; Munro *et al*. 1999; Mayer & Hamann 2004; Piel *et al*. 2004). A recent survey of the literature revealed some 40 papers reporting biologically active compounds and their synthesis from the Southwest Pacific genera *Aciculites*, *Callipelta*, *Discodermia, Microscleroderma, Neosiphonia, Pleroma*, *Reidispongia,* and *Scleritoderma*. Of these genera, the first example of double bioalkylation of the sterol side chain at position 26 was reported from New Zealand's *Aciculites pulchra* (Crist *et al*. 1983), and *Pleroma menoui* Lévi & Lévi, *Reidispongia coerulea* Lévi & Lévi, and *Neosiphonia superstes* Sollas from New Caledonia were the subject of considerable attention for their production of bromindoles (Guella *et al*. 1989) and antiviral (Laille *et al*. 1998), antifungal (D'Auria *et al*. 1995), and cytotoxic macrolides (D'Auria *et al*. 1996; Zampella *et al*. 1997; Carbonelli *et al*. 1999; Bassarello *et al*. 2000).

Lithistid demosponges are of particular interest to paleontology because many extant genera and species are relict from sponge faunas that were more abundant before the present. Lithistid demosponges are known from the Ordovician, Silurian, Devonian, Permian, Late Jurassic, Late Cretaceous, and Eocene (Pisera 2002, 2006; Reid 2004). The Paleozoic fauna was dominated by Orchocladina (extinct in the Permian) and sphaerocladinid sponges (solely represented in the Recent fauna by *Vetulina stalactites* from the tropical Atlantic). The Mesozoic (260–60 Ma) lithistid fauna was dominated by Tetracladina, Megamorina, and Rhizomorina, groups that are still relatively common in Tertiary and Recent lithistid faunas (Pisera 2002, 2006). These sponges fossilise well because of their rigid silica skeletons; 13 suborders, 34 families, and more than 200 fossil genera have been recently revised (Pisera 2002, 2006), and many more nominal genera are known.

Lithistid sponges are known from almost all temperate and tropical oceans but are generally restricted to depths greater than about 80 m in South Pacific locations including New Zealand and the Norfolk Ridge, and 150 m in the tropical Western Atlantic region (Pomponi *et al*. 2001). Apart from the proliferation of the genera *Aciculites, Neoschrammeniella*, and *Pleroma* in the Southwest Pacific, *Corallistes* and *Discodermia* in the western tropical Atlantic, and *Theonella* in the Indo-Pacific, most genera are known only from fragments or single specimens that have been rarely, if ever, recollected (e.g. *Lyidium* [= *Pleroma*] *torquilla* Schmidt, 1870 from Cuba). Lithistid sponges are rarely collected from below about 1700 m depth.

Prior to the present work, two major regional faunas were known worldwide: the continental shelf and slope fauna of the tropical western Atlantic (Schmidt

1870, 1880; van Soest & Stentoft 1988; Kelly-Borges *et al*. 1994; Kelly-Borges & Pomponi 1994; Lehnert & van Soest 1996; Pisera 1999; Pomponi *et al*. 2001) and the seamount fauna of the Southwest Pacific including the seamounts of the New Caledonian Norfolk Ridge (Lévi & Lévi 1983, 1988; Lévi 1991; Schlacher-Hoenlinger *et al*. 2005). In both locations, lithistid sponges dominate the sponge fauna (Lévi 1991; Reed & Pomponi 1997; Richer de Forges *et al*. 2000) between 150 and 1800 m but the structure and taxonomic composition of the communities differ considerably (Pomponi et al. 2003).

THE NEW ZEALAND LITHISTID SPONGE FAUNA

Prior to 1991, when research on the lithistid fauna of New Zealand commenced, only two Recent lithistid species had been described, although several more were known (P.R. Bergquist pers. comm.). Arthur Dendy described the first lithistid sponges for New Zealand—*Aciculites pulchra* Dendy, 1924 and *Lepidothenea incrustans* (Dendy, 1924) from the vicinity of North Cape and the Three Kings Islands, respectively. Bergquist (1968) redescribed this material but recorded no further species. No further species were added by Dawson (1993) in his comprehensive index to the New Zealand Porifera.

From 1991 onwards, many of the lithistid species described by Lévi and Lévi (1983, 1988) from the south New Caledonian slope and seamounts were progressively discovered in the New Zealand region (Kelly *et al*. 1999; Kelly 2000b; Kelly 2001a,b; Pomponi *et al*. 2001; Kelly 2003; Kelly *et al*. 2003; Kelly & Buckeridge 2003; Kelly 2004; Kelly & Tubbs 2006; Kelly *et al*. in press), along with several undescribed species. A voyage to the seamount region south of New Caledonia in August 1999, courtesy of IRD, Nouméa, assisted greatly in the author's understanding of the faunal relationships between the two countries and of lithistid sponge ecology in general.

Homophymia stipitata Kelly, 2000a, discovered in New Zealand waters, was only the second known species of the genus, which was known previously only from a single species from Madagascar and Réunion. Also recently recognised in national collections was *Pleroma aotea* Kelly, 2003a, the third species to be described in a genus principally known from New Caledonian waters.

Prior to the work of Dendy (1924), Hinde and Holmes (1892) described a species-rich assemblage based on siliceous spicules from marine diatomaceous sediments now known to be from the early Runangan (Late Eocene) horizon within the Oamaru Diatomite Member of the basaltic Waireka Volcanics (c. 35 Ma) at Oamaru in North Otago (Suggate *et al*. 1978; Edwards 1991). Amongst the many non-lithistids represented were microfossil spicules of what were considered to be a species of *Lyidium* [= *Pleroma*], and species of *Corallistes*, *Discodermia*, and *Theonella* were illustrated. Hinde and Holmes (1892) also illustrated desmas of tetracladine lithistids (which are comparable to those of the Recent family Phymatellidae) and described a new species of *Vetulina*, *V. oamaruensis*, based upon the sphaerocladine desmas. These desmas strongly resemble those found in a species of *Crambe* from Spirits Bay, Northland and their conspecificity cannot be discounted (Kelly et al. 2003).

Whole-body fossils of lithistid sponges are also known from the mouth of the Kakanui River in the Oamaru district (Kelly *et al*. 2003). These fossils occur in a volcaniclastic Ototara Limestone bed of lower Whaingaroan age just above the top of the Mineral Breccia Member of the Deborah Volcanics (31.6 Ma) (Dickey 1968; Daesch *et al*. 1970). The body fossils were found to be very similar morphologically to the living pleromid sponge *Pleroma aotea* Kelly when compared morphometrically to known extant sponges from New Zealand and New Caledonia. Kelly et al. (2003) considered them to be conspecific with living sponges from deepwater seamounts and banks off northeastern New Zealand, citing several additional examples from the substantial record of lithistid sponges in the Oamaru Diatomite.

Lithistid microfossil spicules and partial body fossils are also known from the Tutuiri Greensand (Teurian–basal Waipawan) in the Chatham Islands (Buckeridge *in* Campbell *et al*. 1993; Buckeridge & Kelly 2002; Kelly & Buckeridge 2005). The spicules are trapped within the skeletons of fossil hexactinellid sponges. These are remarkable for their diversity, and the combination of lithistid, astrophorid, and hexactinellid taxa indicates a paleoenvironment very similar to that found today at depths of 500–800 m on the Chatham Rise (Buckeridge & Kelly 2005) and in the tropical Atlantic (cf. Pomponi *et al*. 2001).

Reasonably well-preserved sponge body fossils resembling lithistid Corallistidae, Isoraphiniidae, Pleromidae, Phymatellidae, and Scleritodermidae, have also been found in the Red Bluff Tuff (Teurian–Waipawan) on Chatham Island (Buckeridge *in* Campbell *et al*. 1993; Buckeridge & Kelly 2006), providing an interesting record for this group that straddles the Mesozoic–Cenozoic boundary (Maastrichtian to early Ypresian) (Kelly *et al*. 2006).

MATERIALS AND METHODS

SAMPLE COLLECTION

Sponges were collected by rock dredge from north-eastern New Zealand waters by the National Institute of Water & Atmospheric Research (NIWA) research vessels *Tangaroa* (1967–1989) and *Kaharoa* (1998) (Fig. 1). Specimens of known New Zealand species collected by the author on the IRD cruise LITHIST (RV *Alis*, August 1999) on the New Caledonian Norfolk Ridge seamounts have been included in the study insofar as they represent a natural northern extension of the range of the New Zealand species. NIWA, NMNZ, and IRD station data are listed in Appendix 3; only the station name is listed in the sections describing material examined. Data for other stations are listed in the text.

Specimens were either frozen immediately upon collection or preserved in 50% isopropanol and prepared for histology and scanning electron microscopy as in Kelly-Borges and Vacelet (1995). Specimens are stored for the long term in 70% ethanol.

SPICULE DIMENSIONS

Whole desmas are notoriously difficult to measure because of their intimate articulation with adjacent spicules and their frequent irregular morphology. The size of the desma is expressed here as the approximate size of the overall spicule, and as the mean clone length and thickness. All spicule measurements are expressed in μm. Microsclere dimensions recorded in this work

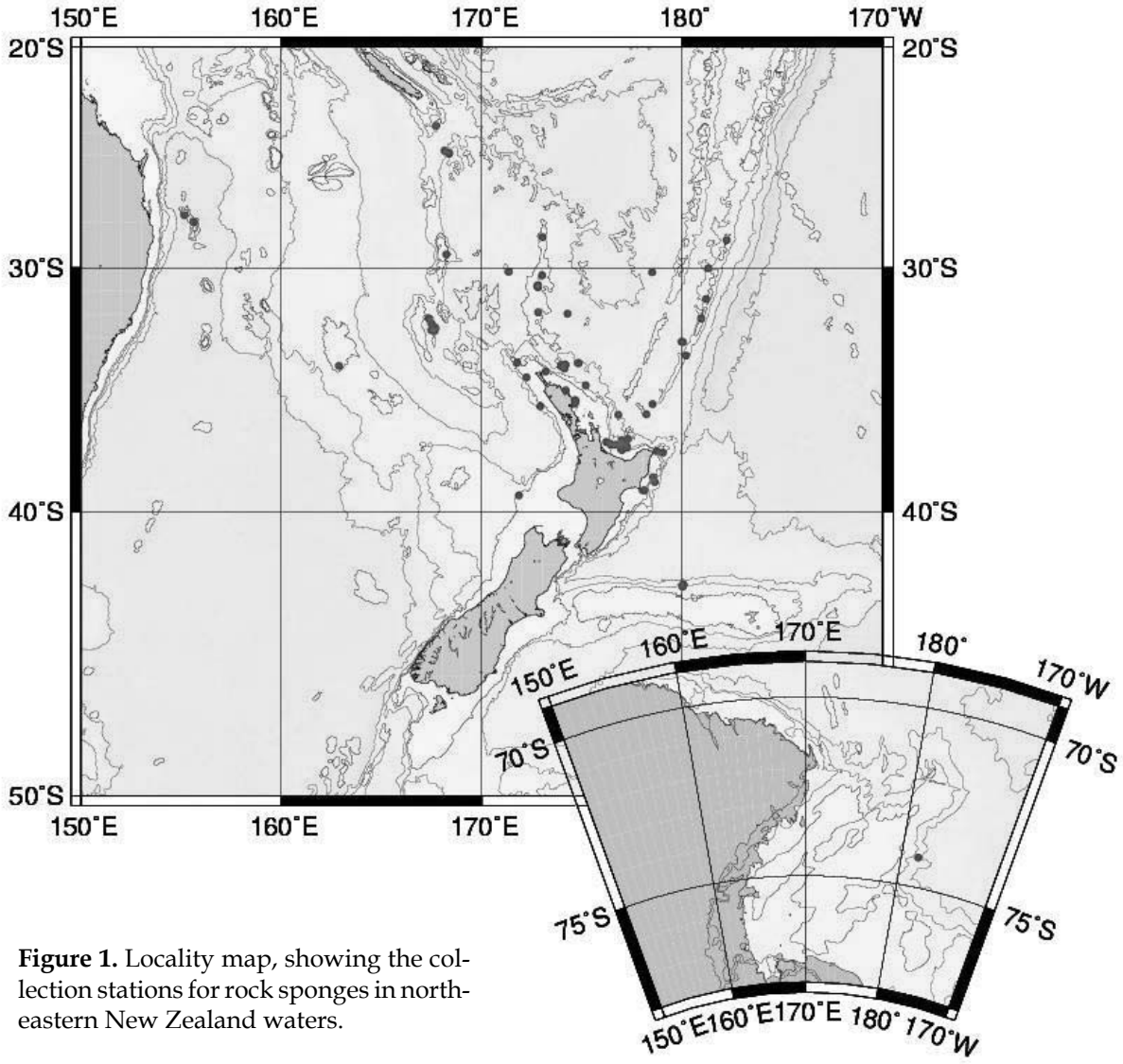

Figure 1. Locality map, showing the collection stations for rock sponges in north-eastern New Zealand waters.

are generally given as mean length (range of length measurements) and mean width (range of width measurements) using the measurements of 10–15 spicules where possible. In the case of the diactinal megascleres, it was very difficult to measure whole spicules as they were typically fragmented. Dimensions are listed in tabular format in the description of each species. The colour of the sponges in life and in ethanol is given by name and also code according to the Reinhold Colour Atlas (Kornerup & Wanscher 1961).

REGISTRATION OF TYPE AND GENERAL MATERIALS

Primary and secondary type materials of new species, and additional material, are deposited in the NIWA Invertebrate Collection at the National Institute of Water & Atmospheric Research (NIWA; formerly New Zealand Oceanographic Institute/ NIWA), Greta Point, Wellington. Previously published type and general registration numbers for the species *Homophymia stipitata* and *Pleroma aotea* are retained in this work, but their new registration numbers (NIWA----) are given in parentheses for reference. Some type and additional material collected by the Coral Reef Research Foundation was previously registered at the Natural History Museum, London (BMNH) and the practice is continued here if the material is from non-New Zealand locations. Some material was previously registered in the Museum of New Zealand Te Papa Tongarewa (formerly National Museum of New Zealand, NMNZ) and retains the prefix NMNZ Por. ---. The prefix IRDR---- is for material sourced with permission from Institut de Recherche pour le Développment (IRD) Noumea, collections. Registration numbers are cited in the text.

AREA OF STUDY

Sponge specimens in this monograph are from collections made by NIWA (formerly as New Zealand Oceanographic Institute of the DSIR) and the National Museum of New Zealand Te Papa Tongarewa. The collection area extends from 24° to 74° S and 155° E to 178° W, covering essentially the Lord Howe Rise, Dampier Ridge, South Fiji Basin, parts of the Norfolk Ridge, the Southwest Pacific Basin, Chatham Rise and Subantarctic Slope in the south, and the Ross Sea, Antarctica (Appendix 3). The region includes Norfolk Island, Lord Howe Island, and the Kermadec Islands in the north. Depths range from 80 to nearly 1680 m. In addition to these New Zealand collections, specimens collected by the author from the New Caledonian Norfolk Ridge seamounts, the Lord Howe Seamount Chain, and Palau, Micronesia, were included in the monograph to complete the present revision.

TERMINOLOGY

Specialist terminology for lithistid sponges follows Kelly (2000a) and Pisera and Lévi (2002a). General terminology for sponges is available in Boury-Esnault and Rützler (1997), but some terms are included here for convenience.

acantho—prefix meaning roughened or microspined, e.g. acanthoxea, acanthorhabd

amphiaster—microsclere with equal numbers of rays projecting from both ends of an elongate centrum, equidistant from the centre; the prefix defines the shape of the ray, whether fine and pointed (oxy-) or rounded and robust (strongylo-)

anaxial desma—devoid of a *crepis* (see sphaeroclone)

clad(ome)—see *triaene*

clone—ray-like arm of a *desma* that is partly (*crepis* extends a short way along the clone from the proximal end) or entirely *anaxial* (devoid of a *crepis*); the number of clones is determined by the *desma* geometry (modified from Pisera & Lévi 2002a)

crepis—the inceptional body or axial filament of the desma that is visible as a short thread-like canal in *monocrepid desmas*, or cruciform canals in *tetracrepid desmas* (modified from Pisera & Lévi 2002a)

desma—articulate choanosomal *megasclere* with a variety of geometries, often with complex interconnected morphology, often highly ornamented; found in lithistid sponges (modified from Pisera & Lévi 2002a)

dichotriaene—an *ectosomal* spicule of triaenose symmetry (see *triaene*) with a regular *cladome* of three branches (protoclads) that can divide further to form usually two *clads* (deuteroclads); the clads can be smooth, tuberculate, or spinose and are tangential to the sponge surface; the *rhad* can be short or long and is always perpendicular to the clads or *cladome*, penetrating the sponge surface; axial canals extend the whole length of the rhabd and clads (modified from Pisera & Lévi 2002a)

dicranoclone—see *monocrepid desma*; arch-shaped and bearing well-developed fungiform tubercles, can be bi-, tri-, or sometimes tetrapodial (four-footed); *zygomes* are terminal on clones and articulate with the upper tubercles of clones from adjacent desmas, e.g. in *Corallistes* and *Herengeria*; (Corallistidae) (modified from Pisera & Lévi 2002a)

discotriaene—*ectosomal megasclere* with tangential *cladome* forming a flat or slightly concave oval disc, margins can be even or incised; *rhabd* is short, *crepis* is *tetraxial*, e.g. in *Discodermia* (Theonellidae) (modified from Pisera & Lévi 2002a)

ectosome—refers to the region just below and at the surface of the sponge; frequently referred to in terms of the architecture of this region as it is often diagnostic and quite different from the under

lying *choanosome* (see Boury-Esnault & Rützler 1997)

heloclone — see *monocrepid desma*; elongate, oxea-like, smooth with notch-shaped zygomes, e.g. in *Costifer* (Isoraphiniidae)

megaclone — see *monocrepid desma*; arched and smooth with cup- or saddle-shaped zygomes, e.g. in *Pleroma* (Pleromidae)

megasclere — see *spicule*

microsclere — see *spicule*

monaxial desma — see *monocrepid desma*

monocrepid desma — *monaxial* desma; the *monocrepidial* nature is revealed by the *crepis* which is a short straight canal in the middle of the clone (modified from Pisera & Lévi 2002a) (see *megaclone, heloclone, dicranoclone, rhizoclone*)

phyllotriaene — ectosomal spicule with a single ray called a *rhabd*, usually perpendicular to the sponge surface and penetrating it, and three others are more or less flat and tangential to the sponge surface, termed the *cladome*; the *cladome* is branched in an irregular manner with the *clads* resembling feathers; the crepis is *tetraxial* and very short in the radiating branches of the *cladome* (modified from Pisera & Lévi 2002a)

pseudodiscotriaene — ectosomal megasclere resembling a *discotriaene* and analogous to it, but is *monocrepid* with the *crepis* located in the rhabd or *cladome* (e.g. Neopeltidae) (modified from Pisera & Lévi 2002a)

pseudophyllotriaene — ectosomal spicule closely resembling a phyllotriaene and analogous to it, but monocrepid (crepis may be located in the rhabd or in the cladome) (modified from Pisera & Lévi 2002a)

pseudospheraster — microscleres with slightly acentrically projecting massive spiny rays and a swollen centrum, that resemble spheraster, but are most probably modified amphiasters

pseudotetraclone — *monocrepid desma*; complex shape with elongate clones resembling a *tetraclone* or *rhizoclone*; the term megarhizoclone has been used to describe a variety of non-related desmas that superficially resemble rhizoclones; Pisera and Lévi (2002a) recommended that this term be abandoned and favoured the use of pseudotetraclone instead of megarhizoclone (see Kelly 2000)

rhab(dome) — see *triaene*

rhizoclone — *monocrepid desma*; usually with numerous spines and or tubercles that serve as lateral zygomes (modified from Pisera & Lévi 2002a)

sphaeroclone — *anaxial desma*; in which several ray-like arms extend from a globular centre that may be spinose (modified from Pisera & Lévi 2002a)

spicule — opaline-silica or calcium carbonate component of the poriferan skeleton; often of elaborate morphology and design; three general size categories include the *megasclere*—the primary structural skeletal component, the *mesosclere*—a medium-sized spicule found in Homosclerophorida, and *microsclere*—the smallest size of spicule (see Boury-Esnault & Rützler 1997)

streptaster — microsclere with rays projecting irregularly along an elongate centrum, the number of rays ranging from numerous to only a few

tetraclone — *tetracrepid desma*; may be smooth or tuberculate; very regular, often with four clones, but often secondarily modified

tetracrepid desma — *tetraxial* desma, *tetraclone*; the *tetracrepidial* nature is revealed by the *crepis* which is cruciform; *zygomes* mostly terminal on *clones* (modified from Pisera & Lévi 2002a)

tetraxial desma — see *tetracrepid desma*

triaene — general term for a tetractinal megasclere with four rays (clads) emanating from a single point in three axial planes (cladome), having one unequal ray (rhabd, rhabdome) that is commonly much longer than the other three rays (see Boury-Esnault & Rützler 1997)

tuberculate — warty; tubercles have a rounded apex and straight or restricted sides, forming a fungiform (mushroom-shaped) tubercle

zygome — the articulating clasp formed between the tips of *clones* of adjacent desmas (modified from Pisera & Lévi 2002a)

ABBREVIATIONS OF INSTITUTIONS

AUT	Auckland University of Technology.
CRRF	Coral Reef Research Foundation, based in the Republic of Palau, Micronesia.
IRD	Institut de Recherche pour le Développement (formerly ORSTOM).
MNHN	Muséum National d'Histoire Naturelle, Paris.
NHM	The Natural History Museum (formerly British Museum (Natural History)), London.
NIWA	National Institute of Water and Atmospheric Research (including the former New Zealand Oceanographic Institute, NIWA), Greta Point, Wellington.
NMNZ	Museum of New Zealand Te Papa Tongarewa (formerly National Museum of New Zealand), Wellington.
0CDN	Sample numbers for material collected by the Coral Reef Research Foundation for United States National Cancer Institute shallow-water collection programme. A complete collection of all 0CDN sponge specimens is located at the Smithsonian Institution (U.S. National Museum), and with the author.
USNM	U.S. National Museum (Smithsonian Institution).

CHECKLIST OF SPECIES

Class **DEMOSPONGIAE**

Family **AZORICIDAE**

Leiodermatium colini n. sp.*
Leiodermatium dampieri n. sp.
Leiodermatium intermedia (Sollas, 1888)*
Leiodermatium linea n. sp.

Family **CORALLISTIDAE**

Awhiowhio osheai n. gen. n. sp.
Awhiowhio sepulchrum n. gen. n. sp.
Awhiowhio unda n. gen. n. sp.
Herengeria auriculata Lévi & Lévi
Herengeria vasiformis Schlacher-Hoenlinger *et al*.
Neoschrammeniella antarctica n. sp.
Neoschrammeniella fulvodesmus (Lévi & Lévi)

Family **ISORAPHINIIDAE**

Costifer wilsoni Lévi

Family **MACANDREWIIDAE**

Macandrewia spinifoliata Lévi & Lévi

Family **NEOPELTIDAE**

Callipelta punctata Lévi & Lévi
Homophymia stipitata Kelly
Lepidothenea incrustans (Dendy) Incertae sedis
Neopelta pulvinus n. sp.

Family **PLEROMIDAE**

Pleroma aotea Kelly
Pleroma menoui Lévi & Lévi
Pleroma turbinatum Sollas

Family **PHYMATELLIDAE**

Neoaulaxinia clavata (Lévi & Lévi)
Neoaulaxinia persicum n. sp.
Neoaulaxinia zingiberadix n. sp.
Neosiphonia motukawanui n. sp.
Neosiphonia superstes Sollas
Reidispongia coerulea Lévi & Lévi

Family **SCLERITODERMIIDAE**

Aciculites manawatawhi n. sp.
Aciculites pulchra Dendy
Aciculites sulcus n. sp.
Microscleroderma novaezelandiae n. sp.
Scleritoderma flabelliformis Sollas

Family **THEONELLIDAE**

Discodermia proliferans Lévi & Lévi

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* The two asterisked species of *Leiodermatium* described in this monograph are found only in the west-central Pacific and Micronesian deep waters, but are included in here for the sake of a complete review of the genus in the Pacific.

SYSTEMATICS

The lithistid Demospongiae have recently been revised by Pisera (2002) and Pisera and Lévi (2002a-o) and are considered by them to comprise 13 extant families with 26 valid genera. The systematics scheme that is used in this volume follows these recent revisions. The reader is referred to the *Systema Porifera*—a major publication for full family and genus-level synonymies.

Lithistid taxa are extremely difficult to identify without practice. To assist field and laboratory identification, a summary section termed Key Diagnostic Characters is given immediately after the Remarks following the formal description of each species. The characters listed are those that can be used rapidly in succession in the field and laboratory to determine genus and species in relation to morphologically similar other species. Keys to the diagnostic field and microscopic characters of New Zealand lithistid sponges is given in Appendices 1 and 2.

Lithistid Demospongiae

(formerly order Lithistida Schmidt, 1870)

Polyphyletic group of encrusting, pedunculate, fungiform, auricular (ear-shaped), fan-shaped, cup-shaped, or massive-amorphous demosponges characterised by the presence of articulated desma megascleres of diverse morphology that render most such sponges rigid and rock-like. Choanosomal desmas are morphologically diverse and comprise tetraxial (tetraclone), monaxial (rhizoclone, megaclone, dicranoclone, heloclone, or various complex branched forms), polyaxial, or anaxial (sphaeroclone) geometry. Additional choanosomal megascleres may include long hair-like oxeas. Ectosomal spicules may include dichotriaenes, phyllotriaenes, pseudophyllotriaenes, discotriaenes, pseudodiscotriaenes, and various roughened oxea-like spicules. Microscleres include a combination of spirasters, streptasters, amphiasters, sigmaspires, roughened oxeas or raphides (after Pisera & Lévi 2002a).

REMARKS: The informal group lithistid Demospongiae has recently been revised by Pisera (2002) and Pisera and Lévi (2002a-o) and is considered by them to contain 13 extant families with 26 valid genera (five of uncertain affinity). The classification scheme that is used in this volume, and the sequence of families and genera, follows these recent revisions. For a full discussion of each family and genus see Pisera (2002) and Pisera and Lévi (2002a-o).

Family **THEONELLIDAE** Lendenfeld, 1903

Theonellidae Lendenfeld, 1903: 125 (in part); Lendenfeld 1907: 343 (part); Wilson 1925: 447; Lévi 1991: 79; Pisera & Lévi 2002e: 327.

Discoderminae Schrammen, 1910: 97.

Discodermiidae: Schrammen 1924: 37, 48; de Laubenfels 1955: E58 (part).

Polymorphic; choanosomal spicules are tetraclone desmas that, in several genera, may be non-articulated with neighbouring desmas, being tetralophose in general shape; ectosomal spicules are phyllotriaenes, discotriaenes, or variations between these forms; choanosomal diactinal megascleres often have a strongylote morphology, some with tylote (hammer-like) proximal and blunt stylote distal ends, or these may be long thin oxeas; microscleres include acanthorhabds, acanthostrongyles, microxeas, streptasters, or pseudospherasters (modified from Pisera & Lévi 2002e).

Discodermia du Bocage, 1870

Discodermia du Bocage, 1870: 1; Zittel 1878: 37, 87; Sollas 1888: 292 (part); Pisera & Lévi 2002e.

Theonellidae with ectosomal discotriaenes; regular tetraclone desmas with smooth or tuberculate clones and zygoses; choanosomal megascleres long oxeote or stylote; microscleres are large curved acanthoxeas and smaller acanthorhabds.

REMARKS: Hinde and Holmes (1892) illustrated several microfossil discotriaenes from the Oamaru Diatomite (c. 35 Ma) at Oamaru, North Otago, indicating that the genus *Discodermia* (or *Theonella* as per Hinde & Holmes, 1892, pl. 14, figs 4, 5, 8–11) was present in the southern New Zealand location that is now Oamaru, during the late Eocene. One microfossil was attributed to *Discodermia sinuosa* Carter, 1881, originally described from the Gulf of Manaar and the southeast coast of Sri Lanka (Hinde & Holmes 1892, pl. 14, fig. 12). The discotriaene of this species also has indented margins, but the similarity of the illustration to the phyllotriaenes of *Macandrewia spinifoliata* Lévi & Lévi cannot be overlooked. Conspecificity with an extant species from the Western Indian Ocean is less likely.

TYPE SPECIES: *Dactylocalyx polydiscus* Bowerbank, 1869.

Discodermia proliferans Lévi & Lévi, 1983 (Fig. 2)

Discodermia proliferans: Lévi & Lévi, 1983: 121, pl. 6 (fig. 4), pl. 7 (figs 1, 2, 4–9); Schlacher-Hoenlinger *et al*. 2005: 681, figs 4A, 17, 31.

MATERIAL EXAMINED:

NIWA Stations: S572 (NIWA18212); X768 (NIWA18213).
IRD Stations: LITHIST Cruise (August 1999) DW5 (NIWA18480), DW7 [NIWA18481, NIWA18482 (IRDR1829)].

DISTRIBUTION: Passe de la Havannah (holotype), Introuvable, Stylaster, and Éponge Seamounts, south New Caledonian slope of Norfolk Ridge; west of Three Kings Ridge, northern New Zealand; Hikurangi Plateau, east of East Cape, New Zealand.

HABITAT: Sponges were dredged from hard surfaces on the tops of seamounts and continental margins; the substratum of sponges from NIWA Stn X768 was grey mudstone. Depth range 175–936 m.

DESCRIPTION:

Morphology arborescent, often a curved arched column with lateral tuberculate projections, frequently joined to neighbouring sponges (Fig. 2A).

Dimensions 40–65 mm long, column 5–10 mm thick, 20 mm thick at widest point including projections.

Texture stony, granular.

Surface smooth with subdermal aquiferous canals visible.

Colour cinnamon brown in life (6D6), ivory in ethanol (4B3).

Choanosomal skeleton is composed of a dense articulation of robust tetraclone desmas interspersed with dense masses of large acanthorhabds (Fig. 2B,C).

Ectosomal skeleton is composed of discotriaenes, acanthoxeas, and acanthorhabds (Fig. 2D). Occasional diactinal spicules traverse the deeper choanosome perpendicular to the surface but do not pierce the surface.

Megascleres (Table 1) robust tetraclone desmas (Fig. 2B–D) with thick short smooth tubercles covering the entire spicule, zygoses are very tight and intricate. Discotriaenes (Fig. 2C–E) with the plane of the disc uneven and the edges frequently faintly crenulate, or deeply incised owing to obstruction from the rhabds of adjacent discotriaenes, rhabds short and conical. Diactinal megascleres with strongylote proximal and distal termini, with spicule curved and abruptly slimming at the ends and curveing inwards, uncommon.

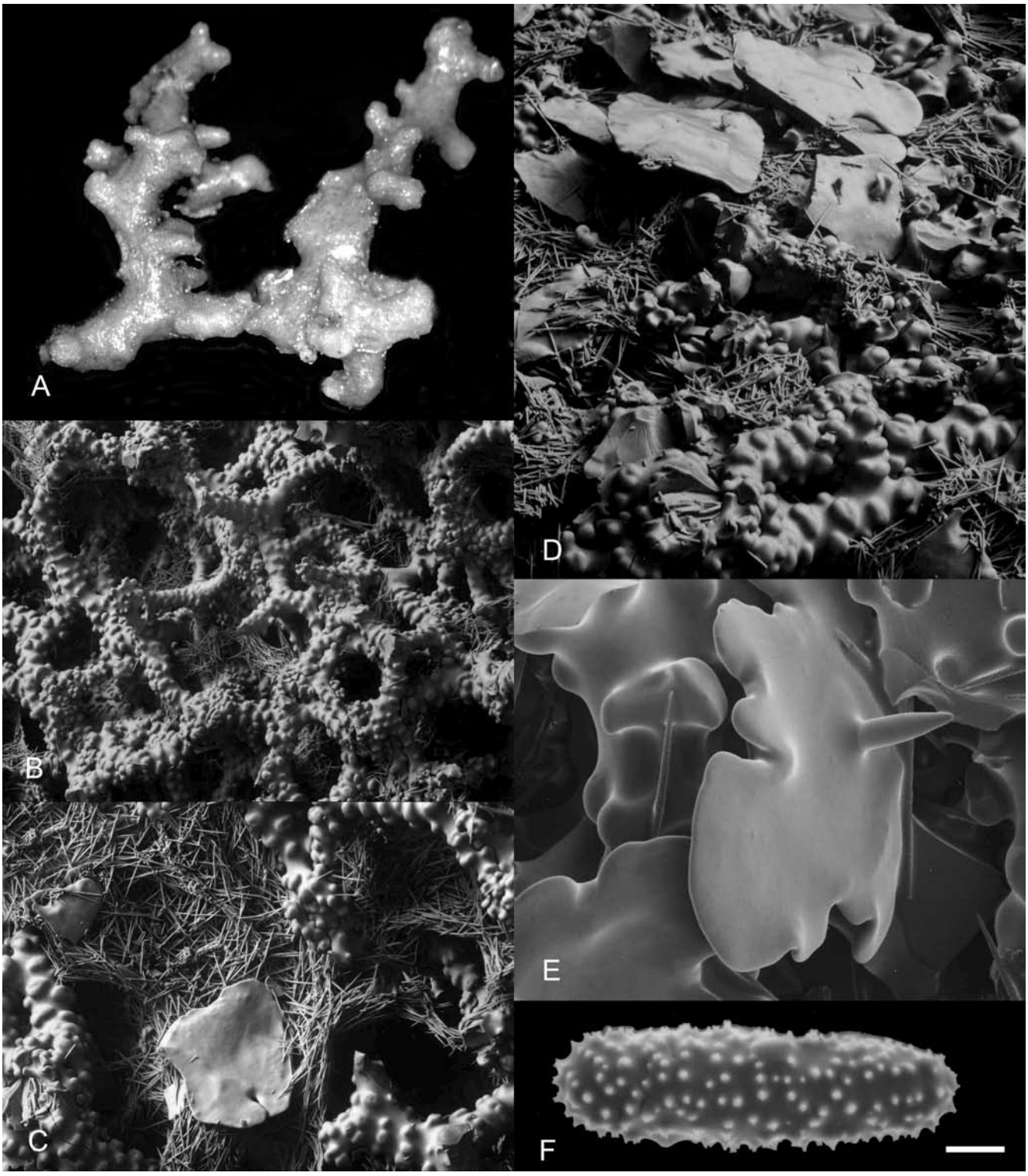
Microscleres (Table 1) large acanthoxeas, faintly centrotylote, and occasionally sharply angled around midsection of spicule (Fig. 2C). Acanthorhabds with strongylote ends, occasionally centrotylote (Fig. 2F).

REMARKS: All specimens examined conform to the holotype of *Discodermia proliferans* from New Caledonia (Lévi & Lévi 1983) and the species is typical of the genus with distinct discotriaenes and two forms of acanthose microsclere. However, although some specimens from Éponge Seamount DW7 (NIWA18481–2) had the same morphology, they had abundant diactinal spicules and differred in the possession of smaller thinner acanthoxeas and acanthorhabds, and the desmas were smaller and ridged rather than distinctly tuberculate.

Tuberculate ornamentation on the clones of Atlantic and Pacific species of *Discodermia* spp. is rare. The only other species of *Discodermia* known to the author that has annular rings or partial ridges and slight nodules on the clones is an undescribed species from Jamaica (Kelly & Pomponi unpubl.). NIWA18481 and NIWA18482 from Éponge Seamount (DW7) are very close to *Discodermia gorgonoides* Burton, 1928 described from the Andaman Islands in the Indian Ocean, except that the latter species lacks acanthoxeas. The holotype of *D. gorgonoides* was only a fragment of what was thought to be a branching sponge with oxeas and notched discotriaenes, but these are only about 180 µm wide. The nodules on *D. gorgonoides* are not as pronounced as on typical specimens of *D. proliferans*.

Table 1. Spicule dimensions (µm) of *Discodermia proliferans* Lévi & Lévi, 1983.

	Desmas (Clone L/Thickness)	Discotriaenes (Max disc ø)	Diactines (L)	Acanthoxeas (L/Thickness)	Acanthorhabds (L/Thickness)
New Zealand					
NIWA18212	300 (250–400)/ 100 (80–150)	243 (190–243)	400–1500	104 (95–112)/3–4	13 (10–15)/3–4
NIWA18213	340 (250–400)/100	540 (375–725)	400–1500	90 (90–100)/5–6	8 (7–10)/3–4
New Caledonia					
NIWA18480	300(200-400)/100	420 (240–620)	530	86 (70–110)/2–3	10 (7–13)/2–3
Lévi & Lévi (1983)	300/50	200–300, 250–400	—	60–80/3–5	8–11
S.-H. *et al.* (2005)	500–600/80–90	492–673	—	84–117/6–7	10–14/5–6



Fiure 2. *Discodermia proliferans* Lévi & Lévi, 1983.

Branching morphology in species of *Discodermia* is not uncommon although most species are cup-shaped or hemispherical with massive or nodular morphology. *Discodermia vermicularis* Döderlein, 1884 from Japan has digitate outgrowths arising from an encrusting base and *D. ramifera* Topsent, 1892 from the Azores is digitate. One of the commonest species of *Discodermia* in the central western tropical Atlantic is digitate (Kelly-Borgest *et al*. 1994) and a further (undescribed) tiny branching species is known from the Gulf of Mexico (Kelly & Pomponi unpubl.).

Specimens from New Zealand and New Caledonia (Lévi & Lévi 1983; Schlacher-Hoenlinger *et al*. 2005) present a broad range of spicule dimensions, particularly the desmas, discotriaenes, and acanthoxeas, but are considered to be conspecific despite this.

KEY DIAGNOSTIC CHARACTERS:

- Sponge forms a small nodulose branch or thick irregular nodulose lump.
- Surface of sponge covered with disc-like triaenes.
- Desmas are heavily tuberculate.
- One form of small microrhabd microsclere.

Family **PHYMATELLIDAE** Schrammen, 1910

Phymatellinae Schrammen, 1910: 72.
Phymatellidae: Schrammen 1924; Lévi 1991: 79; Pisera & Lévi 2002k: 366.

Clavate, multiclavate (tuberose or corm-like), spherical with a restricted base, and cup-shaped to foliose sponges; desmas tetraclones with large, smooth, tuberculate or semi-spinose clones; in some genera clones are branched and ramified; ectosomal megascleres are relatively short-shafted dichotriaenes and long thin oxeas; ectosomal microscleres are acanthose strongyloamphiasters with robust rays, some with streptaster or spiraster modifications, choanosomal microscleres are acanthose amphiasters that merge into streptasters with slender oxeote rays, often in two size categories.

REMARKS: The Phymatellidae contains three valid extant genera differentiated primarily by their habit (Pisera & Lévi 2002k), described as being clavate or apple-shaped in *Neoaulaxinia* Pisera & Lévi, spherical with a stem in *Neosiphonia* Sollas, and cup-shaped or lamellate in *Reidispongia* Lévi & Lévi. New specimens of *Neoaulaxinia clavata* (Lévi & Lévi), *Neosiphonia superstes* Sollas, and *Reidispongia coerulea* Lévi & Lévi have enabled clarification of the skeletal differences between the genera, focusing on the degree of and nature of ornamentation of the tetraclone desmas and the definition of the microscleres. The recognition of two new species of *Neoaulaxinia*, and one of *Neosiphona* has extended the list of diagnostic characters that enable easier differentiation at the generic and species level within the family.

It is interesting to note that microfossil tetraclones and ectosomal triaenes indistinguishable from those of extant phymatellid genera were found in the Tutuiri Greensand (Teurian–basal Waipawan) in the Chatham Islands (Buckeridge & Kelly 2005, fig. 4C), and illustrated from the Oamaru Diatomite at Oamaru in North Otago (Hinde & Holmes 1892; pl. 13, figs 28–30), confirming a more southern distribution for Phymatellidae during the Paleogene.

Neoaulaxinia Pisera & Lévi, 2002

Spherical Phymatellidae with a restricted base, elongated to various degrees, forming clavate (club-shaped), multiclavate, tuberose, or apple-shaped species; subdermal aquiferous canals visible beneath the ectosome converge on a single membranous oscule in a shallow apical depression; desmas are simple tetraclones with smooth clones that vary in the degree of ornamentation (single to multiple fungiform tubercles, to spires of tubercles). Desmas branch at the terminus of the clones. Zygosis is highly developed in mature spicules, forming an enlarged complex tangle; zygosis is positioned terminally and laterally with saddle formations; ectosomal dichotriaenes with finely tapered frequently irregularly curved clades and rhabd; three clearly differentiated microscleres, a robust strongyloamphiaster restricted to an ectosomal crust, a large streptaster with only a few conical rays and a smaller streptaster with numerous fine rays, restricted to the choanosome.

TYPE SPECIES: *Aulaxinia clavata* Lévi & Lévi, 1988.

Neoaulaxinia clavata (Lévi & Lévi, 1988) (Fig. 3)

Aulaxinia clavata Lévi & Lévi, 1988: 243; Pisera & Lévi 2002k: 366, figs 1–5.

MATERIAL EXAMINED**:**

NIWA Stations: KAH0204/07 (NIWA18214); KAH0204/47 (NIWA25644).
IRD Stations: LITHIST Cruise (August 1999) CP8 (NIWA18483), CP9 (NIWA18484).

DISTRIBUTION: Station DW66 (BIOCAL) (holotype), and Éponge Seamount, south New Caledonian slope of Norfolk Ridge; Seamount 441 and Cavalli Seamount, northeastern New Zealand.

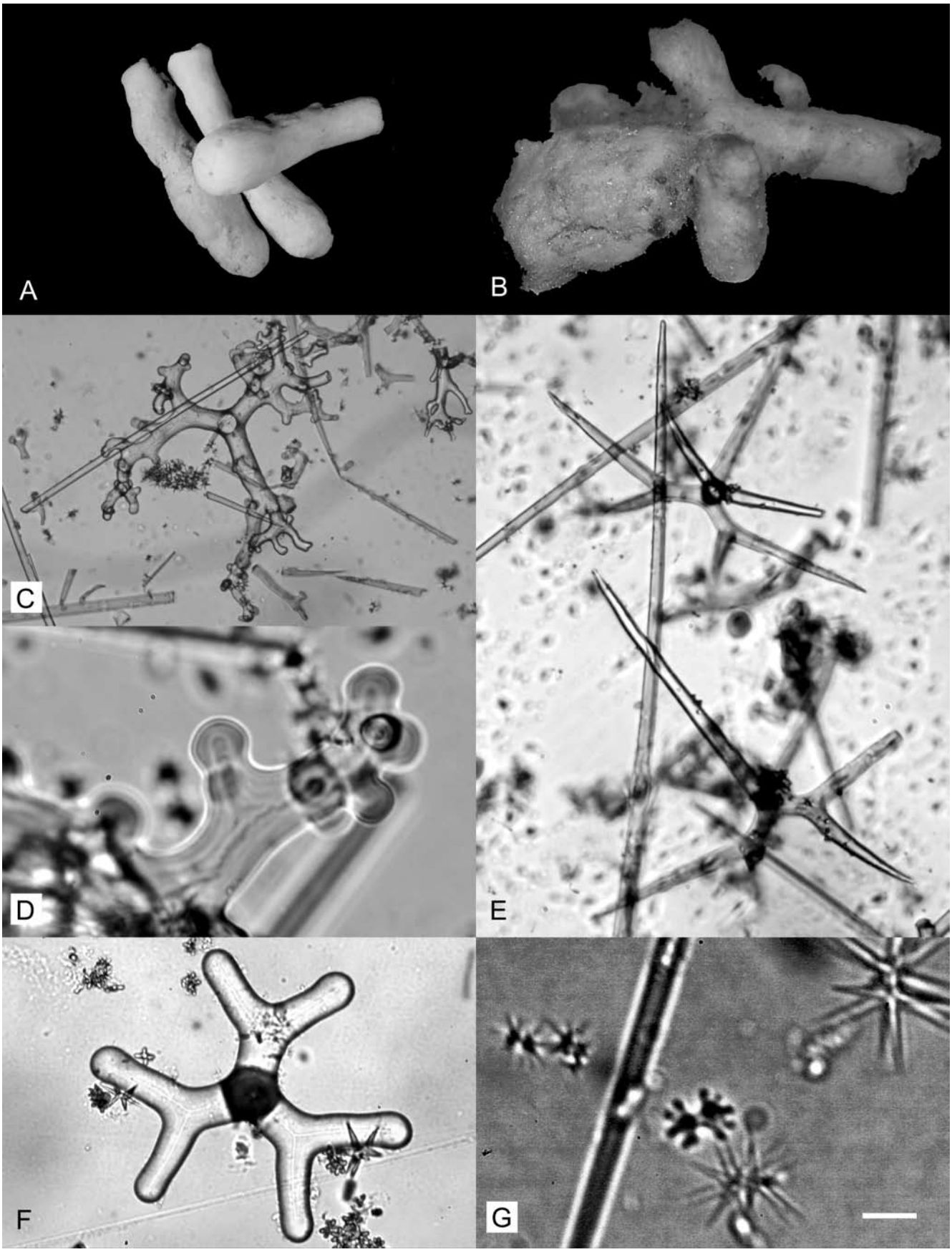


Figure 3. *Neoaulaxinia clavata* (Lévi & Lévi, 1988).

HABITAT: Dredged from hard coral substratum on the tops of seamounts. Depth range 505–880 m.

DESCRIPTION:

Morphology club-shaped, slightly thicker in the upper third, tapering to a rounded apex (Fig. 3A), or multiclavate in older specimens, with a rounded stem, apple-shaped apical bulb, and lateral club-shaped protuberances (Fig. 3B). A single small membranous oscule is visible on the apex of each specimen (or protuberance), less than 1 mm diameter; apical cavity visible only in some specimens, and then only 1–2 mm deep.

Dimensions of single clubs 60–70 mm long, 15–20 mm thick at broadest; multiclavate specimen 160 mm high and 80 mm wide.

Texture firm, slightly compressible.

Surface smooth, glistening, with longitudinal subdermal aquiferous canals clearly visible.

Colour in life and in ethanol ivory (4B3).

Choanosomal skeleton relatively cavernous with aquiferous canals permeating the skeleton, and composed of weakly articulated dispersed desmas, between which are abundant microscleres of the largest category.

Ectosomal skeleton encrusted with robust microscleres, interspersed with the cladomes of the dichotriaenes. Large robust oxeas arise in tracts from within the deeper choanosome, but do not pierce the surface.

Megascleres (Table 2) tetraclone desmas with smooth even clones that branch just before they terminate, each branch dividing into multiple tubercular fingers (Fig. 3C); tubercles are typically single and slightly fungiform (Fig. 3D), zygosis with adjacent spicules is weak, and can be positioned laterally. Dichotriaenes (Fig. 3E) have finely pointed clads and are relatively thin overall. The individual deuteroclads are curved and separated by approximately 45°. In a New Zealand specimen, modification of the cladome to strongylote ends was relatively common (Fig. 3F). Diactinal spicules are relatively thick, finely pointed oxeas (Fig. 3C,E).

Microscleres (ectosomal) are strongyloamphiasters (Table 2, Ms 1, Fig. 3G), choanosomal microscleres are streptasters in two distinct size categories with fine oxeote rays (Table 2, Ms 2.1, 2.2, Fig. 3F,G). NIWA18483 has spirasters with 2–4 whorls.

REMARKS: Only a single specimen has been recorded from New Zealand waters; the description and illustrations provided are based on this and specimens collected from New Caledonian seamounts. The morphology and skeletal details of the New Zealand specimen are very close to the New Caledonian holotype except that the cladome of the dichotriaenes is frequently malformed with rounded strongylote clades (Fig. 3F) and the cladome is occasionally monotrianeose, with unbranched clades. Excellent illustrations of the details of this species in New Caledonia were provided by Lévi and Lévi (1988) and Pisera and Lévi (2002k).

A large multiclavate specimen was recovered from Éponge Seamount on the New Caledonian end of the Norfolk Ridge that is in every aspect of the skeletal and spicule morphology and dimensions, identical to described and new material (Fig. 3B). The size of this specimen indicates that it might be older than the single club-shaped specimens typically recovered in the past, and by this we have an indication of the mature morphology.

KEY DIAGNOSTIC CHARACTERS:

- Sponge typically forms an elongate club with a single oscule at the apex.
- Desmas branch terminally and laterally; zygomes are lightly tuberculate.
- There may be spirasters amongst the microscleres.

Neoaulaxinia zingiberadix n. sp. (Fig. 4)

MATERIAL EXAMINED:

Type material: Holotype BMNH 1995.3.30.3 from NIWA Stn J953.

Table 2. Spicule dimensions (μm) of *Neoaulaxinia clavata* (Lévi & Lévi, 1988).

	Desma (Clone L/T) Desma (Overall size)	Cladome (Max ø) Rhabd (L)	Diactines (L)	Ms 1 (L) Ms 2.2 (L)	Ms 2.1 (L)	Spirasters (L)
New Zealand						
NIWA18214	375–550/50–60 575–750	430 (325–625) 320 (250–375)	—	14 (10–20)	36 (30–40) 20 (15–25)	—
New Caledonia						
NIWA18483	200–400/40–60 575–900 overall	478 (375–575) 423 (325–475)	350-4000	14 (10–18)	42 (38–48) 15 (13–18)	15 (8–18)
Lévi & Lévi (1988)	300–600/100 600–1000 overall	250–600 200–480	700–4000	13–15	20–40	—

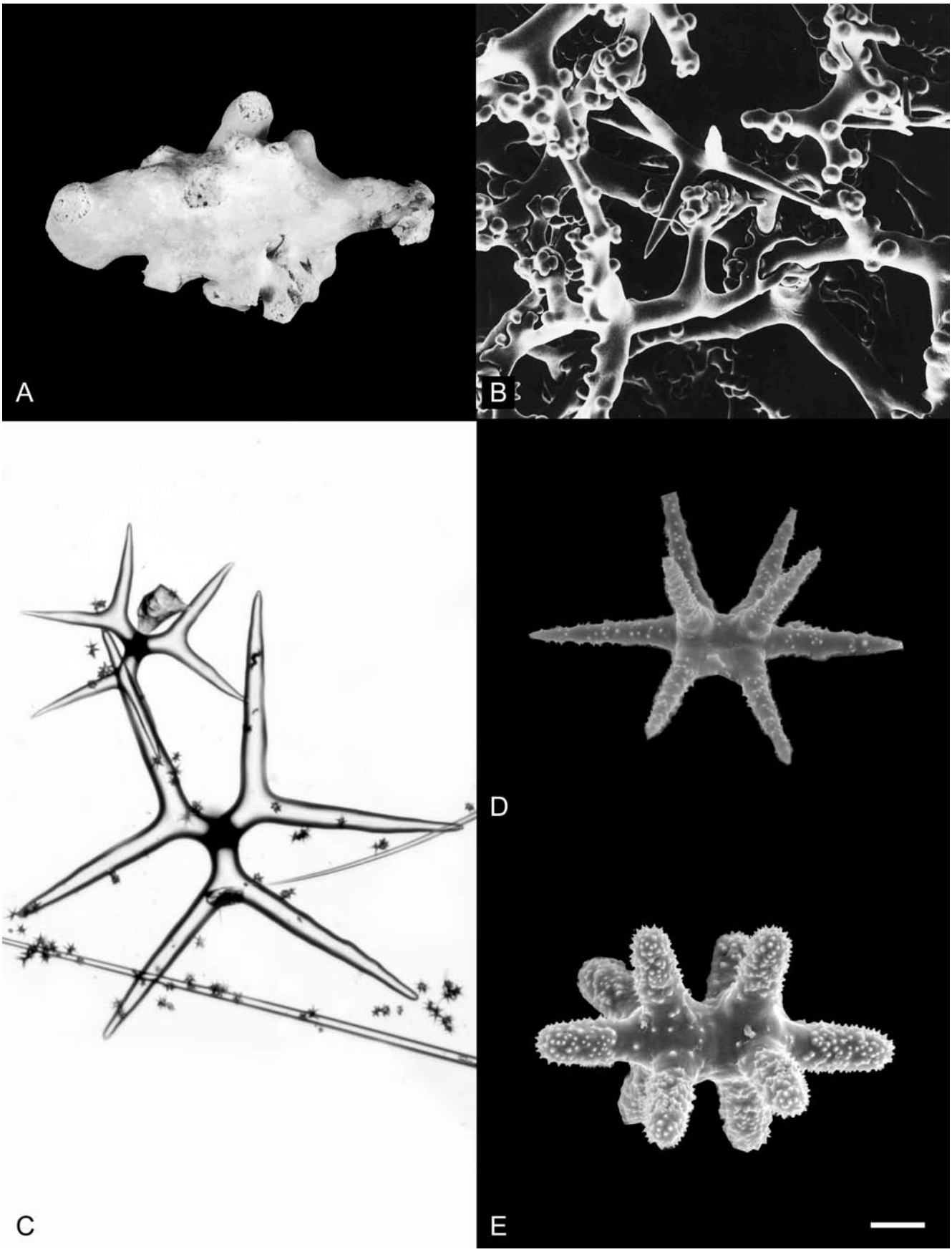


Figure 4. *Neoaulaxinia zingiberadix* n. sp.

TYPE LOCALITY: Western continental slope, Northland, New Zealand.

DISTRIBUTION: Western continental slope, Northland, New Zealand.
HABITAT: Dredged from hard coral substratum on the tops of seamounts. Depth range 260–270 m.

DESCRIPTION:

Morphology tuberose or corm-like with multiple protuberances of irregular size and shape emerging from the mass of the sponge; the point of attachment is a short stem (Fig. 4A); multiple membranous oscules are visible on apex of each protuberance. No apical cavity around oscules.

Dimensions 50 mm high, 30 mm thick.

Texture firm, almost stony.

Surface smooth.

Colour in life unknown, dried, cream (4A2).

Choanosomal skeleton relatively cavernous and is composed of relatively firmly articulated desmas (Fig. 4B).

Ectosomal skeleton encrusted with microscleres. Oxeas arise in tracts from within the deeper choanosome, but do not pierce the surface.

Megascleres (Table 3) tetraclone desmas with smooth even clones that branch just before they terminate, each branch dividing into multiple fingers; tubercles are fungiform and frequently multiple (Fig. 4B). Zygosis is strong and situated laterally and terminally. Dichotriaenes have a short rhabd (Fig. 4B,C). The individual deuteroclads are relatively straight and separated by a greater than 45° angle, so that the individual clads lie close together (Fig. 4C). Diactinal spicules are relatively thick centrally, but taper abruptly to strongylote ends.

Microscleres (choanosomal) are amphiasters with streptaster modifications in two close size categories, differentiated primarily on the number of rays on the spicule; the smaller category has more rays than the larger category (Table 3, Ms 2.1, 2.2) (Fig. 4D). Ectosomal microscleres are strongyloamphiasters with a few robust rays (Table 3, Ms 1, Fig. 4E).

ETYMOLOGY: Named for the morphology of the sponge that resembles the root (Latin, *radix*) of the ginger plant (Latin, *zingiber*).

REMARKS: *Neoaulaxinia zingiberadix* is only the second species described in this genus, known only from the Southwest Pacific. The primary character that differentiates this new species of *Neoaulaxinia* is the morphology of the sponge. Although only a single specimen has been recovered, it is sufficiently distinct from multiclavate specimens of *N. clavata* to warrant the establishment of a new species.

Neoaulaxinia zingiberadix is much less regularly clavate than *N. clavata* and the protuberances vary greatly in size and shape (Fig. 4A). Spicule morphology and dimensions also differ considerably; the strongyloamphiasters are larger in the new species than in *N. clavata*, but the larger category of streptasters in *N. zingiberadix* is generally smaller than *N. clavata*. The dichotriaenes differ dramatically, in the smaller length of the rhabd in *N. zingiberadix* and in the general shape and orientation of the deuteroclads. In *N. zingiberadix* the individual deuteroclads are relatively straight and separated by a greater than 45° angle, so that the clads lie close together (Fig. 4C). In *N. clavata* the individual deuteroclads are curved and emerge with an approximately 45° angle, so that the clads are well separated. As for *N. clavata*, the desmas are sparsely tuberculate and the tubercles are usually fungiform, but in *N. zingiberadix* the tubercles are often double or triple. The articulation of these desmas is very intricate and the sponge is a lot harder as a result. The morphology of the terminal zygosis in the new species is that of sliding clasped fingers (zygosis is lateral as well as terminal) and the lateral zygoses are saddle shaped.

KEY DIAGNOSTIC CHARACTERS:

- Sponge forms a tuberose or corm-like mass.
- Desma clones branch terminally and laterally and are lightly tuberculate, tubercles are frequently double.
- Dichotriaenes have a short rhab and clads emerge from the protorhabd well separated.

Table 3. Spicule dimensions (μm) of *Neoaulaxinia zingiberadix* n. sp.

	Desma (Clone L/T) Desma (Overall size)	Cladome (Max ø) Rhabd (L)	Diactines (L)	Ms 1 (L)	Ms 2.1 (L) Ms 2.2 (L)
New Zealand					
BMNH 1995.3.30.3	300–500/50–70	490 (250–775)	775+	19 (18–23)	29 (23–35)
(holotype)	500–875	158 (100–300)			18 (15–20)

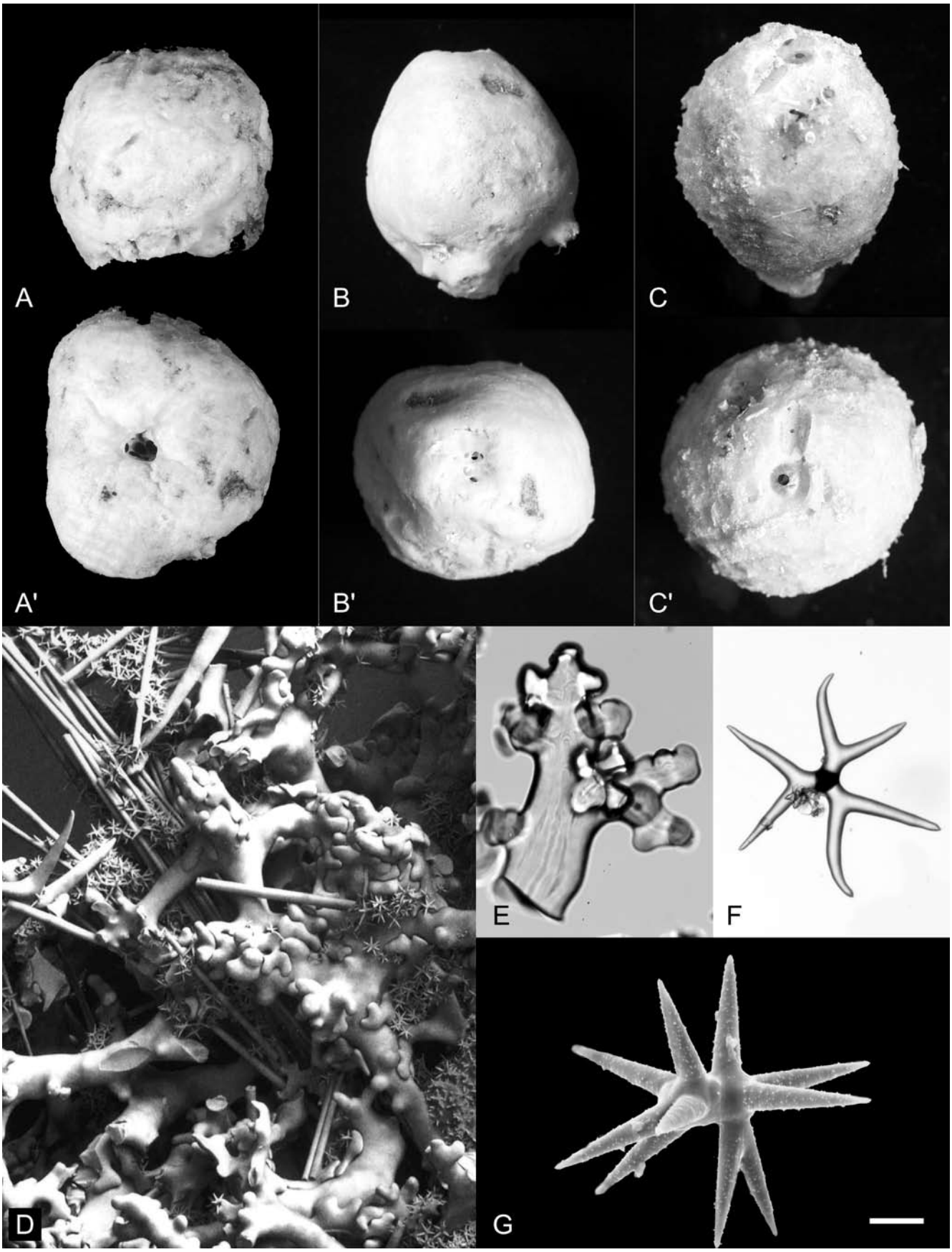


Figure 5. *Neoaulaxinia persicum* n. sp.

Neoaulaxinia persicum n. sp. (Fig. 5)

MATERIAL EXAMINED:

Type material: Holotype NIWA18215 from NIWA Stn X140; paratypes NIWA18221 from NIWA Stn KAH0204/29; NIWA18222 from NIWA Stn KAH0204/30; NIWA18216 from NIWA Stn KAH0204/32; NIWA18217, NIWA18218, NIWA 18219 and NIWA18220 from NIWA Stn KAH0204/40.

NIWA Stations: E731 (NIWA25613); KAH0204/02 (NIWA18225); KAH0204/07 (NIWA18226); KAH0204/29 (NIWA18227, NIWA18228, NIWA18229, NIWA18230); KAH0204/32 (NIWA18231, NIWA18232, NIWA18233); KAH0204/38 (NIWA18234); KAH0204/40 (NIWA18235, NIWA18236); KAH0204/44 (NIWA18237); KAH0204/47 (NIWA18238); RAPUHIA2-15 (25647); T226 (NIWA25650); TAN0104/001 (NIWA18240); TAN0104/002 (NIWA1824, NIWA18247, NIWA18248); TAN0104/048 (NIWA18239); TAN0104/148 (NIWA18242); TAN0104/194 (NIWA18243); TAN0104/288 (NIWA18244); TAN0104/289 (NIWA18245); TAN0104/394 (NIWA18246); TAN0107/232; X201 (NIWA18223); Z9025 (NIWA18224).

TYPE LOCALITY: Bay of Plenty, North Island, New Zealand.

DISTRIBUTION: Seamount east of Three Kings Ridge; West Cavalli, Cavalli, South Cavalli Seamounts, and Seamount 441, northeastern New Zealand; Knights Terrace, East of Poor Knights Islands; Rumble V Seamount, West of White Island, and Ngatoro Ridge, Bay of Plenty; North of Raoul Island, Kermadec Ridge; Diabolical, Graveyard, Morgue, and Scroll Seamounts, Chatham Rise.

HABITAT: Attached to small pieces of scleractinean coral rubble and rock surfaces on the sides of seamounts. Many of the specimens examined appear to have settled on hard coral, eventually engulfing them as they grew. Depth range 503–1680 m.

DESCRIPTION:

Morphology spherical (Fig. 5A) to egg-shaped (Fig. 5B,C); the base is a thin skirt, or encompassing branches of scleractinian corals. A single membranous oscule is situated at the apex of the sponge surrounded by deep subdermal aquiferous canals that converge on the oscule (Fig. 5A). A fringe of very long diactines is present on the base of some specimens.

Dimensions 50 (20–65) mm high, 50 (20–80) mm wide, and 40 (20–60) mm thick.

Texture stony overall, but crumbly on the surface, ectosomal region easily sloughed off.

Surface smooth, slightly rough, unabraided sections have short robust conules dispersed about 5–10 mm apart, raised from projecting diactines (Fig. 5C).

Colour in ethanol pale orange (5A3), honey yellow (5D6) to topaz (5C5).

Choanosomal skeleton composed of robust smooth tetraclones tightly zygosed with adjacent desmas both terminally and laterally. Long diactines emerge from the centre of the sponge in tracts, piercing the surface in low conules. Large microscleres are abundant and regularly distributed within the choanosome.

Ectosomal skeleton an encrustation of small microscleres.

Megascleres (Table 4) tetraclone desmas with very thick smooth clones that rarely branch, and if they do it is towards the terminus of the clone (Fig. 5D). The clones are ornamented with single or double pairs of tubercles or spires of numerous tubercles. Spires occur around the axis of the clone (which is generally quite smooth) and are generally in the most mature spicules (Fig. 5E). Zygosis is terminal although zygoses frequently adhere laterally with a saddle-shaped formation when against adjacent clones (Fig. 5D). The zygoses in older portions of the skeleton are often so intricate and over-developed as to be enlarged many times thicker than the clones. Dichotriaenes with one set of clads shorter than the other two, and one of these

Table 4. Spicule dimensions (μm) of *Neoaulaxinia persicum* n. sp.

	Desma (Clone L/T) Desma (Overall size)	Cladome (Max ø) Rhabd (L)	Diactines (L)	Ms 1 (L)	Ms 2.1 (L) Ms 2.2 (L)
New Zealand					
NIWA18215	250–500/60–100	627 (350–875)	750+	17 (15–20)	50 (43–65)
(holotype)	675–750	496 (375–550)		26 (18–35)	
NIWA18216	375–450/100–120	694 (525–900)	800+	19 (18–23)	46 (33–55)
(paratype)	750–750	388 (375–400)		21 (18–32)	
NIWA18221	250–500/80–100	600 (475–700)	1250+	17 (15–20)	46 (37–50)
(paratype)	500–875	—			24 (20–25)

shorter clads is usually shorter than the other giving the cladome a lopsided appearance (Fig. 5F). The remaining two sets of clads curve inwards, sometimes acutely, to resemble calipers. The tips of the clads are often blunt and strongylote. The rhad is often curved with a strongylote end. Diactines (Fig. 5D) are very thick with oxeote or frequently strongylote ends and are up to several mm long. They are bundled in tracts that emerge within the choanosome. Mature spicules are over 3 mm long.

Microscleres (ectosomal) are small strongyloamphiasters with very robust rays (Table 4, Ms 1), choanosomal microscleres are large streptasters (Fig. 5G) with a reduced number of rays (Table 4, Ms 2.1), and smaller streptasters with numerous sharp rays (Table 4, Ms 2.2).

ETYMOLOGY: persicum (L.) = peach.

REMARKS: *Neoaulaxinia persicum* is clearly differentiated morphologically from *N. clavata* and *N. zingiberadix*. The new species is egg-shaped with a restricted base, contrasting sharply with the elongate club-shaped *N. clavata* and tuberose *N. zingiberadix*. The tracts of oxeas that emerge in a conule at regular intervals on the surface of *N. persicum* are also highly characteristic of sponges that have been recovered with little damage.

At the microscopic level there are several clear differences in the size of the various categories of microscleres and the morphology of the key diagnostic megascleres. In particular, the ornamentation of the tetraclone desmas with multituberculate spires is unique in the genus and the clones are much thicker than in both other species. Zygosis is highly developed in mature spicules, with an enlarged complex tangle of terminal clasps and lateral saddle formations. The dichotriaenes in *N. persicum* have a much wider and more irregular cladome and a longer rhabdome than in the other two species. The choanosomal microscleres are the largest and most robust of species in the genus and all microscleres are only very slightly acanthose, much less so than all other Phymatellidae described thus far.

N. persicum is an easily recognised species that is so far known only from the north and east of New Zealand from the Three Kings Rise and the Chatham Rise.

KEY DIAGNOSTIC CHARACTERS:

- Sponge is spherical to egg-shaped with an apical oscule and subdermal canals
- Desmas with very thick smooth clones, with spires of tubercles, zygosis is very intricate and robust
- Microscleres are very large and only slightly acanthose
- The immature sponge could be mistaken for *Neosiponia motukawanui* n. sp.

Neosiphonia Sollas, 1888

Club-shaped to spherical body with a restricted base of attachment, a bundle of vertical canals arises in the central axis of the sponge emerging within a cavity on the sponge apex, the cavity is covered with a delicate parchment-like ectosomal roof; desmas are branched and ramified tetraclones with sculpted sinuous or tuberculate projections on the clones. Zygosis is intricate in inner parts of the skeleton, weak in the outer (growing) regions of the sponge; dichotriaenes are generally short-shafted (100–200 µm on average), the cladome is wide with clads of irregular length; microscleres are acanthose in two clearly differentiated groups, a robust strongyloamphiaster restricted to an ectosomal crust, and a choanosomal streptaster with conical rays.

TYPE SPECIES: *Neosiphonia superstes* Sollas, 1888.

Neosiphonia superstes Sollas, 1888 (Fig. 6)

Neosiphonia superstes Sollas, 1888: 299, pl. 31, figs 7–12; Lévi & Lévi 1983: 119, fig. 10; Lévi & Lévi 1988: 47, pl. 3, fig. 3; Pisera & Lévi 2002k: 366, figs 6–9.

MATERIAL EXAMINED:

NIWA Stations: E731 (NIWA25614); KAH0204/07 (NIWA18258); KAH0204/32 (NIWA18257); KAH0204/47 (NIWA18256); TAN0107/124 (NIWA18255); TAN0205/20 (NIWA25643); TAN0205/32 (NIWA18249, NIWA18250, NIWA18251); TAN0413/120 (NIWA25051).

DISTRIBUTION: *Challenger* Station 173, off Matuka, Fiji Islands (holotype); BIOCAL Stn DW66, south New Caledonian slope of Norfolk Ridge; East Kermadec Ridge Slope, Volcano E, Kermadec Ridge; Rumble III Seamount and Mahina Knoll, Bay of Plenty; Seamount 441, West Cavalli, and Cavalli Seamounts, northeastern New Zealand.

HABITAT: Attached to hard dead coral or rocky substratum. Depth range 430–999 m.

DESCRIPTION:

Morphology short, squat, spherical body elevated on a short restricted base of attachment with a moderately deep apical cavity (Fig. 6A).

Dimensions typically 35 (20–50) mm high and 35 (15–60) mm at the widest part of the body. The base ranges from 15–20 mm wide. The apical cavity indents 30–35% of the apex and ranges in depth from 5–10 mm.

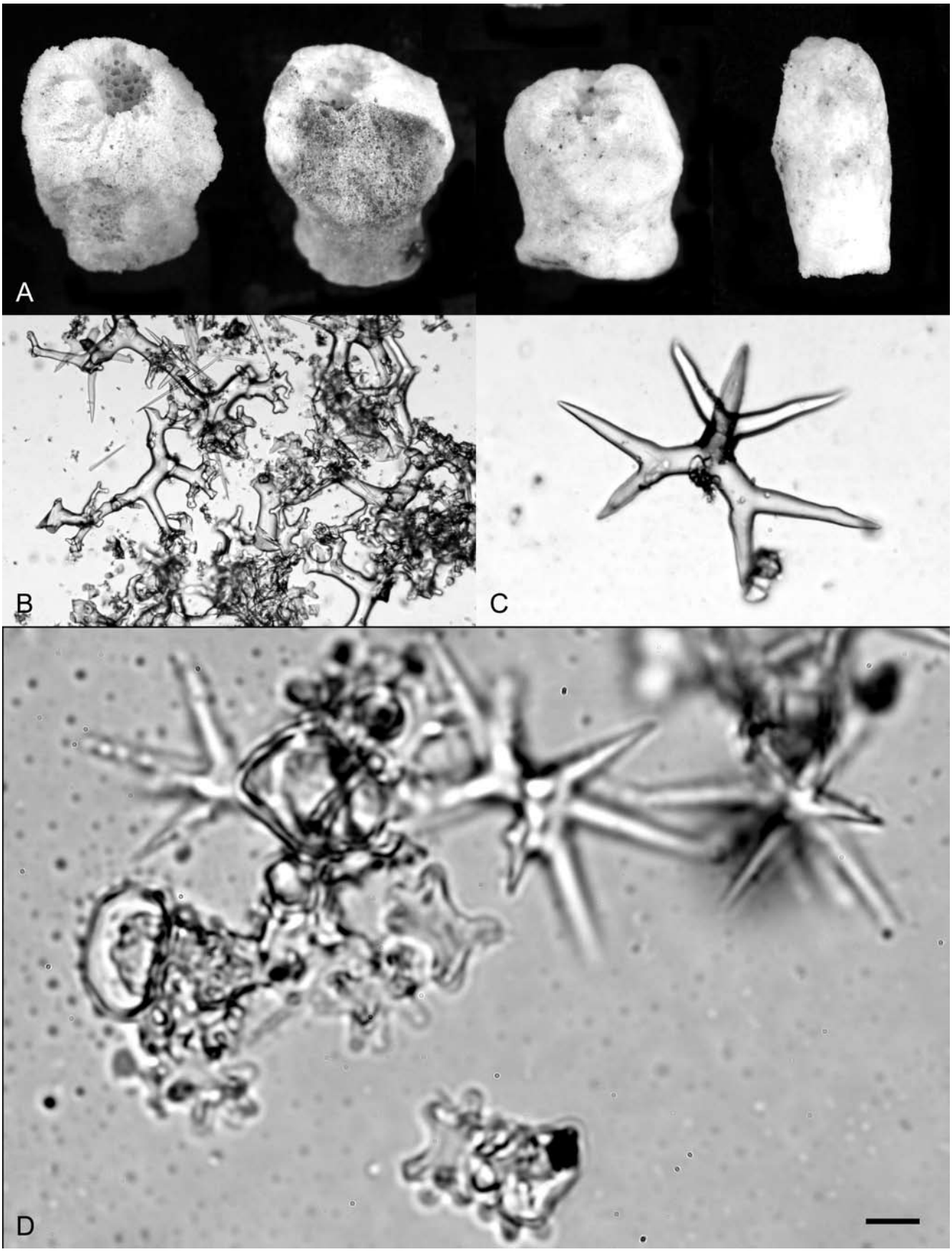


Figure 6. *Neosiphona superstes* Sollas, 1888.

In macerated specimens the grouped vertical canals that run through the centre of the sponge are visible, but in complete specimens the canals are covered with a loose flaky ectosome.

Texture firm, almost stony.

Surface irregularly mounded to smooth.

Colour in life ivory (4B3), in ethanol honey yellow (5D6).

Choanosomal skeleton composed of highly branched tetraclones only weakly articulated with adjacent spicules. Microscleres are abundant. Oxeas arise in tracts from within the deeper choanosome but do not pierce the surface.

Ectosomal skeleton an encrustation of strongyloamphiasters.

Megascleres (Table 5) tetraclone desmas with smooth uneven clones that bifurcate several times, each clone reducing rapidly in thickness, with tubercular and sculpted sinuous protuberances, especially abundant at the clone terminus (Fig. 6B). Zygosis can be weak in immature spicules but is generally relatively strong and situated laterally and terminally. Dichotriaenes have a short rhabd (Fig. 6C) and comparatively wide cladome. The protoclad leading to the two deuteroclads is comparatively long and the clads are separated by a wide angle. Diactinal spicules are fusiform with long fine tapering ends.

Microscleres (Table 5) (ectosomal) are small strongyloamphiasters with short robust rays (Table 5, Ms 1, Fig. 6D, choanosomal microscleres are larger amphiaster/streptasters (Table 5, Ms 2, Fig. 6D, with fine oxeote rays.

REMARKS: The distinguishing characteristics of this well-described species (Sollas 1888; Lévi & Lévi 1983, 1988; Pisera & Lévi 2002k) is the rounded stalked body with an apical cavity and siphon-like central canals, and at the microscopic level the morphology of the desmas (strongly branched with sculpted sinuous tuberculate projections) and the large size of the streptaster/amphiasters. The microscleres were originally described as 'spirasters' by Sollas (1888) and Pisera and Lévi (2002k), but are clearly illustrated as amphiasters in the former publication, and are illustrated in two categories (strongyloamphiasters and amphiasters) in Pisera and Lévi (2002k) as in other members of the Phymatellidae. It is likely that Sollas did not find the robust strongyloamphiasters in the holotype as they are restricted to an ectosomal crust, which would have been absent in the "deciduous" specimen.

Apart from *N. superstes*, only two other species are known. *N. fruticosa* (Wilson, 1925) is a semi-planar branching mass 55 mm high, 90 mm wide, and 50 mm thick, of cylindrical, slightly flattened branches about 7 mm diameter. It was first described from the Philippines. *Neosiphonia schmidti* Sollas, 1888 from Havana, Cuba, probably belongs to a different genus according to Pisera and Lévi (2002k).

KEY DIAGNOSTIC CHARACTERS:

- Sponge is a short squat spherical body elevated on a short stem with a broad apical depression in which many canal openings are visible.
- Desmas are highly branched with sinuous sculpted zygoses.
- Short rhabds on the dichotriaenes (well under 300 μm).
- Microscleres are two types only (but these are in two sizes).
- The immature sponge could be mistaken for *Neoaulaxinia clavata*.

Neosiphonia motukawanui n. sp. (Fig. 7)

MATERIAL EXAMINED**:**

Type material: Holotype NIWA18261 and paratype NIWA18259 from NIWA Stn KAH0204/38.

NIWA Stations: KAH0204/29 (NIWA18265, NIWA18266, NIWA18267); KAH0204/32 (NIWA18264); KAH0204/38 (NIWA18268, NIWA18269, NIWA18270,

Table 5. Spicule dimensions (μm) of *Neosiphona superstes* Sollas, 1888.

	Desma (Clone L/T) Desma (Overall size)	Cladome (Max ø) Rhabd (L)	Diactines (L)	Ms 1 (L)	Ms 2 (L)
Fiji					
BMNH 1891.5.4.11 (holotype)	100–200/70	550 150	2,280	—	45
New Caledonia					
Lévi & Lévi (1983)	200–350/70 600–700	400 100	900 (min)	—	—
New Zealand					
NIWA18250	100–375/60–80 500–600	348 (250–500) 136 (75–200)	750 (min)	16 (13–18)	32 (25–43)
NIWA18249	150–400/50–80 500–700	433 (375–525) 200 (150–275)	675 (min)	19 (18–20)	40 (35–45)

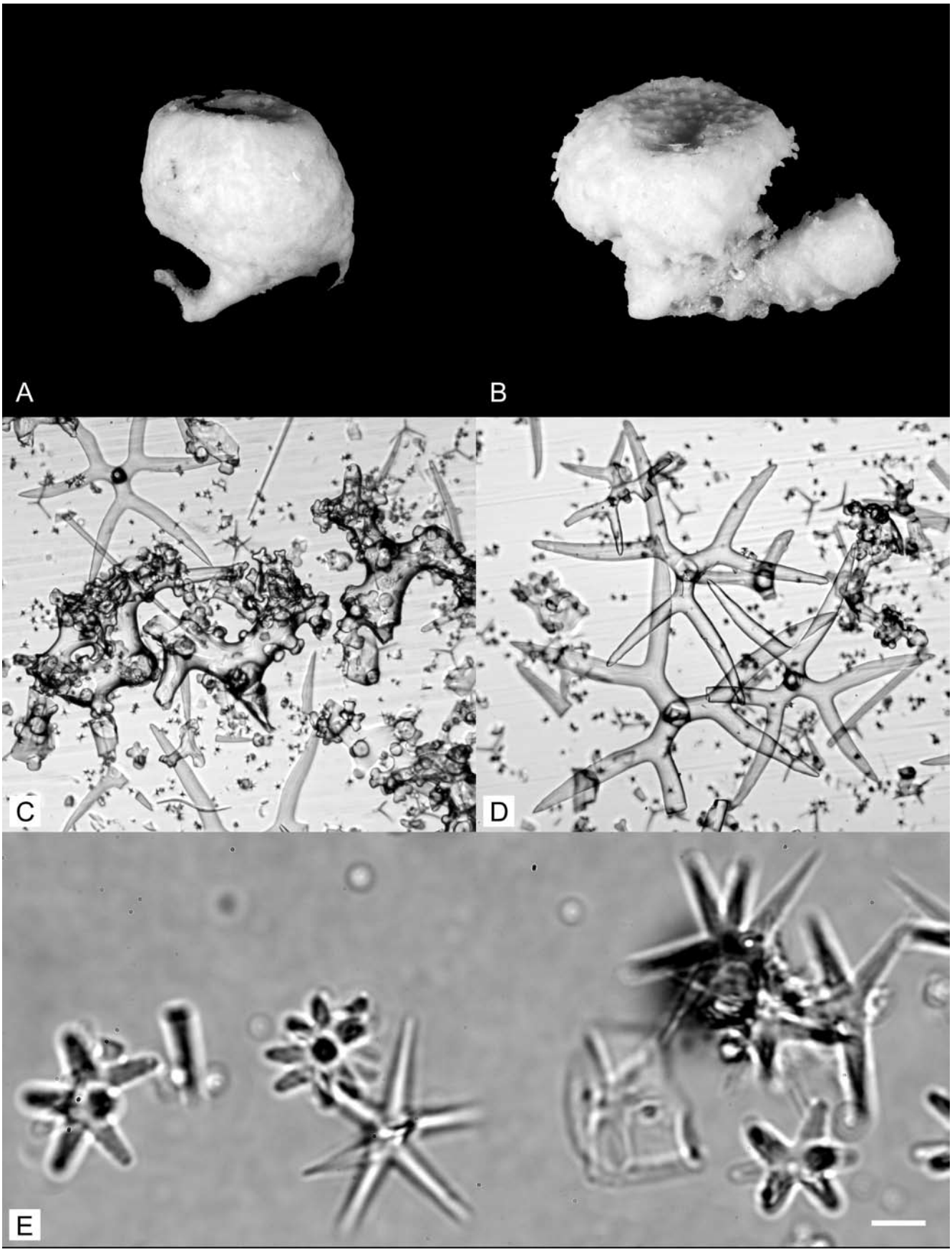


Figure 7. *Neosiphona motukawanui* n. sp.

NIWA18271, NIWA18272); KAH0204/47 (NIWA18260); KAH0204/52 (NIWA18262, NIWA18263, NIWA18273, NIWA18274, NIWA18275).
TYPE LOCALITY: West Cavalli Seamount, Northland.

DISTRIBUTION: Cavalli Seamount Region, northeastern New Zealand.

HABITAT: Sponges were dredged from hard rocky substrata or were attached to small pieces of coral. Depth range 780–910 m.

DESCRIPTION:

Morphology a block-shaped mass with a restricted base of attachment, the apex of which is a flattened parchment-textured roof, under which numerous aquiferous canals open from within the sponge (Fig. 7A,B). The upper third of some specimens may be expanded to form a shallow cup with thick rolled edges (Fig. 7B). The base of these sponges is very narrow and root-like (Fig. 7A, B). NIWA18268 has a thin beard of diatines about 40 mm long extending from around the base of the sponge into the substratum, probably acting as an anchoring device. Immature sponges are elongate to spherical with a shallow broad parchment-like apex, gradually thinning to a narrow base of attachment. The sponges are generally taller than they are wide.

Dimensions of immature specimens in the collection are 25 mm high, 15 mm at the widest point, and 5 mm at the base. Most specimens are approximately 50 mm high, 35 mm wide (maximum), and 15 mm wide at the base. Mature specimens are 60–80 mm high, 40–60 mm at the widest point, and have a base of 20 mm.

Texture internally incompressible, externally flakey, crumbly, easily abraided, especially at the apex.

Surface typically smooth, flakey or crumbly. The surface of many specimens is tufted with long diactinal spicules that form conules on the surface, but these are often abraided away in damaged specimens.

Colour apricot yellow (5B6) in ethanol.

Choanosomal skeleton dominated by desmas with thick tuberculate clones and large intricate zygoses. Oxeote microscleres are abundant.

Ectosomal skeleton a crust of robust strongyloamphiasters. Oxeas arise in tracts from within the deeper choanosome, piercing the surface, and in some locations forming a distinct beard.

Megascleres (Table 6) tetraclone desmas with very thick short clones (Fig. 7C), tuberculation variable and more prominent on the ends of the clones. Single, multiple and spires of tubercles are common. Clones divide at least one, and often twice. Zygoses are very strong, intricate, and enlarged. Dichotriaenes (Fig. 7D) with very wide cladome; clads are thick, irregular and often of uneven length, rhabd short and often strongylote. Dichotriaenes of NIWA18261 are frequently trichotriaenose and the clads are occasionally strongylote, as is the rhabd. Diactines are very long, straight, evenly thick and strongylote.

Microscleres (ectosomal) are robust strongyloamphiasters with a few blunt conical rays (Table 6 Ms 1; Fig. 7E), choanosomal microscleres are larger amphiaster/streptasters with fine rays (Table 6 Ms 2; Fig. 7E). In addition to the standard microscleres, specimen NIWA18264 has rhabds with short projections postioned very irregularly along the length of the spicule which is 17–20 µm long. These were not seen in other specimens, and are most probably malformed strongyloamphiasters.

ETYMOLOGY: Named for the largest island in the Cavalli Island group, Motukawanui, encompassed by the Cavalli Seamount region that is the general type locality of this new species. In the literal sense, *motu* means 'island', *kawa* is the New Zealand pepper tree used extensively in ceremonial protocol, and *nui* means 'big' (*motukawanui*, New Zealand Māori).

REMARKS: *Neosiphonia motukawanui* is only the fourth known species of this genus, and one of these, *N. schmidti* Sollas, 1888 from Havana, Cuba, is thought to belong to a different genus (Pisera & Lévi 2002k). *Neosiphonia* is characterised primarily by a massive globular body that narrows to a restricted columnar base of attachment, the apex of which consists of a covered shallow depression or atrium into which vertical aquiferous canals open.

Table 6. Spicule dimensions (µm) of *Neosiphonia motukawanui* n. sp.

	Desma (Clone L/T) Desma (Overall size)	Cladome (Max ø) Rhabd (L)	Diactines (L)	Ms 1 (L)	Ms 2 (L)
New Zealand					
NIWA18261 (holotype)	125–375/70–80 460–600	523 (450–675) 138 (75–250)	all broken	18 (18–20)	30 (23–35)
NIWA18259 (paratype)	250–400/90–100 500–800	619 (425–900) 142 (75–250)	600+	21 (18–28)	33 (20–43)
NIWA18264	250–500/70–100 500–750	590 (350–725) 100	all broken	18 (18–20)	31 (25–38)

Neosiphonia motukawanui differs from the genus type *N. superstes* Sollas in the shape of the sponge; the body region of *N. superstes* is more globular with a columnar 'stalk' (see Fig. 6A), whereas the body of the former species tapers to a thin attenuating stalk (see Fig. 7A). The apical depression atop *N. motukawanui* is extremely prominent, covering the entire flattened apex of the sponge, while in *N. superstes* the atrium is smaller and deeper. Long tufted diactines in *N. motukawanui* are also a prominent feature in well-preserved material. The dichotriaenes have a wider, larger cladome than in *N. superstes* and the strongyloamphiasters are much thicker and slightly bigger. The desmas of *N. motukawanui* are more robust and tuberculate than the thinner, less ornamented desmas of *N. superstes*.

Younger specimens of *N. motukawanui* may be mistaken in the field for *Neoaulaxinia persicum*, but the latter are spherical without an atrium over the apical cavity, and the former are always club-shaped with low blunt conules. The nature of the ornamentation of the desmas, the size and shape of the microscleres, and the greater rhabd length of the dichotriaenes in *N. persicum*, are always indicative, however.

KEY DIAGNOSTIC CHARACTERS:

- Sponge is block-, club-, or shallow cup-shaped and the flattened top of the sponge is a delicate 'parchment' over a shallow cavity; the bottom of the cavity has numerous aquiferous canals opening into it.
- Desmas are very thick, branched several times, and are tuberculate, with single or double spires.
- The robust microscleres are very thick with few conical blunt rays.
- Could be confused with *Neoaulaxinia persicum*.

Reidispongia Lévi & Lévi, 1988

Cup-shaped with thin smooth walls, elongate chalice-shaped as a young sponge, foliose as a mature sponge; tetraclone desmas are highly ramified with frequently smooth branched clones and tuberculate termini. Zygosis is weak or non-existant on the outer (younger) portions of the lamellae, otherwise it is intricate and very strong in the older skeleton; microscleres are two types of amphiaster in two closely related size categories, one a strongyloamphiaster, and the other an amphiaster with fine rays.

TYPE SPECIES: *Reidispongia coerulea* Lévi & Lévi, 1988.

Reidispongia coerulea Lévi & Lévi, 1988 (Fig. 8)

Reidispongia coerulea Lévi & Lévi, 1988: 245; Pisera & Lévi 2002k: 371, figs 11–14; Schlacher-Hoenlinger *et al*. 2005: 688, figs 4D, 20, 34.

MATERIAL EXAMINED:

NIWA Stations: B314 (NIWA18277); E731 (NIWA25612); KAH0011/30 (NIWA18278, NIWA18279); KAH0011/41 (NIWA18280); KAH9907/49 (NIWA18281); TAN0413/099 (NIWA25056); TAN0413/112 (NIWA25055); TAN0413/117 (NIWA25058); TAN0413/118 (NIWA25057); X861 (NIWA25622).
IRD Stations: LITHIST DW7 (NIWA18486, NIWA18487).

DISTRIBUTION: BIOCAL Stn DW 66 (holotype) and Éponge Seamount, south New Caledonian slope of Norfolk Ridge; Eastern edge of the Challenger Plateau; west of White Island and Rungapapa Knoll, Bay of Plenty; South Kermadec Ridge.

HABITAT: Growing on hard volcanic rock; the cover photo of this memoir shows the surface of a boulder from a volcanic seamount, clearly indicating the earliest stages of settlement and growth of this species. Settlement and coalescence of adjacent individuals indicates that older sponge masses may be made up of several individuals. Depth range 141–1132 m.

DESCRIPTION:

Morphology of mature sponges a folded, tubular mass (Fig. 8A). The smallest individuals are rounded tuberculate nodules with a slightly restricted base and a deep cavity on the apex. As these sponges mature, the walls extend upwards and outwards, the sponge then resembling a low flat, or high narrow chalice (Fig. 8B; see also cover photo). Portions of large sponges can appear to be lamellar or tubular when broken.

Dimensions of juveniles 5 mm high, 4 mm wide at apex, 4 mm diameter at base; typical immature chalice-shaped sponges 15–22 mm high, 20 mm wide at apex, 9 mm wide at base; the holotype is 60–80 mm high, 90–100 mm wide at the apex, but the sponge grows much larger, up to 150 mm high and 300 mm wide; 3–5 mm thick.

Texture stony to touch, but the lamella is easily broken and crushed.

Surface very smooth, slightly glistening owing to faintly projecting diactines, oscules not visible.

Colour characteristically vivid blue (22B8) in life, this colour able to be retained in ethanol, becoming sapphire blue (23D7), but several sponges are cream (4A3) or putty-coloured (4B2) in preservative.

Choanosomal skeleton very regular and packed with small tetraclone desmas between which are abundant amphiasters. Dichotriaenes are regularly spaced along the ectosome with rhabds clearly visible perpendicular to the ectosome surface. Slightly sinuous diactines are dispersed sparsely throughout the outer choanosome (Fig. 8C). These frequently pierce the ectosome.

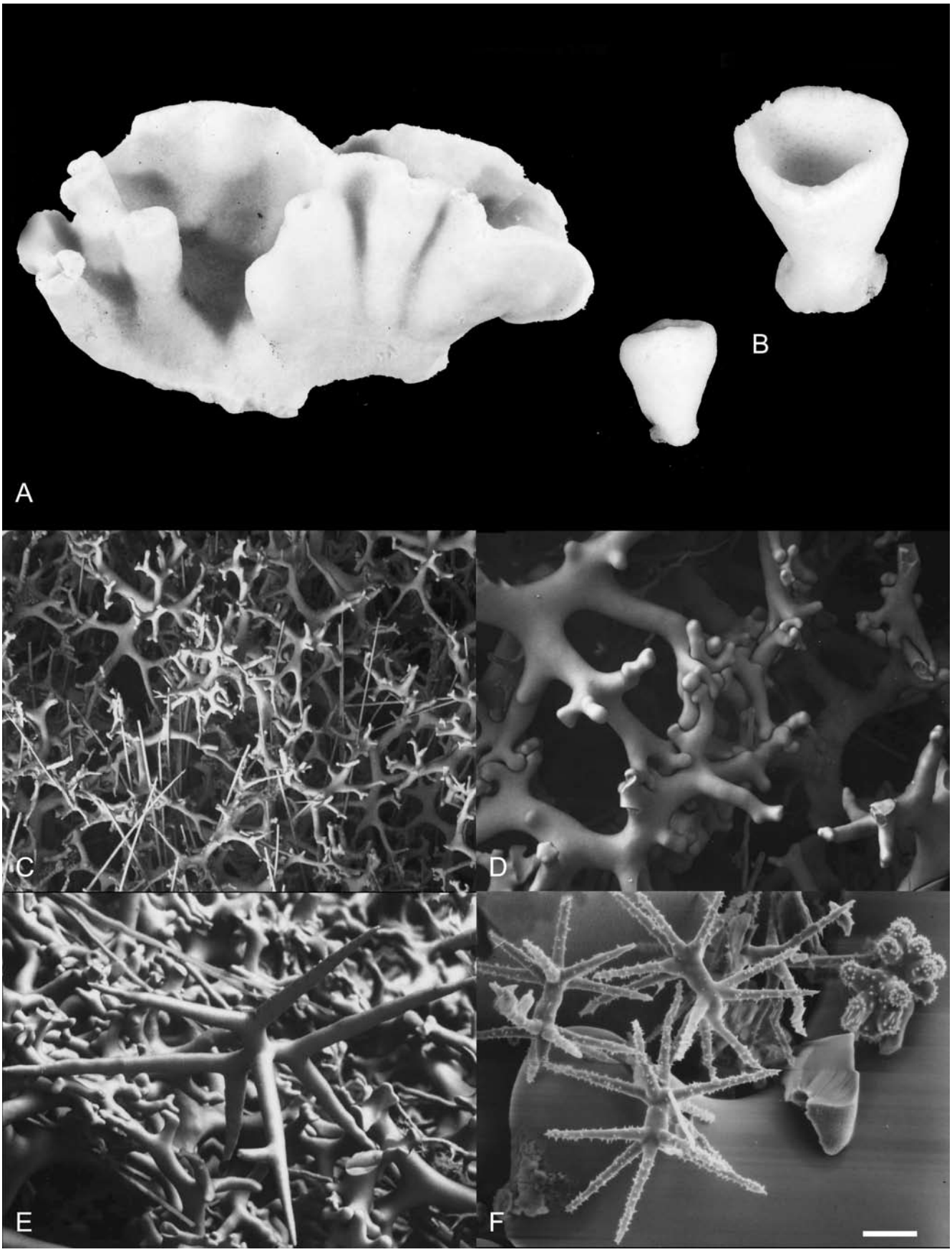


Figure 8. *Reidispongia coerulea* Lévi & Lévi, 1988.

Ectosomal skeleton a crust of strongyloamphiasters.

Megascleres (Table 7) desmas (Fig. 8C,D) are smooth, highly branched and ramified, branching up to 4 times, and the termini are tuberculate. The centre of the lamella zygosis is very intricate and forms a rigid enlarged articulation mass (Fig. 8D); in the outer (younger) sections of the lamella, zygosis is weaker (Fig. 8C) or non-existant. Dichotriaenes have long straight deuteroclads and a relatively short spured rhabd (Fig. 8E). Diactines (Fig. 8C) are thickened centrally, thinner and flexuous on the ends that are strongylote.

Microscleres (ectosomal) are robust strongyloamphiasters (Table 7 Ms 1); choanosomal microscleres are larger fine-rayed amphiasters (Table 7, Ms 2; Fig. 8F).

Remarks: This sponge has been well described by Lévi and Lévi (1988) and Pisera and Lévi (2002k). The New Zealand specimens are almost identifical in all aspects of morphology and spicule dimensions. The description given here adds to knowledge of the settlement patterns and morphology of the most juvenile forms.

Key diagnostic characters:

- Folded thin-walled vivid blue mass or tiny blue chalices or nubbins.
- Two clearly differentiated types of amphiaster microscleres of a similar size.

Table 7. Spicule dimensions (μm) of *Reidispongia coerulea* Lévi & Lévi, 1988.

	Desma (Clone L/T) Desma (Overall size)	Cladome (Max ø) Rhabd (L)	Diactines (L)	Ms 1 (L)	Ms 2 (L)
New Zealand NIWA 18277	200–300/20–30 300–500	300 (220–400) 200 (160–270)	446 (250–770)+	8 (8–11)	15 (13–18)
New Caledonia Lévi & Lévi (1988)	200/20 125–200/18–20	300	500–1000	9–10 300–475	15–18
S.-H. et al. (2005)	—/20–30 380-420	190–300 —	500–1000	10–13	16–21

Family **CORALLISTIDAE** Sollas, 1888

Corallistidae Sollas, 1888: 301 (partim); Topsent 1894: 290 (partim); Schrammen 1910: 64 (partim).

Massive ear-, vase-, plate-, or cup-shaped lithistid Demospongiae; choanosomal desmas are dicranoclones, ectosomal megascleres are dichotriaenes, microscleres are spirasters typically of two types; streptasters, amphiasters, microxeas, microstyles, and microstrongyles (from Pisera & Lévi 2002c).

Remarks: Redefinition of the Corallistidae by Pisera and Lévi (2002c) and description of new species of *Corallistes*, *Herengeria*, and *Neoschrammeniella* by Schlacher-Hoenlinger *et al*. (2005) have facilitated the recognition of corallistid genera in New Zealand waters. Species of Corallistidae occur in deep-water worldwide, but *Herengeria* and *Neoschrammeniella* are so far known only from the Southwest Pacific. Most species are poorly known and badly in need of revision (Pisera & Lévi 2002c).

Neoschrammeniella Pisera & Lévi (formerly *Iouea* Lévi & Lévi, 1988) differs from *Corallistes* Schmidt in the possession of two types of spirasters (with short blunt and long oxeote rays), a very large streptaster in some species, and smooth anisoxeas; *Corallistes* also has two types of spiraster, both with oxeote rays (short and long rays), but lacks the anisoxeas. Research here has resulted in the transfer of *C. fulvodesmus* Lévi & Lévi, 1983 to *Neoschrammeniella* as it possesses anisoxeas and a very large streptaster, amongst other characters. *Corallistes multituberculatus* Lévi & Lévi, 1983 is probably also a species of *Neoschrammeniella* as it has two types of spiraster, while *C. undulatus* Lévi & Lévi, 1983 has only one and remains in *Corallistes*. Only two species of *Corallistes* are presently recognised in the Southwest Pacific — *C. undulatus* Lévi & Lévi, 1983 and *C. australis* Schlacher-Hoenlinger, Pisera & Hooper, 2005.

Species of *Herengeria* are separated from *Neoschrammeniella* in the possession of acanthose centrotylote oxeas and spiral or rod shaped micropolyrhabd microscleres in addition to normal spirasters, and in the manner in which the desmas zygose. *Awhiowhio* n. gen. is similar to *Herengeria*, but lacks the ectosomal acanthose microxeas and choanosomal spirasters, and the desmas are less ornamented with smooth nodular projections rather than multituberculate fungiform

projections. This new genus is endemic to New Zealand waters.

The separation of species with nodulose dichotriaene cladomes from *Corallistes* to *Neophrissospongia*, suggested some years ago by Lévi (1991) and supported by Kelly (2000), further differentiates the family. This genus is represented in the southwest Pacific by a single species, *Neophrissospongia microstylifer* (Lévi & Lévi, 1983) (Pisera & Lévi 2002c), which has not been found in New Zealand waters.

It is interesting to note that microfossil ectosomal triaenes indistinguishable from those of extant Corallistidae were found in the Tutuiri Greensand (Teurian–basal Waipawan) in the Chatham Islands (Buckeridge & Kelly 2005), and illustrated from the Oamaru Diatomite at Oamaru in North Otago (Hinde & Holmes 1892, pl. 13, figs 7–8, 11–12), suggesting a more southern distribution for Corallistidae during the Paleogene.

Neoschrammeniella Pisera & Lévi, 2002

Iouea Lévi & Lévi, 1988.

Shallow cup-shaped or deep vase-shaped Corallistidae with a smooth surface; desmas are heavily tuberculate dicranoclones. Ectosomal spicules are smooth dichotriaenes. Medium-length anisoxeas with attenuated tips may be present in the ectosome in several species and large diactines may form a fringe along the sponge margin. Microscleres are two types of acanthose spirasters, one with robust rays and one with thin pointed rays, and a large amphiaster/streptaster with smooth thin pointed rays in several species (emended from Pisera & Lévi 2002).

TYPE SPECIES: *Iouea moreti* Lévi & Lévi, 1988.

Neoscrammeniella fulvodesmus (Lévi & Lévi, 1983) (Fig. 9)

Corallistes fulvodesmus Lévi & Lévi, 1983: 110, pl. 5, fig. 2,5, pl. 13, 2, fig. 4.

MATERIAL EXAMINED:

NIWA Stations: I92 (NIWA18289); KAH0204/29 (NIWA18295); KAH0204/32 (NIWA18293); KAH0204/40 (NIWA18292); KAH0204/44 (NIWA18294); S571 (NIWA18291); S572 (NIWA18284, NIWA18285); TAN0413/070 (NIWA25049); TAN0413/111 (NIWA18296, NIWA18297, NIWA25050); TAN0413/173 (NIWA18298); U606 (NIWA18287); X128 (NIWA18283); X140 (NIWA18290); Z9025 (NIWA18288); Z2098 (NIWA18286); Z9751 (NIWA18515).

IRD Stations: LITHIST DW7 (NIWA18488).

DISTRIBUTION: Éponge Seamount, and south New Caledonian slope of Norfolk Ridge (holotype); South Norfolk Basin; Norfolk Ridge south of Norfolk Island; north, west and east of Three Kings Ridge, northern New Zealand; West and South Cavalli Seamounts, northeastern New Zealand; Rungapapa, Tuatoru and Mahina Knolls, Bay of Plenty, New Zealand.

HABITAT: Sponges were dredged from hard rocky substrata; specimens frequently had coral incorporated into their bases. Depth range 180–1680 m.

DESCRIPTION:

Morphology a shallow cup-shape with flared margin and narrow base of attachment, or an erect concave plate attached along a restricted curved base (Fig. 9A–C). Immature specimens form a nodule on the substratum with a single apical channel that gradually widens and expands as the sponge matures into either a cup or a plate. Several small specimens had hermitcrabs living in their narrow aperture.

Dimensions of cups are 40–90 × 30–90 mm wide and 25–50 mm high with a margin 4–8 mm thick. The base of attachement is circular or elliptical and varies with the size of the sponge. Small sponges typically have a base of c. 10 mm; larger sponges have a base c. 40 mm wide. Plate sponges are 25–120 mm wide and 25–60 mm high with a base of attachment 10–40 mm wide.

Texture very rigid, stony.

Surface smooth, granular to the touch, regular.

Colour cream (4A3) or putty-coloured (4B2) in ethanol preservative.

Choanosomal skeleton dense, with very heavily tuberculated dicranoclones (Fig. 9D).

Ectosomal skeleton a dense layer of robust microscleres that obscure the cladomes of the dichotriaenes. Large streptasters are abundant in the choanosome with smaller thin-rayed spirasters (Fig. 9D).

Megascleres (Table 8) — desmas are highly tuberculate dicranoclones with fungiform tubercles across the primary arched clone (Fig. 9E–F). There are approximately 4 clones arising off each arch. Dichotriaenes are robust with short conical clads (Fig. 9F), and characterised by bifurcating tips, a character first noted by Lévi and Lévi (1983). The diactines are extremely long. Attenuated oxeas are present in ectosomal preparations.

It is worth noting that in specimen NIWA18298 from Rungapapa Knoll, Bay of Plenty, over 50% of the dichotraienes are severely malformed, with only two of the three clads present, with a rhabd-like structure continuing through the cladome, to odd spurs emerging from the centre of rhabds. The tips of cladomes

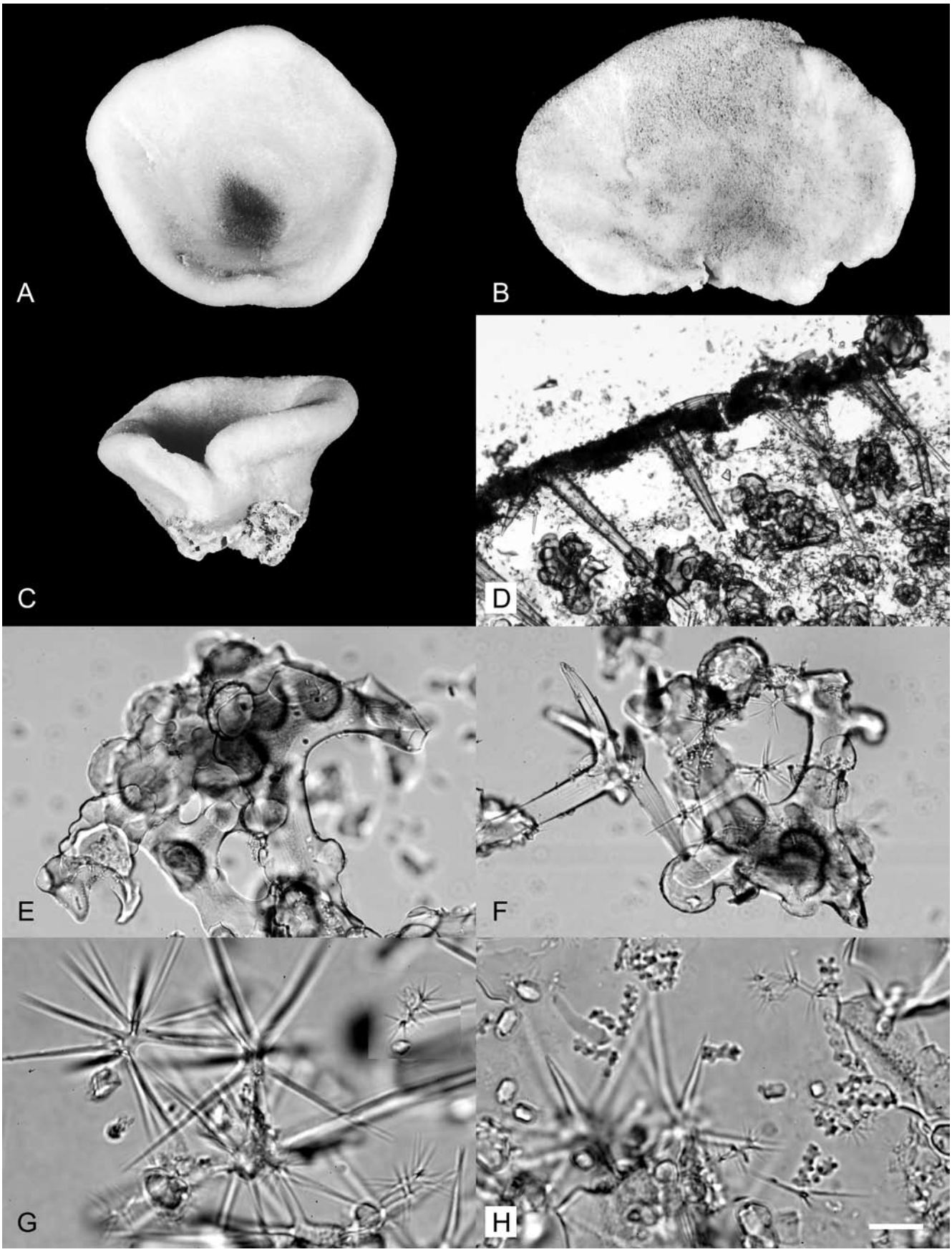


Figure 9. ***Neoscrammeniella fulvodesmus*** (Lévi & Lévi, 1983).

Table 8. Spicule dimensions (μm) of *Neoschrammeniella fulvodesmus* (Lévi & Lévi, 1983).

	New Zealand		New Caledonia
	NIWA18285	NIWA18288	Lévi & Lévi (1983)
Desma Clone L/T	200/50–120	100–200/60–100	–/100–150
Overall size	400–600	500–-600	600
Cladome (Max ø)	500 (400–625)	348 (250–400)	80–200
Rhabd (L)	500 (400–625)	475 (375–625)	600
Diactine (long)	>1 mm	>1 mm	1200–1300
Anisoxea	–	396 (240–600)	–
Spiraster (robust)	17 (15–20)	19 (15–25)	10–15
Spiraster (thin)	21 (15–25)	22 (20–25)	not measured but figured
Streptasters	61 (52–67)	58 (50–62)	35–45
Ray length	28	25–30	20–25

are frequently bifurcate, but in this specimen they are often trifurcate and multiply branched.

Microscleres (Table 8) (ectosomal) are robust spirasters (Fig. 9H); choanosomal microscleres are spirasters with numerous thin rays, and very large streptasters with thin rays (Fig. 9G).

REMARKS: New Zealand specimens examined here are clearly conspecific with *Corallistes fulvodesmus* Lévi & Lévi, 1983, which is now included in *Neoschrammeniella*. Corallistid genera are largely differentiated on the morphology of the microscleres and the presence of various diactines in the ectosome. *Neoschrammeniella norfolkii* Schlacher-Hoenlinger, Pisera & Hooper, 2005, *N. antarctica* n. sp. (described below), and New Zealand and New Caledonian specimens of *N. fulvodesmus* are characterised by the presence of extremely large streptaster/ amphiasters in the choanosome in addition to two forms of spiraster, which, in combination with anisoxeas, define the genus. This cluster of characters notwithstanding, the large streptaster/amphiasters are present in all species except the actual type of the genus, i.e. *N. moreti* (Lévi & Lévi, 1988), and *N. castrum* Schlacher-Hoenlinger, Pisera & H, 2005. Two courses of action are available to accommodate these species with an additional huge streptaster category. Either a new genus can be erected for these sponges with an additional microsclere category, or the diagnosis of *Neoschrammeniella* can be emended. Although there may seem to be some justification for the former action (*N. moreti* is columnar with an axial canal compared to the cup- or plate-shaped morphology of *N. fulvodesmus*), *N. antarctica* forms a tall narrow cup that approaches the morphology of the genus type. Moreover, there is very little difference in the desma morphologies of *N. moreti* and *N. fulvodesmus* (both have very strongly tuberculate desmas with terminal articulation), and thus the decision only to expand the diagnosis is upheld.

KEY DIAGNOSTIC CHARACTERS:

- Relatively thin-walled regular cup or plate with smooth granular surface.
- Diagnostic spiraster microscleres of two types (thick-rayed robust spirasters and very large thin-rayed spirasters).
- May be mistaken in the field for *Herengeria vasiformis* but the concave surface is much less furry; the microscleres of *H. vasiformis* are also unique, and diagnostic of that species.
- May be confused in the field with *Awhiowhio osheai* n. sp., but this sponge has raised oscules on the concave face, unique polymicrorhabds, and lacks the large streptaster category.

Neoschrammeniella antarctica n. sp. (Fig. 10)

MATERIAL EXAMINED:

Type material: Holotype NIWA18299 and paratype NIWA18300 from NIWA Stn A0527.

TYPE LOCALITY: Ross Sea, Antarctica.

DISTRIBUTION: Ross Sea, Antarctica.

HABITAT: Both specimens were dredged from hard substrata; the smaller of the two bears remains of the substratum, which appears to be igneous rock. Depth range 352 m.

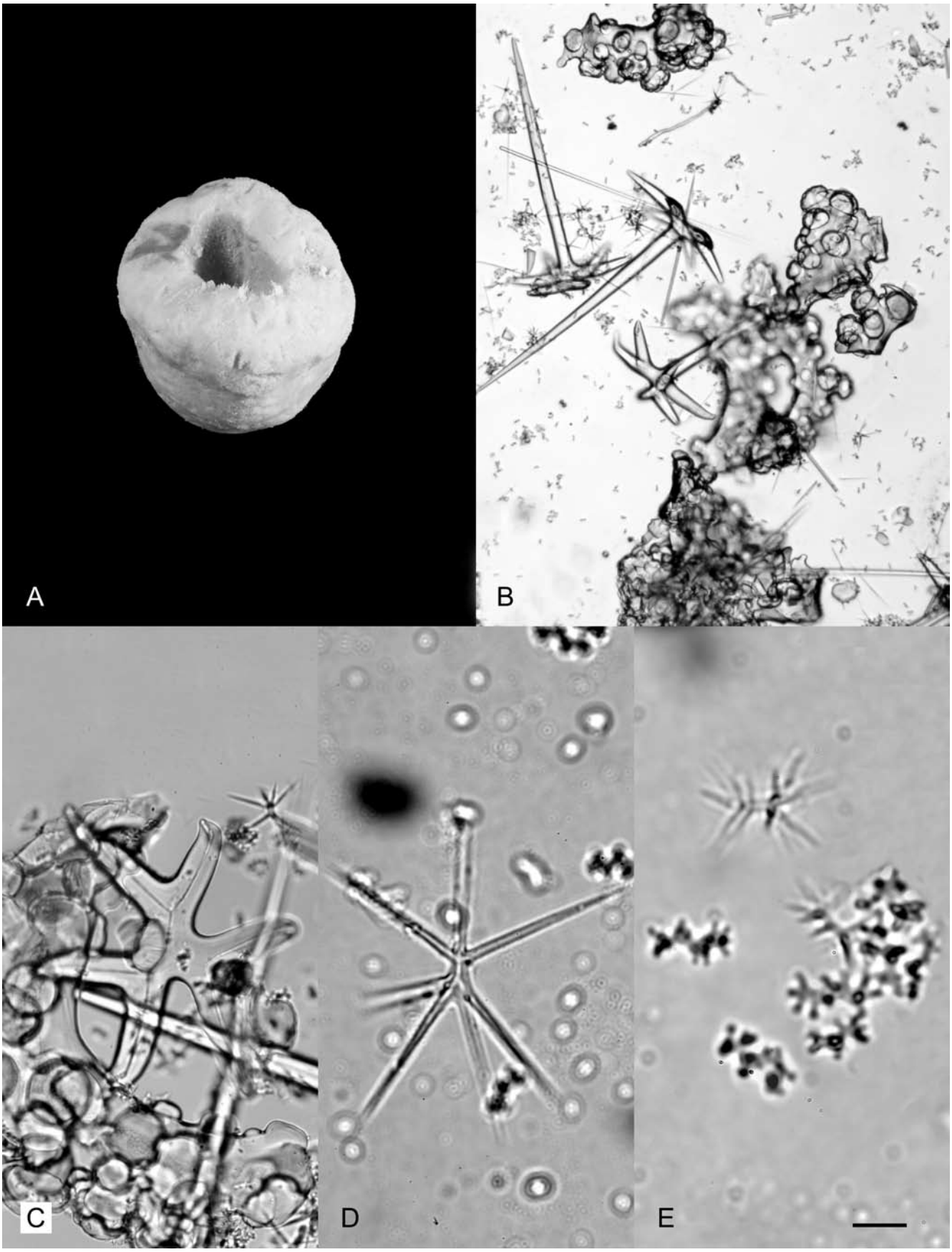


Figure 10. ***Neoscrammeniella antarctica*** n. sp.

DESCRIPTION:

Morphology of holotype is a tall, thick-walled, regular conical cup with a deep aperture and square margin at the apex (Fig. 10A). The cup diameter reduces to a regular narrow base of attachment that is circular in profile. The smaller immature paratype has a similar morphology but the sponge has rounder sides and the upper margin is rounded. There is no aperture, just a shallow depression with a soft parchment-like surface.

Dimensions of holotype: 50 × 60 mm wide at apex, tapering to 20 mm wide at base, 65 mm high, wall thickness 16 mm, aperture 30 long × 15 mm wide. Paratype 34 × 30 mm wide at apex, tapering to 12 mm wide at base, 33 mm high, central cavity 31 × 13 mm wide, 2 mm deep.

Texture stony.

Surface smooth, slightly pitted, granular, except for the concave surface of the aperture that is furry with projecting diactines, and the inner margin that is fringed in places with the same spicules.

Choanosomal skeleton extremely dense with large heavily tuberculate dicranoclones and abundant microscleres. The choanosome is traversed by extremely long thick diactines.

Ectosomal skeleton crowded with robust spirasters and dichotriaenes.

Megascleres (Table 9) — desmas are large dicranoclones with clones that are heavily ornamented on all surfaces with bumpy fungiform tubercles (Fig. 10 B, C). Zygosis is predominantly terminal, with clasp-like structures. Dichotriaenes are large and robust with short conical clads, the tips of which are frequently bifurcate (Fig. 10 B, C). The diactines are extremely long and thick. Oxeas with attenuated tips are present in ectosomal preparations.

Microscleres (Table 9) (ectosomal) are robust spirasters that form a crust (Fig. 10E); choanosomal microscleres are small spirasters with numerous thin rays and large streptasters with thin smooth rays (Fig. 10D, E).

ETYMOLOGY: Named for its Antarctic distribution.

REMARKS: *Neoschrammeniella antarctica* is very similar to *N. fulvodesmus* from northern New Zealand and the Norfolk Ridge and to *N. norfolkii* from the Norfolk Ridge, but differs in gross morphology, in the subtle detail of the morphology and ornamentation of the desmas, and in the size of the accessory megascleres. Specimens of *N. antarctica* are tall thick-walled vases with a deep cavity and square lip, whereas both *N. fulvodesmus* and *N. norfolkii* appear more cup-shaped.

The desmas in all three species are quite similar in overall size but those of *N. fulvodesmus* and *antarctica* are much larger overall. The desmas of *N. fulvodesmus* have very large nodular fungiform tubercles that are commoner on the primary arched clone, as opposed to being spread regularly over all clones in *N. norfolkii*. The desmas of *N. antarctica* have large pedestals of tubercles as well, principally on the arched side of the primary clone.

Table 9. Spicule dimensions (μm) of *Neoschrammeniella antarctica* n. sp.

	New Zealand **NIWA 18299 (holotype)**
Desma Clone L/T	350/70
Overall size	350–750
Cladome (Max ø)	386 (250–500)
Rhabd (L)	612 (425–725)
Diactine (long)	> 2 mm
Anisoxea	203 (150–350)
Spiraster (robust)	14 (8–18)
Spiraster (thin)	17 (15–20)
Streptasters	74 (57–90)
Ray length	25–38

While the dichotriaenes in all three species are quite similar in cladome shape, the rhab is longer than in the two other species and the clads are frequently trifurcate. All categories of microscleres are quite similar in length with the exception of the thin-rayed spirasters in *N. norfolkii* (22–26 um), which are larger than in the other two species. The large category of streptaster is quite a lot smaller in *N. fulvodesmus*, however. The anisoxeas of *N. antarctica* are smaller than those in *N. fulvodesmus*; these spicules are not mentioned in the description of *N. norfolkii*.

N. antarctica is the first record of a lithistid sponge from a polar region and the only lithistid sponge record south of the Challenger Plateau and the Chatham Rise of New Zealand.

KEY DIAGNOSTIC CHARACTERS:

- Very thick-walled conical cup.
- From Antarctica.

Herengeria Lévi & Lévi, 1988

Massive or cup-shaped. Massive species have a lateral inhalant sieve-pore area and long tufts of diactines; cup-shaped species have no localised inhalant structure, but the upper concave part of the cup is bristly. Choanosomal megascleres are smooth dicranoclones with multituberculate fungiform nodules and spires;

zygoses are intricate, terminal or predominantly lateral via saddle-shaped formations, clones forming reinforced 'bridges' around 'trabeculae' or channels in the network. Ectosomal spicules are smooth dichotriaenes; choanosomal microscleres are abundant acanthose centrotylote microxeas and long-rayed streptaster/amphiasters. Ectosomal microscleres include short-rayed spirasters, amphiasters, and highly irregular micropolyrhabds. Large oxeas protrude from the upper surface (modified from Pisera & Lévi 2002c).

TYPE SPECIES: *Herengeria auriculata* Lévi & Lévi, 1988.

REMARKS: The diagnosis has been modified from that given by Pisera and Lévi (2002c) to include a new form of choanosomal amphiaster microsclere found in all specimens of *Herengeria auriculata*.

Herengeria auriculata Lévi & Lévi, 1988 (Fig. 11A–G)

Herengeria auriculata Lévi & Lévi, 1988: 250, pl. 5, fig. 5; Schlacher-Hoenlinger, Pisera & Hooper 2005: 665, figs 2G, 11, 25.

MATERIAL EXAMINED**:**

NIWA Stations: U591 (NIWA18301); Z2098 (NIWA18302).
IRD Stations: LITHIST DW7 (NIWA18516).

DISTRIBUTION: BIOCAL Stn DW 66 (holotype), Éponge and Introuvable Seamounts, south New Caledonian slope of Norfolk Ridge; Tui Seamount and north of Three Kings Ridge, northern New Zealand.

HABITAT: Free-living with no indication of an attachment. Depth range 486–920 m.

DESCRIPTION:

Morphology globular, egg-shaped, with a truncate apex. One side of the sponge is a flattened demarcated 'auricle' that is softer and more porous than the surrounding sponge material, representing a localised concentration of inhalant ostia. Tufts of very long spicules emerge from the apex and sides of the sponge (Fig. 11A, B). A short oscular chimney may emerge from base of sponge.

Dimensions 15–25 mm high, 8–20 mm wide, 6–15 mm thick, excluding spicule tufts that emerge from 2–7 mm beyond the sponge surface. The holotype was described as 15 mm high and 10 mm wide (Lévi & Lévi 1988).

Texture stony; inhalant auricle is soft, crumbly.

Surface relatively smooth except for the tufts of spicules.

Colour apricot-yellow (5B6) in life and in ethanol, with a reddish tinge.

Choanosomal skeleton composed of very large dicranoclone desmas that form a cavernous structure (Fig. 11C), in between which are dispersed numerous microxeas, sharp-rayed spirasters and, less commonly, long-rayed amphiasters. Enormous tracts of oxeas are visible emerging from the choanosome, penetrating and emerging beyond the sponge surface.

Ectosomal skeleton a crust of microxeas and spiraled microscleres.

Megascleres (Table 10) dicranoclone desmas (Fig. 11 C,D), slightly curved, tripod-shaped, bearing abundant fungiform projections, the upper part of each being nodulose (Fig. 11D). Zygoses are terminal and lateral along the clones between the fungiform processes. Dichotriaenes of typical form with a regular long conical rhabd and regular smooth cladome. Diactines, very long, centrally thickened oxeas that project in bundles from the choanosome to form tufts on the surface.

Microscleres (ectosomal) acanthose microxeas, either acutely bent in the middle or straight and centrotylote (Fig. 11E,G); ectosomal spirasters, thick curved spirals (Table 10 Ms 1; Fig. 11E); choanosomal spirasters with numerous sharp slightly curved rays (Table 10 Ms 2; Fig. 11F); choanosomal amphiasters with long curved rays (Table 10 Ms 3; Fig. 11F).

Table 10. Spicule dimensions (μm) of *Herengeria auriculata* Lévi & Lévi, 1988.

	Clone (thickness) Overall size of arch	Cladome (Max ø) Rhabd (L)	Diactines (L)	Microxeas (L)	Ms 1 (L)	Ms 2 (L) Ray (L)	Ms 3 (L) Ray (L)
New Caledonia							
Lévi & Lévi (1988) (holotype)	50–75 450–800	160–680 300–475	<10 mm	70–100	23–33	20–22	–
S.-H. *et al*. (2005)	50–75 450–800	245–500 300–475	10 mm	70–100	32–40	19–25	–
New Zealand							
NIWA18301	80–100 375–1000	454 (375–625) 366 (270–430)	<10 mm	85 (75–95)	30 (25–35)	23 (18–25) 5–6	23 (20–25) 10–13

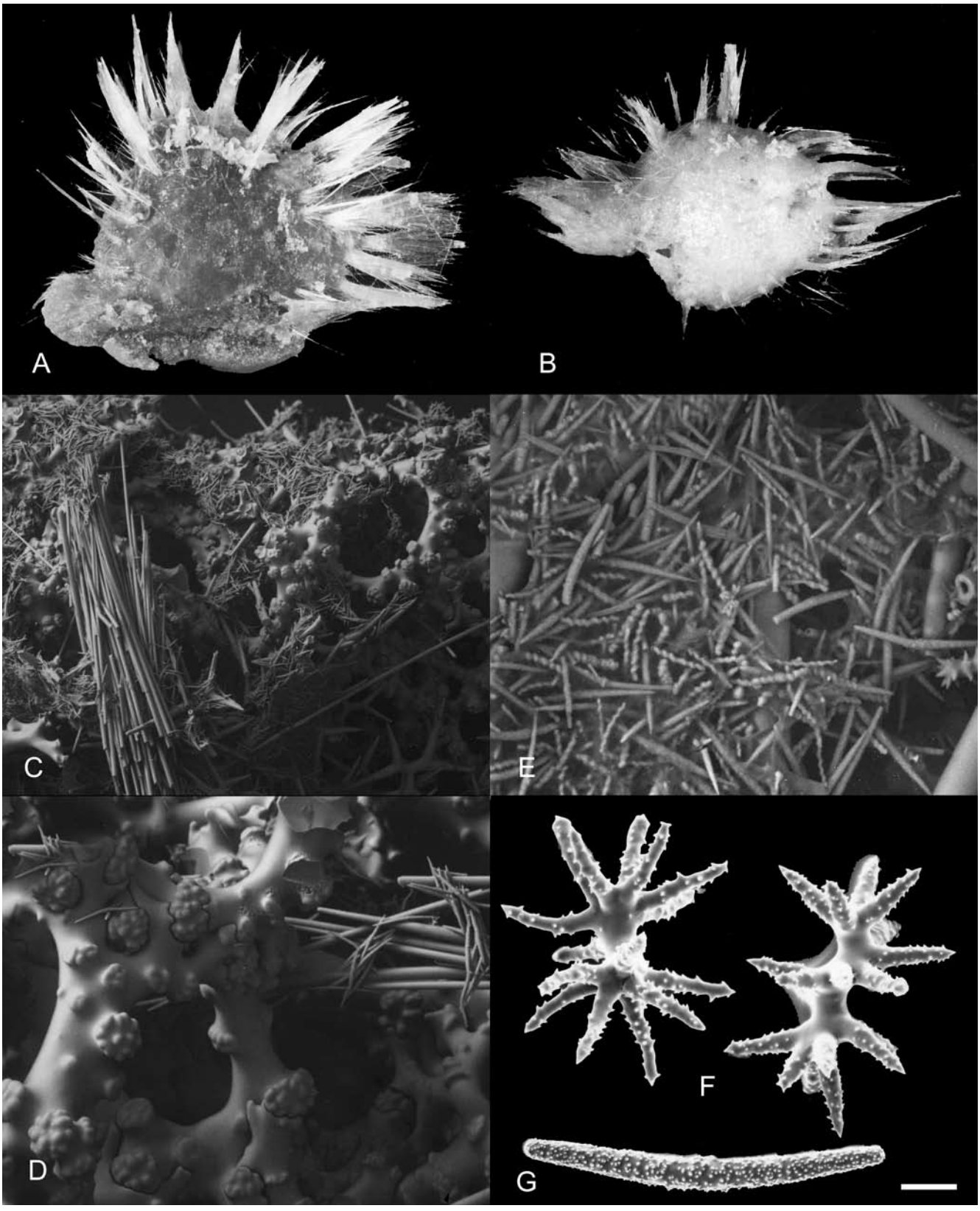


Figure 11. ***Herengeria auriculata*** Lévi & Lévi, 1988.

REMARKS: The New Zealand specimens conform well to the holotype description. All New Zealand and new New Caledonian specimens contain an additional choanosomal microsclere — an amphiaster with long, curved rays — which has not been described previously. The genus diagnosis has been emended accordingly.

KEY DIAGNOSTIC CHARACTERS:

- Small stony nubbin sponges with tufts of long spicules emerging from the top
- With an ear-shaped expansion that contains localised inhalant pores

Herengeria vasiformis Schlacher-Hoenlinger, Pisera & Hooper, 2005 (Fig. 12)

Herengeria vasiformis Schlacher-Hoenlinger, Pisera & Hooper, 2005: 668, figs 2F, 10, 24.

MATERIAL EXAMINED**:**

NIWA Stations: E636 (NIWA18309); KAH0011/30 (NIWA18312); I372 (NIWA25781); KAH0011/40 (NIWA18313); KAH0011/41 (NIWA18314); KAH0011/44 (NIWA18310); KAH9907/48 (NIWA18316, NIWA18317); KAH9907/50 (NIWA18319, NIWA18320, NIWA18321, NIWA18322, NIWA18323); S572 (NIWA18308); TAN0205/32 (NIWA18315); TAN0413/074 (NIWA18327); TAN0413/077 (NIWA25047); TAN0413/085 (NIWA18326); TAN0413/112 (NIWA18328, NIWA25046); TAN0413/117 (NIWA18324); TAN0413/118 (NIWA18325); U594 (NIWA18307); U606 (NIWA18303, NIWA18304); X207 (NIWA18305); Z9748 [NIWA18817 (0CDN6853-J)].
IRD Stations: LITHIST DW7 (NIWA18517).

DISTRIBUTION: New Caledonian slope of Norfolk Rige; east Kermadec Ridge slope; South Norfolk Basin; east of Hikurangi Plateau; West Three Kings Ridge; Doubtless Bay, North Cape; Tuatoru and Rungapapa Knolls, and west of White Island, Bay of Plenty, New Zealand.

HABITAT: Dredged from hard rocky (volcanic) substrata. Depth range 154–1100 m.

DESCRIPTION:

Morphology a shallow regular spherical cup, the sides shorter than wide (Fig. 12B), occasionally vase-shaped (Fig. 12A,D); immature specimens short and dome-shaped with central cavity (Fig. 12C); margins of cup smooth, wavy; sections of cup margin may be indented; base flanged.

Dimensions 86 (45–120) x 79 (45–115) mm wide, 42 (20–80) mm high, wall thickness 6–10 mm (outer margin) to 12–25 mm at the base.

Texture stony.

Surface — internal surface furry with projecting diactinal spicules (Fig. 12B), surface textured, slightly rough; convex outer surface rough and slightly irregular.

Colour in life ivory (4B3), in preservative teak brown (6F5).

Choanosomal skeleton dense with aquiferous canals visible under the ectosome, but the desma skeleton is largely obscured by extremely abundant acanthose microxeas, particularly on the outer ostial face. Microxeas are absent from the oscular face. Desmas form thick heavy arches within the deep choanosome and a less dense reticulation in the ectosome.

Ectosomal skeleton a dense crust of micropolyrhabd microscleres (Fig. 12F).

Megascleres (Table 11) — desmas very thick, with 2–4 clones, heavily ornamented with fungiform nodulose tubercles (Fig. 12E). Zygosis is lateral and terminal, building a very dense reticulation in the mature inner sections of the sponge; desmas have a granular brown core, immature desmas are sparsely tuberculate with relatively smooth thin clones; dichotriaenes (Fig. 12F), regular, long rhabd and short thick clads, rhabd often with a spur; oxeote diactines, smooth, very thick centrally, with whip-like extremities.

Microscleres — micropolyrhabds (Table 11 Ms 1; Fig. 12G), acanthose, extremely irregular, ranging from rod-shaped to nodulose, to spiraster-shaped with thick blunt nodules. Most spicules are non-uniform, with nodules projecting randomly along one or both sides; streptasters (Table 11 Ms 2), extremely fine and irregular, with very long thin occasional rays, rare; microxeas, slender, curved, or slightly angled around central tylote expansion; acanthose with short sharp spines that curve inwards towards middle of spicule (Fig. 12E).

REMARKS: The New Zealand specimens agree well with the holotype recently described from seamounts off southern New Caledonia on the Norfolk Ridge (Schlacher-Hoenlinger *et al*. 2005), except that the streptaster microscleres (Table 11, Ms 2) in the New Zealand specimens are extremely rare, and the sponges are larger with a thinner wall. The micropolyrhabds are unique in Corallistidae, and unusual in the lithistid sponges. They are comparable to similar microscleres in several new species of *Neoschrammeniella* (Schlacher-Hoenlinger *et al*. 2005) but this genus lacks the centrotylote microxea — an abundant microsclere within *Herengeria*. *Herengeria vasiformis* is very different

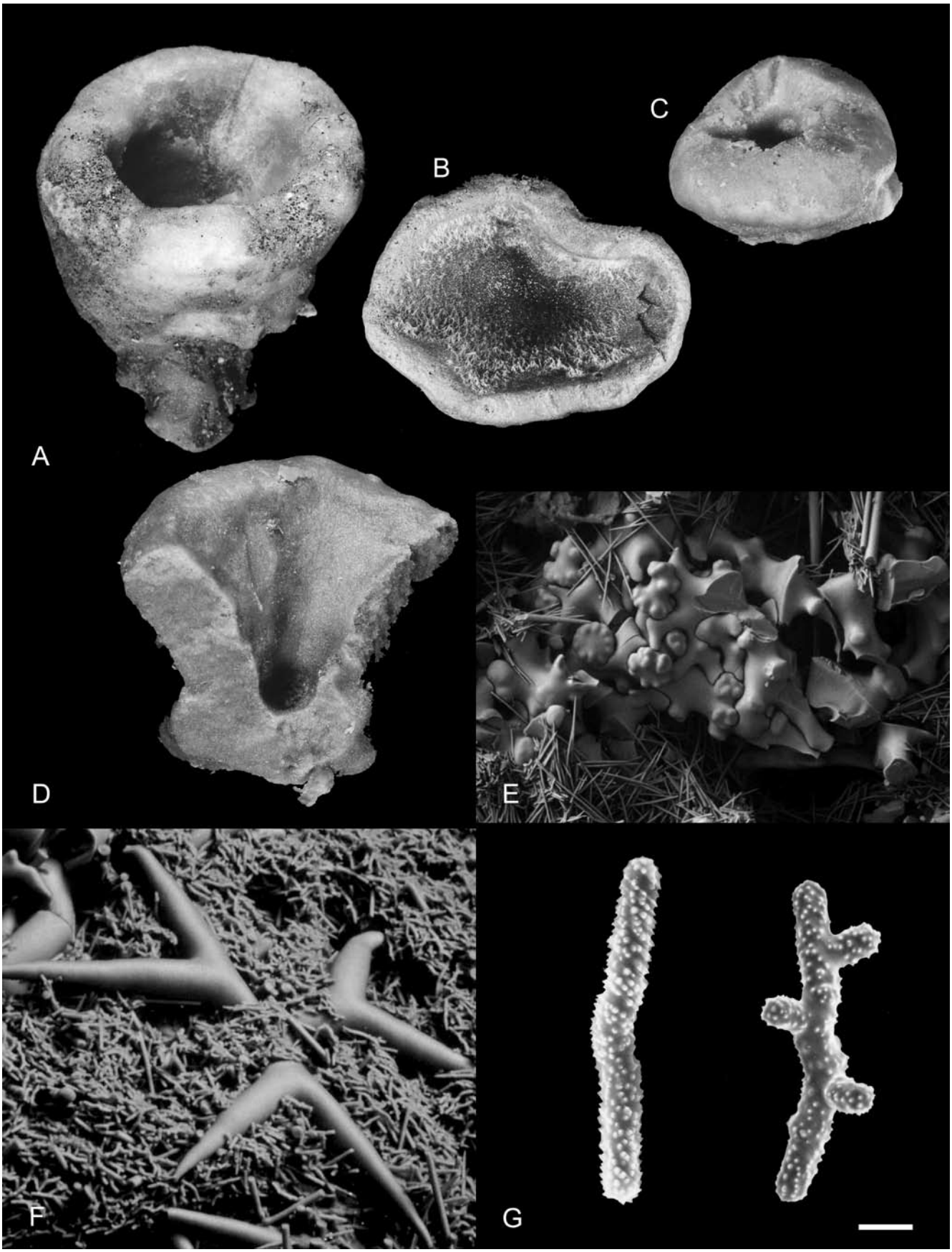


Figure 12. ***Herengeria vasiformis*** Schlacher-Hoenlinger, Pisera & Hooper, 2005.

Table 11. Spicule dimensions (μm) of *Herengeria vasiformis* Schlacher-Hoenlinger, Pisera & Hooper, 2005.

	Clone (thickness) Overall size of arch	Cladome (Max ø) Rhabd (L)	Diactines (L)	Microxeas (L)	Ms 1 (L)	Ms 2 (L)
New Caledonia						
S.-H. *et al*. (2005)	40–60	452–606	(broken)	83–111	13–17	15–21
(holotype)	400–600	162–209				
New Zealand						
NIWA18303	50–80	220 (150–300)	1–5 mm	116 (100–130)	18 (10–23)	18
	375–750	530 (375–750)				
NIWA18305	60–90	225 (150–300)	2–5 mm	91 (80–103)	20 (13–25)	32.5
	300–625	630 (450–750)				
NIWA18307	50–80	238 (180–300)	1–5 mm	114 (100–125)	21 (15–38)	26 (25–28)
	300–500	614 (400–875)				

morphologically from the type species *H. auriculata* in that it is cup-shaped rather than nubbin-shaped, requiring an expansion of the diagnosis given by Pisera and Lévi (2002c).

KEY DIAGNOSTIC CHARACTERS:

- Irregular micropolyrhabds on the surface.
- Thick-walled cup with a hairy concave surface; can be confused in the field with *Costifer wilsoni* or *Pleroma menoui*, but these are more ear-shaped.
- May be confused with *Neoschrammeniella moreti* microscopically, but this species lacks acanthose microxeas.

Awhiowhio n. gen.

Massive cup- or plate-shaped Corallistidae. Choanosomal megascleres are smooth nodulose dicranoclones with spires of smooth nodules, forming very robust intricate zygoses with 'trabeculae' through the entire mass. Ectosomal spicules are smooth dichotriaenes. Choanosomal microscleres are small fine-rayed streptaster/spirasters. Ectosomal microscleres are irregular acanthose micropolyrhabds or irregular nodulose spirasters.

ETYMOLOGY: Named for the spiral shape of the microscleres in this genus, but also relating to the general possession of spiralled or spiraster microscleres in Corallistidae (*āwhiowhio*, New Zealand Maori noun for a 'spiral', 'winding', 'whirlwind' or 'whirlpool', or adjective for 'circuitous').

TYPE SPECIES: *Awhiowhio osheai* n.sp., here designated.

REMARKS: *Awhiowhio* n. gen. is established a Bay of Plenty species (*A. osheai*) that was initially taken to be a species of *Herengeria*, but it lacks the characteristic acanthose ectosomal microxeas, nodulose tuberculate dicranoclones, and long hair-like diactines of *Herengeria*. The discovery of a second species with similar characteristics from the South Fiji Basin (*unda*), and a third species from the Chatham Rise (*sepulchrum*), confirmed that these species form a group closely related to *Herengeria*.

The simple desma morphology is similar to that in species of *Corallistes* (Pisera & Lévi 2002c; Schlacher-Hoenlinger *et al*. 2005), but desmas of *Corallistes* do not typically form spires. The lack of microxeas and large streptasters also suggests affinity with the genus *Corallistes*, but this genus is reserved for species with two types of sharp-rayed spirasters. Moreover, *Corallistes* sensu strictu has been recorded only from the New Caledonian section of the Norfolk Ridge (*C. australis* Schlacher-Hoenlinger *et al*. 2005 and *C. undulatus* Lévi & Lévi 1983).

Awhiowhio is defined primarily by the smooth granular surface (indicating the lack of long hair-like diactines), the lack of distinctive acanthose microxeas found in *Herengeria*, and the presence of diacranoclones that have smooth nodules rather than multituberculate fungiform tubercles. The desmas are typically corallistid, however, with a tripod to polypod shape and saddle-shaped lateral zygomes. Like *Herengeria*, *Awhiowhio* has only two types of asterose microscleres — the ectosomal polyrhabd and the choanosomal streptaster/spiraster with multiple rays.

Awhiowhio osheai n. sp. (Fig. 13)

MATERIAL EXAMINED:

Type material: Holotype NIWA18332 from NIWA Stn KAH9907/50; paratypes NIWA18333 from NIWA Stn E636, NIWA18334 from NIWA Stn KAH0011/30, NIWA25043 from TAN0413/093, and NIWA25042 from TAN0413/117.

NIWA Stations: KAH9907/48 (NIWA18335); TAN0413/085 (NIWA25044); TAN0413/093 (NIWA18336, NIWA25041); Z2364 (NIWA25619).

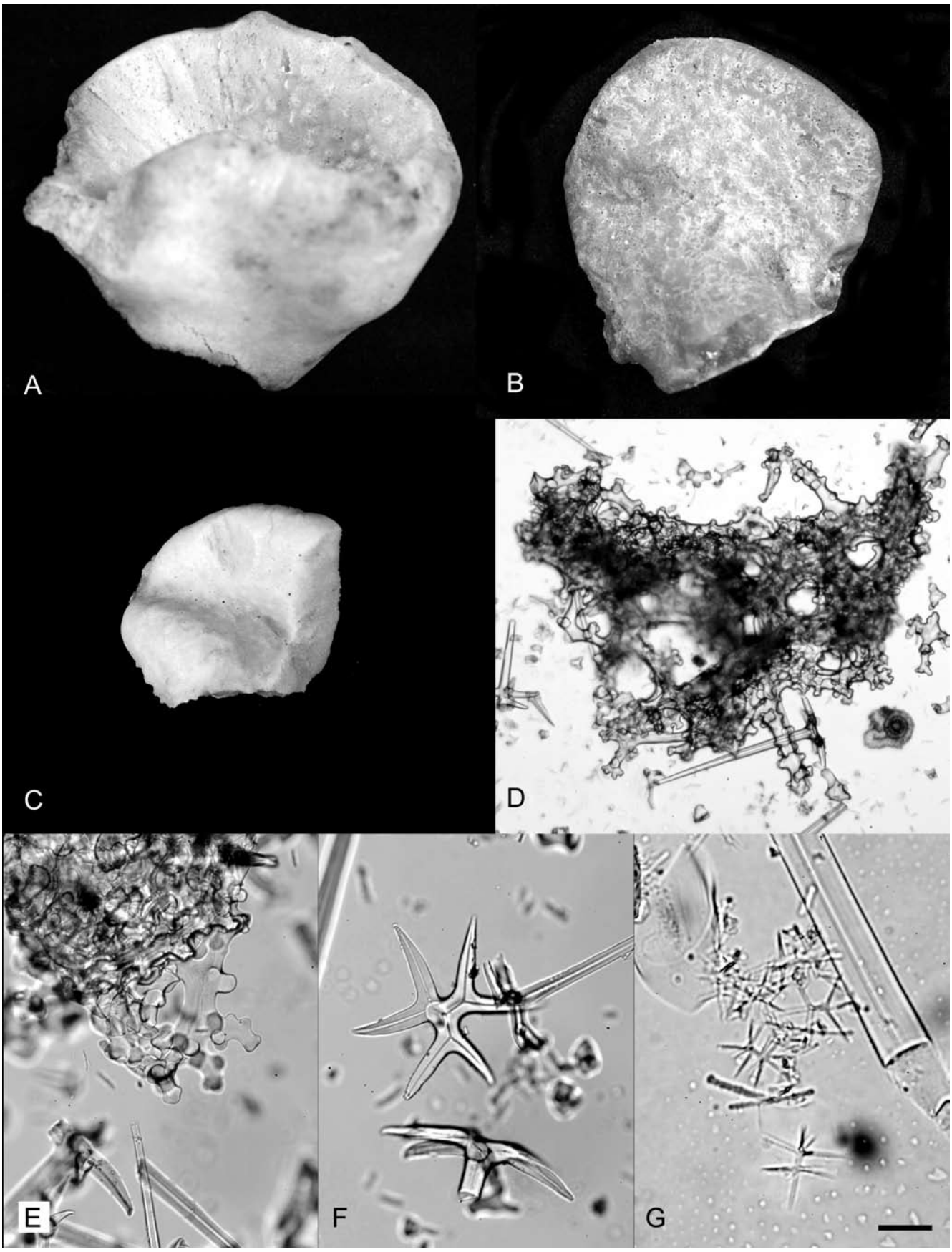


Figure 13. *Awhiowhio osheai* n. sp.

TYPE LOCALITY: Bay of Plenty, New Zealand.
DISTRIBUTION: West of White Island, Rungapapa and Tuatoru Knolls, Bay of Plenty, New Zealand.

HABITAT: Encrusting on basalt rocks. Depth range 159–318 m.

DESCRIPTION:

Morphology conical to cup-shaped with thick straight walls (Fig. 13A,C). NIWA18333 is a vertical plate with a spherical outline (Fig. 13B); the base is broad and elliptical, margins of the plate are smooth.

Dimensions 33–70 mm wide, 22–53 mm high, 8–12 mm thick, base 18–46 mm long, 13–26 mm wide.

Texture stony.

Surface — outer surface of cup smooth to undulating with a granular texture; oscules, c. 0.1 mm diameter, scattered regularly over the concave face in cup-shaped specimens, flush with the surface in some specimens and raised in others; ostia not visible.

Colour dull yellow (3B3) in life and in ethanol.

Choanosomal skeleton a dense reticulation of desmas and massive intricate zygoses that are pierced by circular channels (Fig. 13D).

Ectosomal skeleton a dense regular crust of micropolyrhabds over the dichotriaene cladomes.

Megascleres (Table 12) desmas are relatively slender with 2-4 clones, heavily nodulose with single or multiple nodular spires (Fig. 13D). Zygoses are massive, highly intricate and spread laterally along the clones in mature sections of the sponge skeleton, forming a dense aggregation with trabeculae. Desmas have a granular brown core, immature desmas are sparsely tuberculate with relatively smooth thin clones; dichotriaenes (Fig. 13D–F) have a relatively long rhabd and short robust clads, with frequent trichotriaene modifications.

Microscleres (Table 12) relatively regular rod-shaped acanthose micropolyrhabds (Fig. 13G), with bulbous ends and a central expansion, straight or curved or in a few cases, abruptly angled centrally. Streptasters (Table 12) with extremely fine long rays are common in the choanosome (Fig. 13G).

ETYMOLOGY: Named for Dr Steve O'Shea, formerly of NIWA Wellington, for his considerable knowledge of New Zealand deep-sea faunas and his passion for the discovery of new lithistid sponges and other invertebrate groups.

REMARKS: *Awhiowhio osheai* differs from the two known species of *Herengeria* in the lack of acanthose microxeas that are abundant on the ostial face of *H. vasiformis* and *H. auriculata*, the lack of hair-like diactines, and the simpler ornamentation of the desmas. The ectosomal micropolyrhabds are also simpler, with no branches and only small irregular protrusions. In *A. osheai* the oscules are clearly visible and raised on the concave surface of the cup. *Awhiowhio osheai* is so far known only from seamounts in the Bay of Plenty, New Zealand.

KEY DIAGNOSTIC CHARACTERS:

- Relatively regular bean- or rod-shaped micropolyrhabds on the surface.
- No surface microxeas and diactines.
- Thick straight-walled cup with a smooth dimpled concave surface; can easily be confused in the field with *Aciculites pulchra* but the oscules on the latter are more pronounced and flatter and the sponge is a curvaceous ear rather than straight-walled.

Awhiowhio unda n. sp. (Fig. 14)

MATERIAL EXAMINED**:**

Type material: Holotype NIWA18337 from NIWA Stn K826.

TYPE LOCALITY: Southern South Fiji Basin.

DISTRIBUTION: Southern South Fiji Basin.

HABITAT: Attached to a piece of dead coral. Depth range 390–490 m.

DESCRIPTION:

Morphology comprising a highly foliose thick-walled lamella attached along the base, the lamella with multiple infoldings and undulations, the margin slightly expanded and flared (Fig. 14A).

Dimensions 64 mm long, 45 mm wide, 35 mm high, lamella 7–10 mm thick.

Texture stony.

Table 12. Spicule dimensions (μm) of *Awhiowhio osheai* n. sp.

	Clone (thickness) Overall size of arch	Cladome (Max ø) Rhabd (L)	Micropolyrhabd (L) (Thickness)	Streptaster (L)
NIWA18332 (holotype)	50–60 c. 200–500	206 (150–250) 461 (325–700)	27 (20–38) 4–5	30 (25–38)
NIWA18333 (paratype)	40–50 c. 200–500	183 (100–240) 490 (260–675)	24 (15–30) 2–5	30 (23–38)

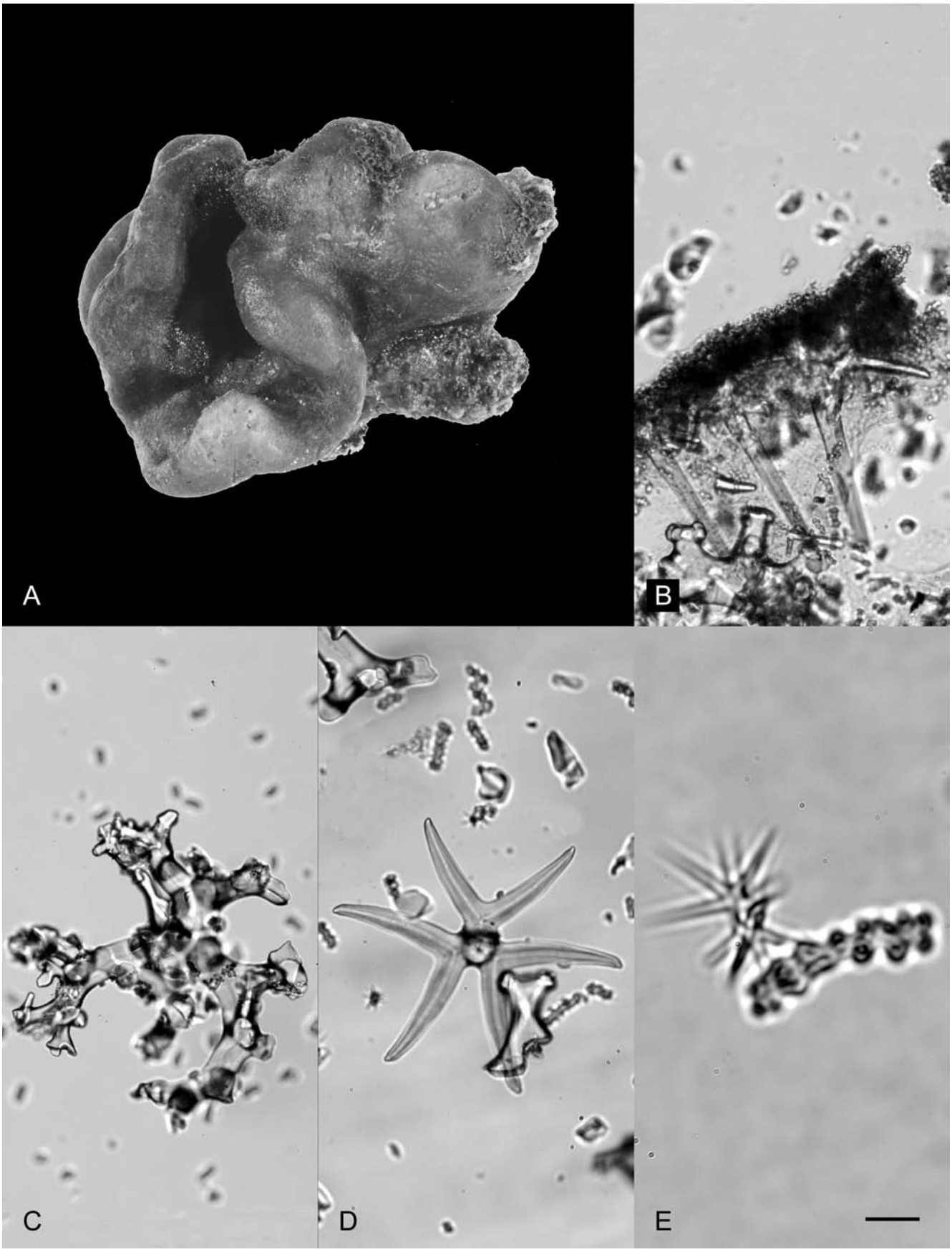


Figure 14. *Awhiowhio unda* n. sp.

Table 13. Spicule dimensions (μm) of *Awhiowhio unda* n. sp.

	Clone (thickness) Overall size of arch	Cladome (Max ø) Rhabd (L)	Microrhabds (L) (Thickness)	Streptaster (L)
NIWA18337 (holotype)	20–50 c. 200–300	195 (150–240) 296 (150–420)	18 (15–23) 5–8	25 (20–33)

Surface smooth, granular.

Colour coffee brown (5F6) in preservative.

Choanosomal skeleton comparatively delicate, formed by small, relatively slender tripod-shaped dicranoclones. Small streptasters are abundant in the choanosome amongst the desmas (Fig. 14B).

Ectosomal skeleton a shallow layer of robust microscleres. Dichotriaene cladomes line the ectosome (Fig. 14B).

Megascleres (Table 13) — desmas small, frequently tripod-shaped and relatively slender, the clones are smooth with smooth nodules (Fig. 14C). The nodules on the apex of tripod desmas are spires with bumpy tubercles (Fig. 14B). Zygosis is mostly terminal and relatively weak as articulation is via saddle-shaped clasps to adjacent clones. Dichotraienes are small and the cladomes are short and robust (Fig. 14B, D).

Microscleres (Table 13) — choanosomal microscleres are streptasters verging on spirasters with sharply pointed rays (Fig. 14E). Ectosomal microscleres are irregular thick micropolyrhabds that may have an irregular spiraster-shape (Fig. 14D,E).

ETYMOLOGY: Named for the wave-like morphology of the sponge walls and the microscleres (*unda*, L.)

REMARKS: *Awhiowhio unda* is similar to *A. osheai* in that it has small, relatively smooth desmas with nodulose clones, but the streptasters and micropolyrhabds are more spiraster-like. The species has a unique wavy morphology.

KEY DIAGNOSTIC CHARACTERS:

- Frilled wave-like sponge wall.
- Small non-tuberculate desmas compared to other species.

Awhiowhio sepulchrum n. sp. (Fig. 15)

MATERIAL EXAMINED**:**

Type material: Holotype NIWA18338 from NIWA Stn TAN0104/002.

TYPE LOCALITY: Graveyard Seamount, Chatham Rise.

DISTRIBUTION: Known only from the Graveyard seamount complex, a series of small knolls and hills on the Chatham Rise.

HABITAT: Silty hard substratum. Depth range 757–875 m.

DESCRIPTION:

Morphology comprising a large erect plate with a broad undulation in the plane of the upper margin, the margin indented by what appear to be large shallow pits c. 5–7 mm wide. Base of sponge thick, flanged (Fig. 15A).

Dimensions c. 300 mm wide, c. 210 mm high, base 130 wide, 40 mm wide; thickness of plate at base 44 mm, at middle of plate 28 mm, margin 12 mm.

Texture brittle, stony, the margin slightly flexible.

Surface macerated, the underlying skeleton smooth, indicating its possible condition in life.

Colour dirty white in macerated condition.

Choanosomal skeleton of heavily zygosed desmas that form 'bridges' (Fig. 15C,D). Only a single triaene was seen (Fig. 15E).

Megascleres (Table 14) — large desmas that form large rounded arches or 'bridges' joined laterally via saddle-shaped zygomes (Fig. 15C–E). Nodular spires arise from the arched side of the primary clone. Desmas are large and thick, with a granular centre. Clones are smooth with occasional nodules that are 'sculpted' around the termini. Smaller, more intricately branched desmas (Fig. 15 B) were observed in preparations of the abraided surface of the sponge, where short clones arise on all sides of the primary linear clone. Dichotriaenes with robust straight conical rhabd and clads.

Microscleres absent owing to macerated condition of sponge.

ETYMOLOGY: Named for the type locality, the Graveyard Seamount on the Chatham Rise (*sepulchrum*, Latin, grave).

Table 14. Spicule dimensions (μm) of *Awhiowhio sepulchrum* n. sp.

	Clone (thickness) Overall size of arch Overall size of smaller ramose desmas	Cladome (Max ø) Rhabd (L)
NIWA18338 (holotype)	70–150 c. 900–1200 c. (600–800) – (300–400)	375–900 450–750

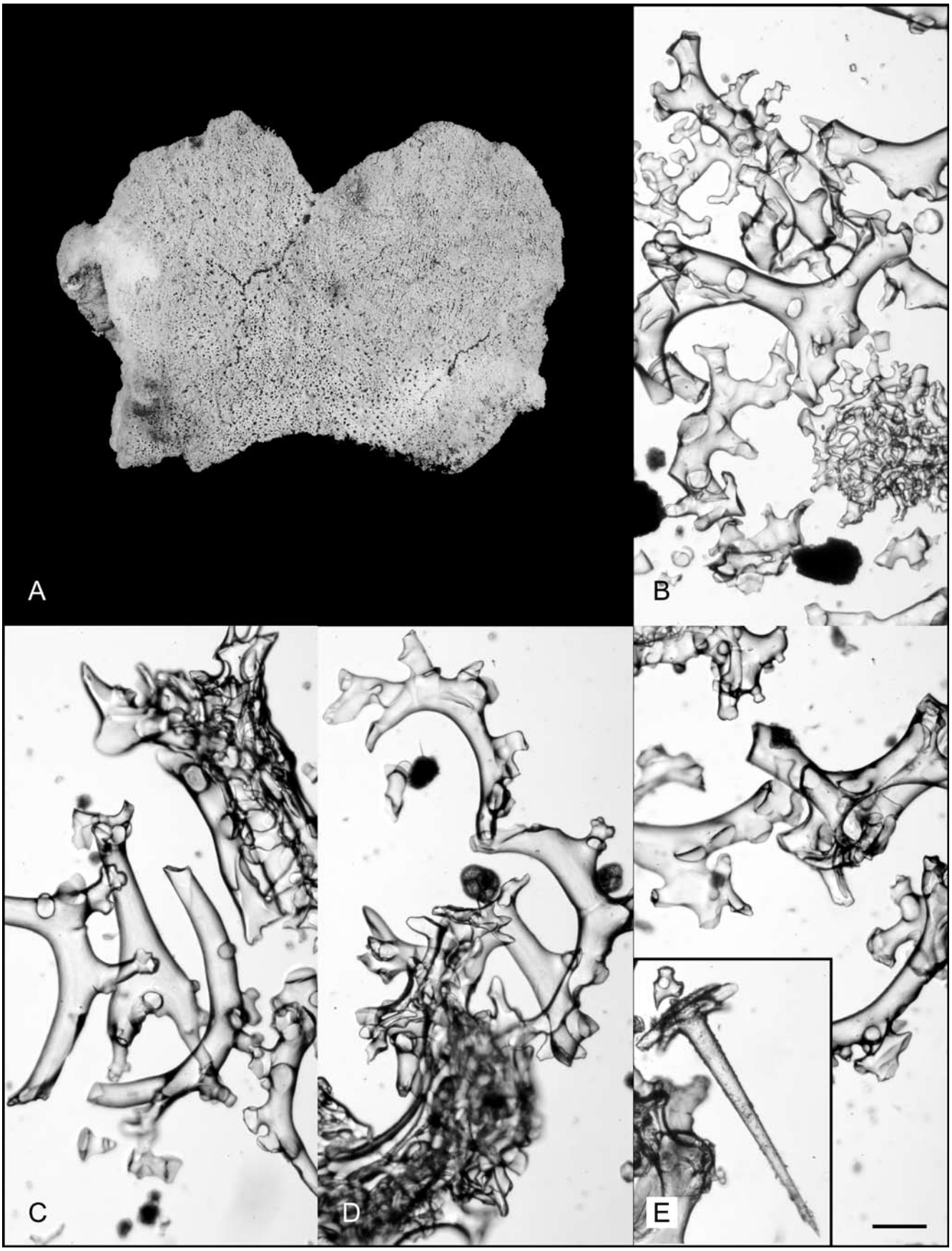


Figure 15. *Awhiowhio sepulchrum* n. sp.

REMARKS: The specimen described above is tentatively assigned to *Awhiowhio* n. gen. because the absence of diagnostic microscleres precludes full identification. The specimen was dead before collection, with nothing remaining of the surface and mesohyl or all microscleres and non-desma megascleres, with the exception of a single dichotriaene, having sloughed off the desma skeleton.

The assignment to *Awhiowhio* is based on the morphology of the desmas. These are relatively smooth dicranoclones with a few nodulose spires on the outer edge of the arched tripod-shaped primary clone. The basic shape and ornamentation of the desma, with nodules rather than multituberculate fungiform projections, separates the sponge from *Herengeria*, but the strong lateral bridge-forming zygoses strongly resembles that of both *Awhiowhio* and *Herengeria*, linking it to Corallistidae.

Despite the lack of diagnostic microscleres and accessory megascleres, the assignment of a species name to NIWA18338 is justified by the possession of several unique features. NIWA18338 is the only known representative of the family Corallistidae in the Chatham Rise region. With the exception of *Neoschrammeniella antarctica* from the Ross Sea, Corallistidae are common in waters only as far south as Raukumara Plain off East Cape. The species is also readily distinguished from other Corallistidae by the greater size and simpler ornamentation of the dicranoclone desmas. A more detailed evaluation of the genus assignment is not possible without living specimens in which megasclere and microsclere complements are intact.

KEY DIAGNOSTIC CHARACTERS:

- Sponge forms a very large flat plate.
- Very large arched simple dicranoclones with a dense brown granular core.

Family **NEOPELTIDAE** Sollas, 1888

Neopeltidae Sollas, 1888: 344; Topsent 1894: 290; Schrammen 1903: 20; Kelly 2000: 281 (partim).
Daedalopeltidae de Laubenfels, 1936: 184.

Thickly encrusting, planar, pedunculate, fungiform lithistid demosponges with monaxial pseudodiscotriaenes, pseudophyllotriaenes, and/or siliceous discs; desmas are monocrepid with a complex branching shape resembling tetraclones (pseudotetraclones); may be accompanied by strongyles; microscleres are amphiasters and/or acanthose microxeas.

REMARKS: The discovery of a second species of *Homophymia* from continental-shelf banks off northeastern New Zealand led Kelly (2000) to redefine the genus and to evaluate the integrity of the Corallistidae as a whole. In doing so, it became obvious that *Callipelta*, *Daedalopelta*, and *Homophymia* differ considerably from typical corallistid genera like *Corallistes*, *Herengeria*, and *Neoschrammeniella* in having pseudotriaenes, smooth monocrepid pseudotetraclones, and amphiasters as microscleres. *Callipelta*, *Daedalopelta* and *Homophymia* were accordingly transferred to the Neopeltidae.

Pisera and Lévi (2002g) upheld this decision in their recent review of the Neopeltidae but they disagreed with the hypothesis of Kelly (2000) that Neopeltidae and Corallistidae are closely linked in the suborder Dicranocladina, a subgroup of lithistid sponges that have monaxial desmas. Recent rDNA data analyses (Kelly & McCormack unpubl.) indicate that the Neopeltidae and Corallistidae are indeed linked and that this group is quite separate from tetracladine, rhizomorine, and megamorine taxa.

Homophymia Vacelet & Vasseur, 1971

Fan-shaped or clavate Neopeltidae with monocrepid pseudotetraclones, smooth monocrepid pseudophyllotriaenes as ectosomal megascleres, and a single form of amphiaster microsclere.

TYPE SPECIES: *Homophymia lamellosa* Vacelet & Vasseur, 1971.

Homophymia stipitata Kelly, 2000 (Fig. 16A–F)

Homophymia stipitata Kelly, 2000: 9, figs 5–8.

MATERIAL EXAMINED:

NIWA Stations: I96 [NIWA holotype H-705 (NIWA7503), NIWA paratypes P-1152 (NIWA4775) and NIWA P-1155 (NIWA4778)]; J953 [NIWA paratype P-1153 (NIWA4776, BMNH 1995.3.30.2)]; J954 [NIWA paratype P-1156 (NIWA4779, BMNH 1995.3.30.5), NIWA25611]; P8 (NIWA25645); P10 [NIWA paratype P-1154 (NIWA4777)]; Z9747 [BMNH 2005.9.23.1 (fragment of 0CDN6731-Z)].
NMNZ Stations: NMNZ Por. 615.

DISTRIBUTION: Wanganella Bank (holotype); West Norfolk Ridge; west of Pandora Bank; western continental slope of Northland, New Zealand.

HABITAT: Collected from coralline and shell rubble banks on the northeastern continental shelf of Northland. The sponge is typically attached to hard substrata but may be partially buried. This species is part of a biodiverse invertebrate assemblage in which hydroids, soft corals, bryozoans, and ascidians are typical. Other lithistid sponges include *Aciculites pulchra*, *Discodermia proliferans*, and several species of *Neoschrammeniella* and *Pleroma* (Kelly 2000). Depth range 192–757 m.

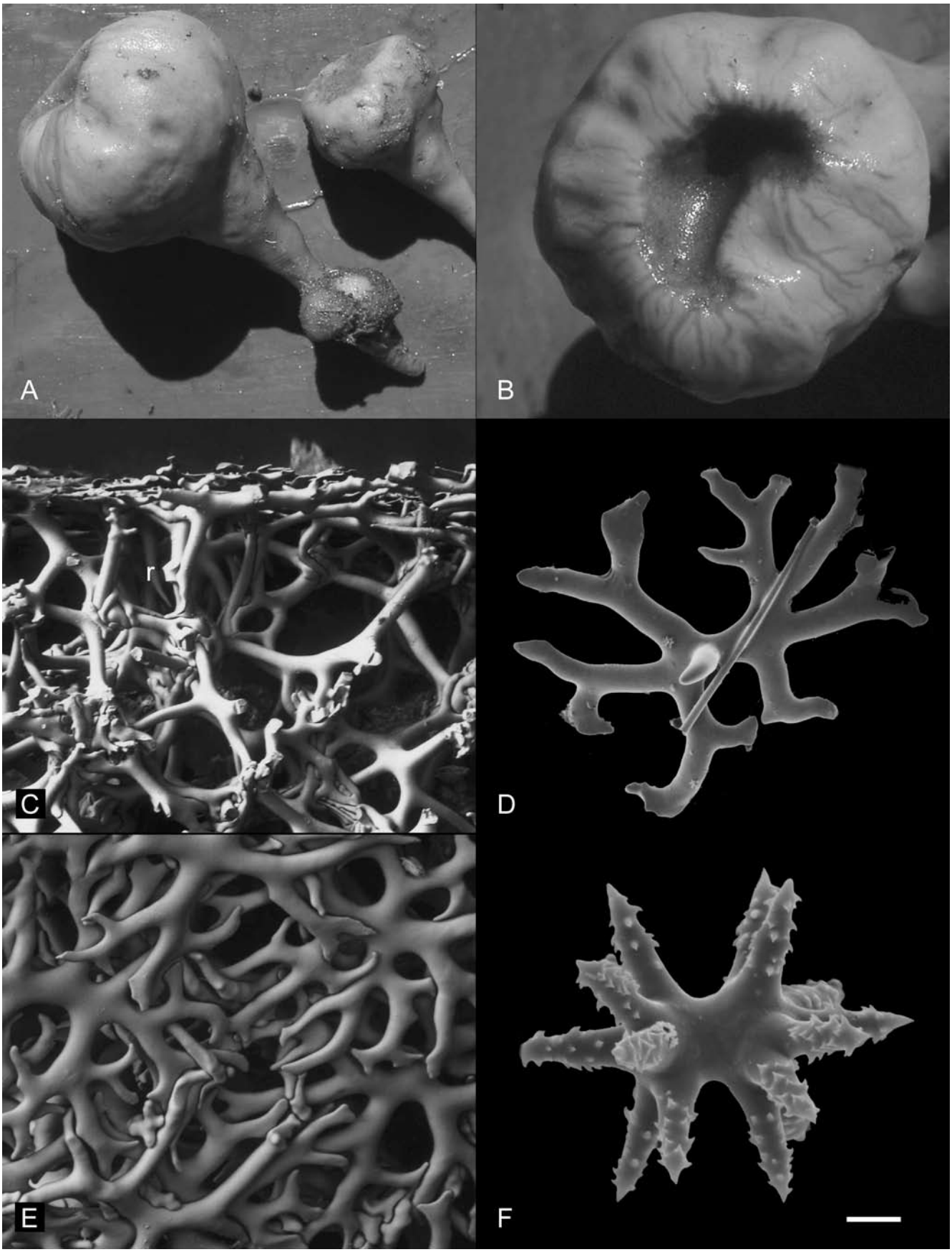


Figure 16. ***Homophymia stipitata*** Kelly, 2000.

DESCRIPTION (after Kelly 2000):
Morphology parsnip-shaped (stipitate) with an irregular globular body that bulges in places (Fig. 16A); apex is depressed, forming a translucent oscular sieve through which exhalant canals are clearly visible (Fig. 16B).

Dimensions of body 40–50 mm diameter, about one third of total length of 150–220 mm, elevated upon and tapering to a relatively long fine stalk ranging from 20 mm diameter at the junction of the body, to 5 mm diameter at the base of the stalk.

Texture barely compressible, stalk is rigid but relatively flexible along entire length.

Surface smooth but slightly undulating and irregular, granular to the touch. Exhalant canals are visible on surface of body and stalk beneath the translucent ectosome (Fig. 16B).

Colour in life ivory (4B3), in preservative light golden brown (5B7), apical depression dark grayish blue (20E4).

Choanosomal skeleton composed of huge smooth monocrepid pseudotetraclones (Fig. 16C) and tracts of large oxeas that radiate through the stalk towards the apical surface. Amphiasters are abundant throughout the choanosome and the ectosomal region.

Ectosomal skeleton packed with pseudophyllotriaenes, the sinuous 'fingers' of the 'cladome' partially zygose with neighbouring 'cladomes' and desmas below the surface. The 'rhabds' of these pseudophyllotriaenes are perpendicular to the surface.

Megascleres (Table 15) — desmas of the choanosome are huge smooth ramose monocrepid pseudotetraclones (Fig. 16C). Ectosomal megascleres are pseudophyllotraienes (Fig. 16D,E) in which the 'rhabd' is irregular in shape and thickness, is sinuous, and the cladome is polyfurcate with sinuous branches. The spicules are laminated and granular in appearance. Diactines are strongyloxeas, curved, syringe-like, in two size classes.

Microscleres (Table 15 Ms 1) — amphiasters (Fig. 16F) with curved spines on the distal two thirds of oxeote rays.

REMARKS: *Homophymia stipitata* was the second species to be described, the genus being previously known only from Madagascar. Schlacher-Hoenlinger *et al*. (2005) recently described a third species of *Homophymia* from Kaimon Maru Seamount in New Caledonian waters; it is spherical with an apical depression and a short stalk. A fourth species has since been collected from the New Caledonian Norfolk Ridge seamounts (Kelly unpubl.), the morphology of which is similar to that of *H. stipitata* but with a smaller, penicillate body and only a slight expansion of the apical region. The typical form of the type species, *H. lamellosa*, is easily distinguishable from the above three species in that it is a folded lamellate fan and is apparently restricted to the Western Indian Ocean.

It is noteworthy that very similar 'phyllotriaenes' to those of *H. stipitata* were figured from the Oamaru Diatomite (c. 35 Ma) (Hinde & Holmes 1892, pl. 14, fig. 1), and described from the Tutuiri Greensand of Chatham Island (c. 63–50 Ma). Superficially, the Tutuiri, Oamaru, and Recent spicules appear to be very similar, and were indeed considered to be congeneric by Kelly and Buckeridge (2005). Closer examination of the Tutuiri specimens, however, indicates that while they are indeed identical to the Oamaru material, they differ from those of Recent specimens in the possession of a triaenose inception canal, which is clearly illustrated in the Hinde and Holmes (1892) figure.

KEY DIAGNOSTIC CHARACTERS:

- Parsnip-shaped with a grey-blue apical depression.
- Surface covered with pseudotriaenes with an extremely sinuous cladome and short irregular rhabd.
- Desmas are very big and resemble tetraclones but the epirhabd is only a short bar.
- One type of amphiaster.

Callipelta Sollas, 1888

Pillow-shaped, spherical, clavate, and multiclavate Neopeltidae, with relatively small irregular monocrepid desmas that resemble tetraclones; ectosomal megascleres are moncrepid pseudodiscotriaenes to pseudophyllotriaenes with strongly incised denticulate margins on the 'clads', the upper surface of which may be tuberculate; microscleres are amphiasters.

TYPE SPECIES: *Callipelta ornata* Sollas, 1888.

Table 15. Spicule dimensions (μm) of *Homophymia stipitata* Kelly, 2000.

	Desma (Clone L/T) Desma (Overall size) Epirhabd (L)	Cladome (Max ø) Rhabd (L)	Diactines 1 (L) Diactines 2 (L)	Ms 1 (L)
NIWA7503 (holotype)	147–588/20–59 400–682 193 (147–225)	627 (465–711) 254 (186–323)	1055 (809–1372) 472 (308–617)	15 (12–19)

Callipelta punctata Lévi & Lévi, 1983 (Fig. 17)

Callipelta punctata Lévi & Lévi, 1983: 118, pl. 6, fig. 1, pl. 8, figs 1–3, 9.

MATERIAL EXAMINED:

NIWA Stations: KAH0011/30 (NIWA18339); TAN0413/117 (NIWA24045).

DISTRIBUTION: New Caledonia (holotype); Rungapapa Knoll, Bay of Plenty.

HABITAT: Numerous small specimens encrusting specimens of *Erylus nigra* Bergquist, 1968 (Porifera, Astrophorida, Geodiidae) and volcanic basalt substrata, with numerous other invertebrates including immature *Reidispongia coerulea*. Depth range 159–360 m.

DESCRIPTION:

Morphology semi-spherical to columnar, with a single small oscule on the slightly depressed apex of the sponge (Fig. 17A). NIWA24045 from TAN0413/117 is a tiny slightly raised encrustation.

Dimensions 3–7 mm diameter, 5–10 mm high, oscule 0.5 mm diameter. The New Caledonian material was reported as 15–18 mm diameter and 10 mm high.

Texture stony, crumbly.

Surface microscopically rough and punctate, slightly hispid with projecting diactines; occasional aquiferous canals converging on the oscules incising the surface or appear below it.

Colour in life cream (4A3) and in ethanol golden brown (5D7).

Choanosomal skeleton composed of monocrepid desmas and short diactines.

Ectosomal skeleton lined with the scale-like cladome of the pseudophyllotriaenes.

Megascleres (Table 16) are monocrepid pseudotetraclone desmas with a short epirhabd in which a short slender bar crepis (30 µm) resides (Fig. 17C). Two thick clones arise from each end of the epirhabd; these have a granular core, the terminus of each clone tuberculate or spinose, the zygosis between spicules relatively rigid (Fig.17C); ectosomal megascleres are pseudophyllotriaenes with a short rhabd that is often slightly obliquely set (Fig. 17B). The centre of each rhabd has a crepis about 30 µm long as in the desmas. The cladome is not precisely perpendicular to the rhabd, and often appears slightly concave in profile. The pseudoclads may be composed of a pseudoprotoclad, which may split to form two branches, or may remain single. The end of the clad may branch again; the whole is very delicate and lacy in appearance. The upper surface of the cladome is denticulate (Fig. 17B). Diactines are relatively short fusiform oxeas.

Microscleres (Table 16) amphiasters with long fine acanthose rays (Fig. 17D).

REMARKS: These sponges are most similar to *Callipelta punctata* Lévi & Lévi, 1983 from New Caledonia in terms of spicule morphology and dimensions. In particular, the upper surfaces of the pseudophyllotriaenes have tuberculate projections, a character that appears to be unique to *C. punctata* and species of *Macandrewia* (Macandrewiidae).

The New Zealand sponges are more columnar than those described from New Caledonia, but the punctate surface is characteristic. In gross morphology they are perhaps more similar to *Callipelta sollasi* Lévi & Lévi, 1989 from about 100 m depth off Luzon and Mindoro Islands in the Philippines, but this latter species has pseudophyllotriaenes with a smooth cladome surface, which is also much wider (300–350 µm) than those of *C. punctata*.

The only other described species, *C. cavernicola* (Vacelet & Vasseur, 1965), *C. thoosa* Lévi, 1965, and *C. mixta* Vacelet, Vasseur & Lévi, 1976 are quite different morphologically and in terms of spiculation, and all three species are known only from submarine tunnels and grottos on the coast of Madagascar. *Callipelta mixta* is probably a species of *Neopelta* as it contains discotriaene-like megascleres and acanthose microxea.

Despite extensive collection, this species has so far been found only at a single New Zealand location, the Rumbles Seamount in the Bay of Plenty.

Table 16. Spicule dimensions (µm) of *Callipelta punctata* Lévi & Lévi, 1988.

	Desma (Clone L/T)	Pseudophyllotriane cladome Desma (Overall size)	Diactines (L) (Max ø) Rhabd (L)	Amphiaster (L)
New Caledonia				
(holotype)	60–80/20–30	200–300	350–500	20
	—	75–150		
New Zealand				
NIWA18339	80–130/30	224 (150–280)	400–600	16 (15–18)
	180–230	100 (50–140)		

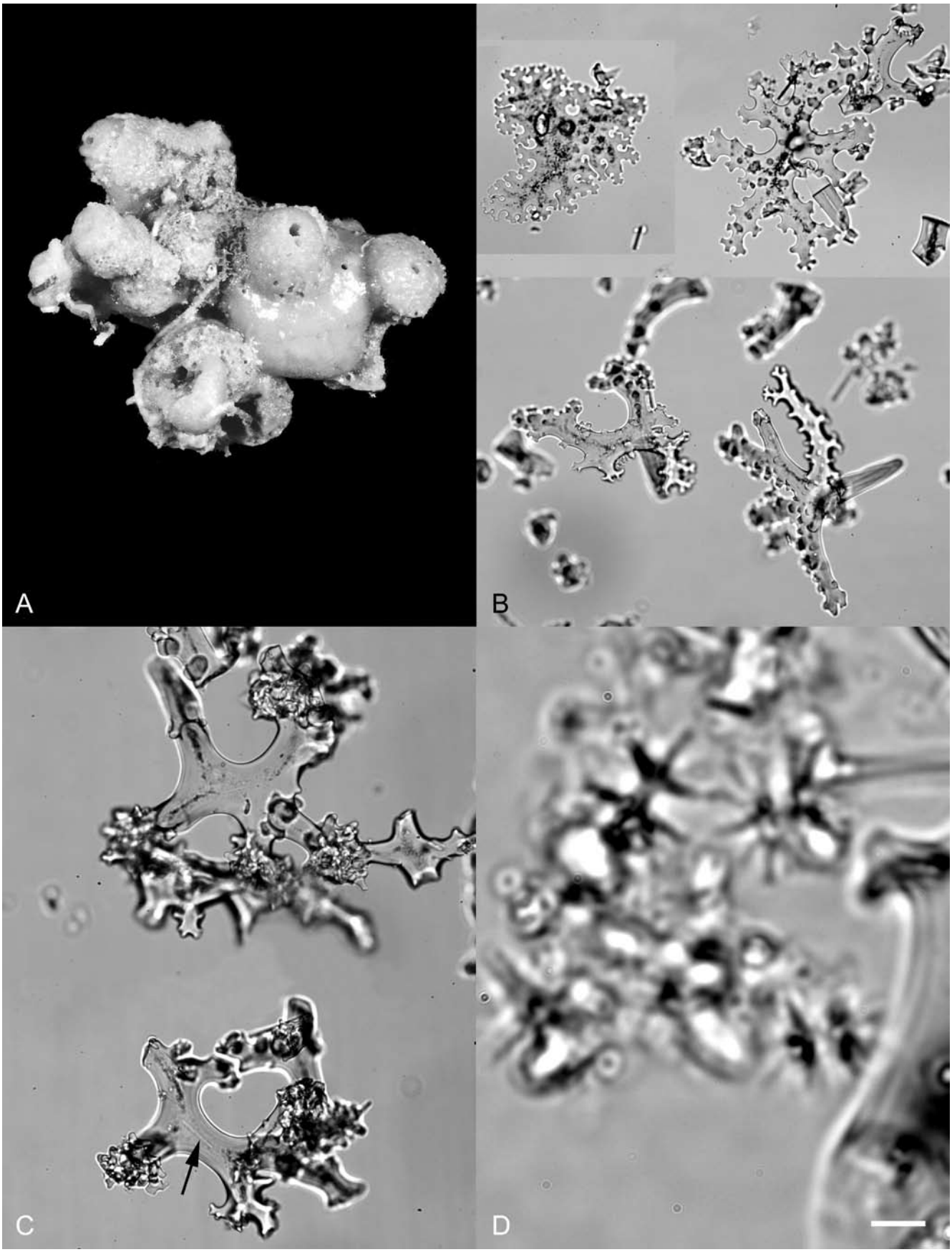


Figure 17. ***Callipelta punctata*** Lévi & Lévi, 1983.

KEY DIAGNOSTIC CHARACTERS:

- Tiny columnar or encrusting sponges (< 20 mm diameter) with a tiny apical oscule and a rough punctuate surface.
- Desmas and pseudophyllotriaenes are granular in the centre.
- Desmas have a single fine bar crepis (monocrepidial) in the epirhabd.
- Can be mistaken for *Macandrewia spinifoliata* in the field; the presence of amphiasters and the lack of ectosomal smooth strongylote oxeas (present in *Macandrewia spinifoliata*) in *Callipelta punctata*, are indicative.

Neopelta Schmidt, 1880

Pillow-shaped and columnar Neopeltidae with small complex tuberculate monocrepid desmas that resemble tetraclones; ectosomal megascleres are moncrepid circular, oval to elongate, sculpted and angular and ridged discs; some are pseudodiscotriaenes with an oblique pseudorhabd projection that contains the monaxial crepis; other megascleres may include slender curved oxea-like diactines that occur singly or in bundles; microscleres are amphiasters; acanthose microxea occur in some species.

TYPE SPECIES: *Neopelta perfecta* Schmidt, 1880.

REMARKS: *Neopelta plinthosellina* Lévi & Lévi, 1988 from New Caledonia differs from the type species *N. perfecta* in that it lacks acanthose microxea and has elongate and highly sculpted discs. The diagnosis above has been broadened to accommodate the peculiar sculpted discs of *N. plinthosellina*, and the lack of microxeas and choanosomal oxeas and tuberculate regular palmate desmas in both southwestern Pacific species.

Neopelta pulvinus n. sp. (Fig. 18)

MATERIAL EXAMINED**:**

Type material: Holotype NIWA18340 from NIWA Stn TAN0205/75 spicule slide labelled 'NIWA18340'.

TYPE LOCALITY: Volcano L, Kermadec Ridge, northeastern New Zealand.

DISTRIBUTION: Volcano L, Kermadec Ridge, northeastern New Zealand.

HABITAT: Encrusting hard basalt substrate. Depth range 154–240 m.

DESCRIPTION:

Morphology pillow- or cushion-shaped, edges thinning to the substratum.

Dimensions 10 mm long, 7 mm wide, 4 mm thick.

Texture stony, brittle.

Surface smooth.

Colour in ethanol honey yellow (5D6).

Choanosomal skeleton composed of small robust monocrepidial desmas that form very intricate zygoses. Amphiasters are abundant in the choanosome.

Ectosomal skeleton partially lost, but in patches pseudodiscotriaenes form a scaled surface.

Megascleres (Table 17) — monocrepid pseudotetraclone desmas (Fig. 18B) with a short thick epirhabd with four short thick clones that extend into very tuberculate termini. The clones are less tuberculate towards the smooth epirhabd. On the sponge surface, clones are palmate and similar to moose antlers in shape. The zygoses are very complex and highly robust. Ectosomal megascleres (Table 17) are pseudodiscotriaenes with a flat to slightly concave disc, which are circular, elongate, or multilobate in overall shape, with circular indentations on the edge of the disc, usually one per spicule. The upper surface of the discs is ornamented (Fig. 18A), some with swirls of small evenly spaced tubercles, some with what appear to be knobbed ridges leading to the centre of the disc, and some which lack either embellishment.

Microscleres (Table 17) are amphiasters with long fine rays.

ETYMOLOGY: Named for the pillow- or cushion-shaped gross morphology (*pulvinus*, L.).

REMARKS: This single specimen of *Neopelta pulvinus* was initially identified as a species of *Callipelta* (Neopeltidae) because it has ectosomal monocrepidial pseudodiscotriaenes, amphiasters as microscleres, and lacks the characteristic acanthose microxea of the type species (*Neopelta perfecta* Schmidt, 1880) and *N. imperfecta* Schmidt, 1880, both from the Caribbean.

Table 17. Spicule dimensions (μm) of *Neopelta pulvinus* n. sp.

	Desma (Clone L/T) Desma (Overall size) Desma crepis (L)	Pseudodiscotriaene disc (Max ø) Pseudorhabd (L) Epirhabd (L)	Amphiaster (L)
New Zealand			
NIWA18340	100–250/50–70	227 (88–300) by 140 (63–220)	19 (15–25)
(holotype)	300–500	20	
	30	18	

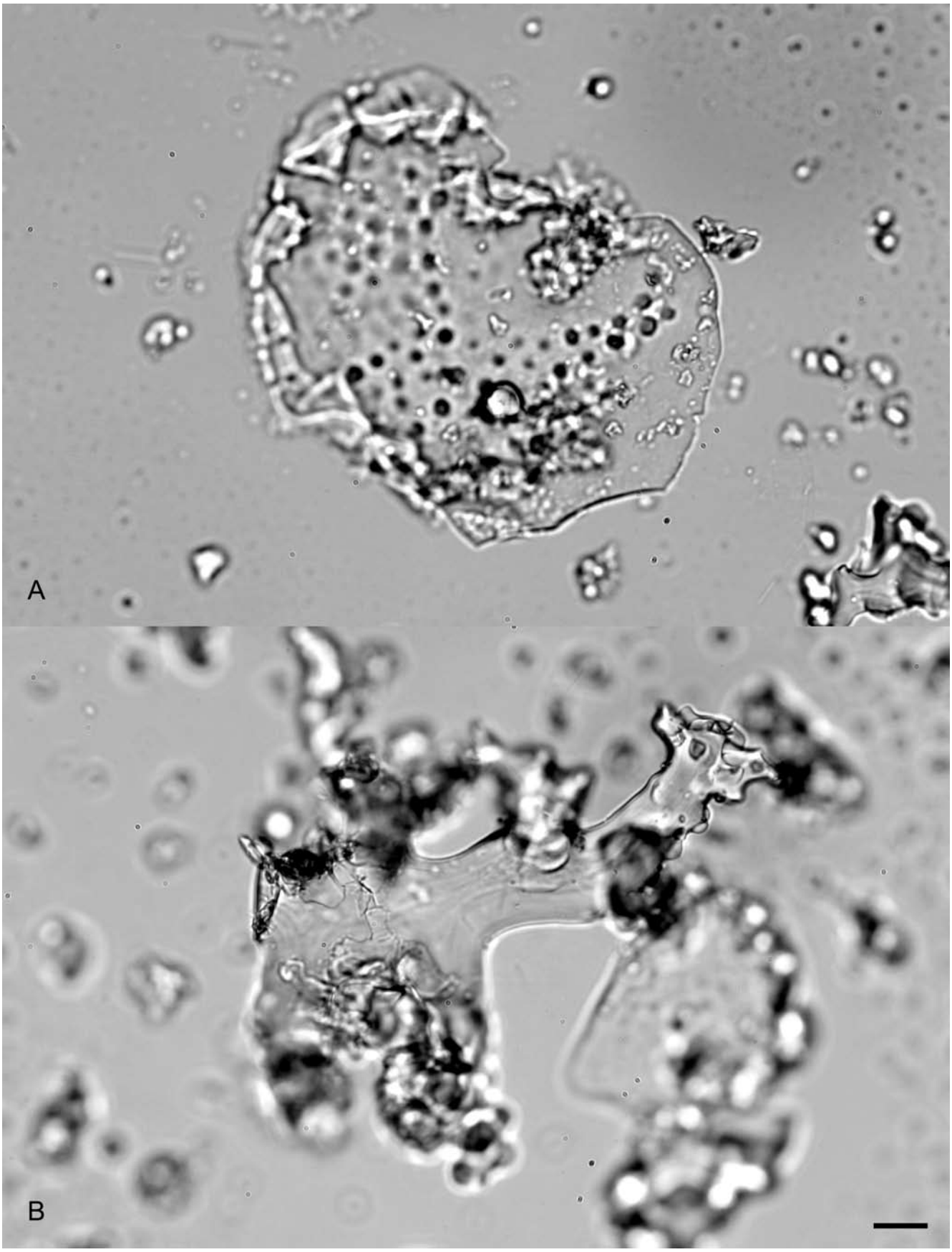


Figure 18. ***Neopelta pulvinus*** n. sp.

The ectosomal discotriaenes, however. are quite different from those of most species of *Callipelta* in that they are discate rather than phyllamentous. The discotriaene pseudorhabd in this new species is also unlike those of the pseudophyllotriaenes of *Callipelta* species, which are almost always well defined and perpendicular to the cladome. In *N. pulvinus* the rhabds are solid, short, frequently with two flanges that adhere to the underside of the disc, and the pseudorhabd is often positioned obliquely or perpendicular to the underside of the disc. This unusual rhabd morphology has been described for both species of Caribbean *Neopelta* (Sollas 1888), albeit rarely, but not for the only other known species, New Caledonian *N. plinthosellina* Lévi & Lévi, 1988.

Neopelta plinthosellina, like *N. pulvinus* n. sp., lacks acanthose microxeas and both species have very similar desmas; some are typically pseudotetraclones with smooth or tuberculate clones and heavily tuberculate zygoses, but some are plamate and spreading as illustrated by Lévi and Lévi (1988, pl. 6). The desmas of the southwestern Pacific species also differ from those of the Caribbean species, which are complex with smooth rays and are frequently branched (see Pisera & Lévi 2002g). It is thus with some confidence that the Kermadec Ridge specimen is assigned to the same group as *N. plinthosellina* from New Caledonia, but little confidence is placed in the assignment of both species to the Caribbean genus *Neopelta*. Despite the obvious differences between the Caribbean and southwestern Pacific species of *Neopelta*, additional specimens of both species, particularly of *N. pulvinus*, are required for full characterisation of these differences, and separation from *Neopelta* as a new genus.

KEY DIAGNOSTIC CHARACTERS:

- Tiny encrusting cushion sponge.
- Surface has scale-like discs with tiny projecting tubercles on the upper surface and usually one or more circular indentations.
- Desmas are frequently palmate.

INCERTAE SEDIS

Lepidothenea de Laubenfels, 1936

Sponge forms a very thin encrustation, without desmas; skeleton comprises an upper and lower adherent of overlapping scale-like discs or occasionally discotriaenes, between which is a thin choanosome. Microscleres are microrhabds. (Modified from Dendy 1924).

TYPE SPECIES: *Lepidospongia incrustans* Dendy, 1924.

REMARKS: As pointed out by Bergquist (1968), De Laubenfels (1936) proposed the new name *Lepidothenea* for *Lepidospongia* Dendy, 1924, which was preoccupied. He transferred *Lepidothenea incrustans* to the Kaliapsidae de Laubenfels (= Phymaraphiniidae in part) owing to the possession of what he perceived to be 'phyllotriaenes' instead of dichotriaenes (de Laubenfels 1936). Bergquist (1968) did not re-examine this material but retained it in the original family Theonellidae, no doubt convinced that the report of what appeared to be rhabds on some discs, i.e. 'discotriaenes', abundant ectosomal microrhabds, and vestigial style-like megascleres, indicated broad affinity with species in the genus *Discodermia*. Pisera (pers. comm. 2004) has suggests that while the sponge does indeed resemble a juvenile *Discodermia*, albeit without desmas, it also resembles members of the genus *Neopelta*. It is his opinion that *Lepidothenea* is probably a younger synonym of *Neopelta*.

Lepidothenea incrustans (Dendy, 1924) (Fig. 19)

Lepidospongia incrustans Dendy, 1924: 317, pl. 13, figs 1–3.
Lepidothenea incrustans: de Laubenfels 1936: 176; Bergquist 1968: 64.

MATERIAL EXAMINED**:** None.

DISTRIBUTION: Holotype Terra Nova Station 90, approximately 20 km southwest of the summit of Great King Island (34º24'S, 172º06'E) (Harmer & Lillie 1914).
HABITAT: Dendy (1924) described the habitat of 'Terra Nova' Station 90 as being remarkable in that it yielded thirty-eight species of sponges. The depth was about 183 m and the substratum was rocky. The sponge formed a thin crust on a small block of basalt with numerous other encrusting organisms.

DESCRIPTION:

Morphology a thinly spreading encrustation. The specimen was described as partially rubbed off the substratum.

Dimensions 10 × 10 mm, the thickness was not given by Dendy (1924).

Texture crisp, delicate.

Surface formed of overlapping scales, interrupted by fairly numerous delicate minute conical apertures (Dendy 1924), presumably oscules.

Colour in life described as 'beautifully' silvery. The sandwiched choanosome was dark brown and dry.

Skeleton comprised of an upper and lower layer of overlapping discate scales, the latter adherent to the underlying substratum, separated by an equally thin choanosome. Some thin vestigial megascleres were found to be associated with the rhabds of some discotriaenes.

Megascleres almost exclusively irregular oval to circular discs, perfectly smooth and structureless, the margins occasionally indented, without any trace of a shaft or axial

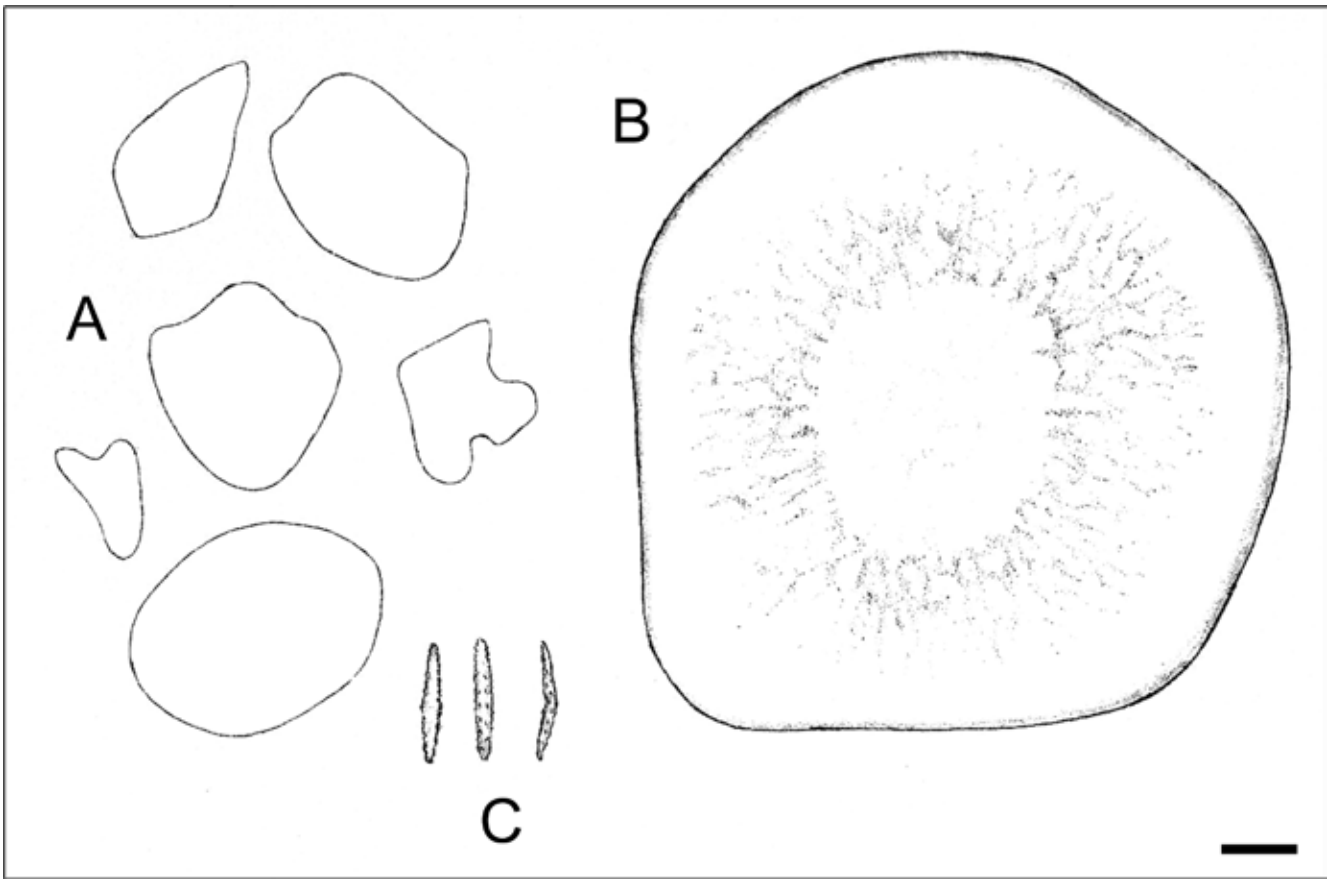


Figure 19. ***Lepidothenia incrustans*** (Dendy, 1924)

canals; a few have a stout, well-developed rhabd, and some cladomes have a reticulate pattern; maximum diameter of cladome 250 μm (Fig. 19A, B).

Microscleres are microrhabds, fusiform, straight or centroangulate, slightly roughened; c. 20 μm long and 2 μm thick (Fig. 19C).

REMARKS: The genus *Lepidothenea* de Laubenfels is known from a single very small specimen dredged from 183 m off the Three Kings Islands. No further material is available and the sponge has not been recollected since.

The phylogenetic affinity of *Lepidothenea incrustans* remains in contention. Some characters (occasional 'discotriaenes' with a stout 'rhabd', microrhabds, rare vestigial styles) weakly link this species with *Discodermia* (Theonellidae) and (microrhabds, monocrepidial discs) *Neopelta* (Neopeltidae) but the sponge lacks desmas. The lack of desmas in a lithistid sponge has a precedent, however; a species of *Theonella* from Vanuatu is known to lack ectosomal phyllotriaenes and desmas; all that remain is the strongyle megasclere skeleton and microrhabds in the ectosome (Kelly unpubl.). On balance, *L. incrustans* has some affinity with species in the Family Neopeltidae, but differs in the unique thinly encrusting form, the lack of desmas, the lack of amphiasters, and the lack of microxeas common in the family. It is recommended that *Lepidothenea* be retained as a valid genus, though *incertae sedis*, within the Neopeltidae.

KEY DIAGNOSTIC CHARACTERS:

- Tiny encrustation.
- Surface has scale-like discs.
- The only other spicules are acanthose microrhabds.

Family **MACANDREWIIDAE** Schrammen, 1924

Macandrewiidae Schrammen, 1924: 39.

Polymorphic lithistid demosponges with dentate phyllotriaenes, smooth ectosomal strongylar oxeas, and desmas with a triaenose crepis. (Modified from Pisera & Lévi 2002m).

Macandrewia Gray, 1859

Cup-shaped, massive-irregular, branching, or lamellate Macandrewiidae with dentate phyllotriaenes, the clads of which form intricate swirling antler-like

patterns, desmas with a triaenose crepis resembling tetraclones overall; the ectosome is encrusted with smooth strongylar curved oxeas. Microscleres may include roughened centrotylote microxeas.

TYPE SPECIES: *Macandrewia azorica* Gray, 1859.

Macandrewia spinifoliata Lévi & Lévi, 1983 (Fig. 20)

Macandrewia spinifoliata Lévi & Lévi, 1983: 116, fig. 8, pl. 6, fig. 3, pl. 8, figs 4–6.

MATERIAL EXAMINED**:**

NIWA Stations: KAH9907/48 (spicule slide labelled 'MKB 1829'); I372 (NIWA25780).

DISTRIBUTION: New Caledonia (holotype); Doubtless Bay, North Cape; west of White Island, Bay of Plenty, New Zealand.

HABITAT: Encrusting basalt rock. Depth range 211–395 m.

DESCRIPTION:

Morphology nubbin-shaped; Lévi and Lévi (1983) recorded numerous specimens that were digitate and ramified with knobby ends.

Dimensions 13 mm wide, 4 mm high.

Texture fragile, crumbles easily.

Surface smooth.

Colour in ethanol ivory (4B3).

Choanosomal skeleton composed of small pseudotetraclone desmas that form a close mesh and intricate zygoses.

Ectosomal skeleton lined with the phyllotriaene cladomes, encrusted with strongylote oxeas and rough microrhabds.

Megascleres (Table 18) comprising small robust desmas (Fig. 20A) with a triaenose crepis (one actine is longer than the other three) that resemble tetraclones (Fig. 20B). The clones are smooth around the epirhabd but can be tuberculate towards the zygoses, which are highly intricate. Phyllotriaenes (Fig. 20C) with straight conical rhabd, cladome irregularly circular to polyclad, with differential development of some clads, the edges crenulate and indented.

Microscleres (Table 18) smooth curved spicules with strongylote ends, the ends (Fig. 20D).

REMARKS: The details of spiculation conform to the holotype description except that the desmas are triaeneose, not monocrepidial rhizoclones as described by Lévi and Lévi (1983). While Pisera and Lévi (2002m) refuted the hypothesis put forward by Kelly (2000) that this genus has affinities with the Neopeltidae, it is interesting to note that the phyllotriaenes of *Macandrewia spinifoliata* are very similar in structure and size to the desmas, as in the neopeltid genera *Homophymia* and *Callipelta*. The contention that the phyllotriaenes of *Macandrewia* are pseudophyllotriaenes is supported by the fact that the short axial filaments of the crepis do not extend in the plane of the cladome to give rise to monoclads or deuteroclads as in the triaenes in sponges with tetraclone desmas. The phylogenetic affinities of this monogeneric family remain elusive.

A single specimen of *Macandrewia spinifoliata* was recognised during close inspection of the minute species that grow on basalt boulders dredged from the Bay of Plenty seamounts. These boulders have proved to be a rich source of new species of lithistid sponges.

KEY DIAGNOSTIC CHARACTERS:

- Tiny encrustation (on basalt rock on Bay of Plenty seamounts).
- Surface has feather-like triaenes and curved strongylote oxeas.
- Microscleres in the shape of asters are absent.

Family **PLEROMIDAE** Sollas, 1888

Megamorina Zittel, 1878: 99 (partim).
Pleromidae Sollas, 1888: 312; Topsent 1894: 290; Wilson 1925: 461; de Laubenfels 1955: E50.
Pleromatidae: Lendenfeld, 1903: 140.
Pléromides: Moret, 1926: 118.

Massive, conical, plate- to ear-shaped or globose lithistid demosponges; surface usually granular or hispid with projecting megascleres, texture stony. Desmas smooth or nodulose monocrepid megaclones with

Table 18. Spicule dimensions (µm) of *Macandrewia spinifoliata* Lévi & Lévi, 1983.

	Desma (Clone L/T) Desma (Overall size)	Phyllotriaene disc (Max ø) Rhabd (L)	Diactines (L)	Microxea (L)
New Caledonia				
Lévi & Lévi, 1983	—	200–300	400	60–70
(holotype)	150–250	100–125		
New Zealand				
'MKB 1829'	120–150/30–34	200 (150–250) x 272 (160–450)	378 (250–425)	80 (63–108)
	200–250	121 (90–150)		

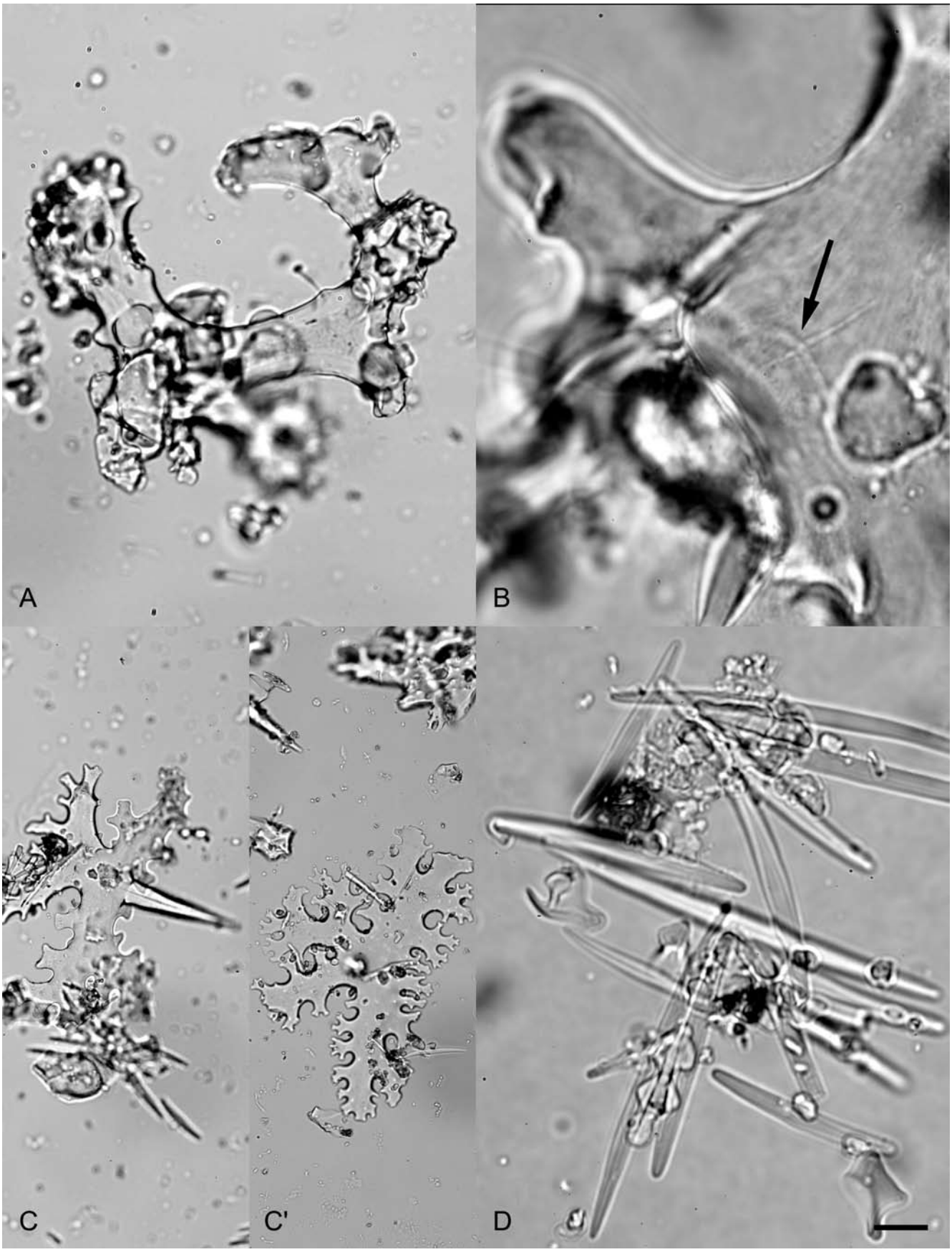


Figure 20. ***Macandrewia spinifoliata*** Lévi & Lévi, 1983.

saddle- or cup-shaped zygomes; ectosomal spicules are dichotriaenes and/or anatriaene-like megascleres; microscleres are spirasters, amphiasters, streptasters in various sizes, and finely spined microxeas and/or lightly acanthose style-like monactines. (From Kelly 2003).

REMARKS: Two valid extant genera, *Pleroma* and *Anaderma*, are recognised in Pleromidae, with four species known from seamounts and banks in the Southwest Pacific including New Zealand and New Caledonia (Pisera & Lévi 2002d; Kelly 2003; Kelly *et al*. 2003).

Pleroma Sollas, 1888

Lyidium Schmidt, 1870: 84.
Pleroma Sollas, 1888: 312; Lendenfeld 1903: 140; de Laubenfels 1955: E50; Pisera & Lévi 2002d: 324, figs 5–7.

Massive irregular encrustations, thick folded plates, or globular with a flattened apex; the surface granular and hispid in places, texture stony. Desmas are smooth or fully nodulose monocrepidial megaclones with cup-shaped, saddle-shaped, or irregular zygomes with indented margins, megascleres are large oxeas and dichotriaenes, microscleres are roughened microxeas and one to two types of microspined spiraster, amphiaster, and streptaster. (From Kelly 2003).

Remarks: Hinde and Holmes (1892) illustrated several megamorine microfossil desmas from the Oamaru Diatomite (c. 35 million years ago), at Oamaru in North Otago. These are remarkably similar to desmas of *Pleroma turbinatum* (Hinde & Holmes 1892, pl. 13, fig. 25) and *P. menoui* (Ibid., pl. 13, figs 26, 27).

TYPE SPECIES: *Pleroma turbinatum* Sollas, 1888.

Pleroma turbinatum Sollas, 1888 (Figs 21, 22)

Pleroma turbinatum Sollas, 1888: 312, pl. 33, figs 5–7; Lendenfeld 1903: 140; de Laubenfels 1955: E50, fig. 31.3; Lévi & Lévi 1983: 105, fig. 2, pl. 2, figs 5–8; Pisera & Lévi 2002d: 324–326, figs 5–7; Kelly 2003: 116, figs 2A,B, 3.

MATERIAL EXAMINED:
NIWA Stations: I92 (BMNH 2002.3.4.1, NIWA25061); KAH9907/50 (NIWA18344); X140 (NIWA18341, NIWA18342); Z2092 (NIWA18343); Z9400 (NIWA25620).
IRD Stations: LITHIST CP9 (NIWA18519, NIWA18520), DW7 (NIWA18521).

DISTRIBUTION: Makutu coast, Fiji Islands (holotype); Havannah, south coast of New Caledonia, and Éponge Seamount, south New Caledonian slope of Norfolk Ridge; Lord Howe Seamount Chain; Norfolk Ridge south of Norfolk Island; Challenger Plateau, northern slopes; west of White Island, Bay of Plenty.

HABITAT: The sponges were attached to hard rocky substrata on the flanks of seamounts. Depth range 230–860 m.

DESCRIPTION (modified from Kelly 2003):
Morphology a curved ear-like semicircular plate, attached to the substratum along the base of the sponge (Fig. 21A), or with a restricted base of attachment (Fig. 21B). The edges of the plate are rounded in profile.

Dimensions of body up to 240 mm high and wide, 10–30 mm thick.

Texture stony.

Surface velvety on the upper concave surface, granular on the lower convex surface, oscules are not visible (see Fig. 21A).

Colour in life beige, in preservative cream to beige.

Choanosomal skeleton composed of megaclones with saddle-shaped zygomes. Abundant microxeas fill the interstices between the desmas (Fig. 22A).

Ectosomal skeleton an encrustation of microscleres and dichotriaenes.

Table 19. Spicule dimensions (μm) of *Pleroma turbinatum* Sollas, 1888 (summarised from Kelly 2003).

	Desma (Clone L/T) Desma (Overall size)	Cladome (Max ø) Rhabd (L)	Diactines (L)	MO (L)	Ms1	Ms2
Fiji						
Sollas (1888)	—/50–90	448	1350	180–210	24–30	—
(holotype)	500–800	960				
New Caledonia						
Lévi & Lévi (1983)	200–300/70–90	360–590	1500–1700	130–150	12	—
	500–550	1000–2000				
New Zealand						
Kelly (2003)	100–800/60–100	375–750	1000–2000	130–165	10–20	12
	375–625	650–875				

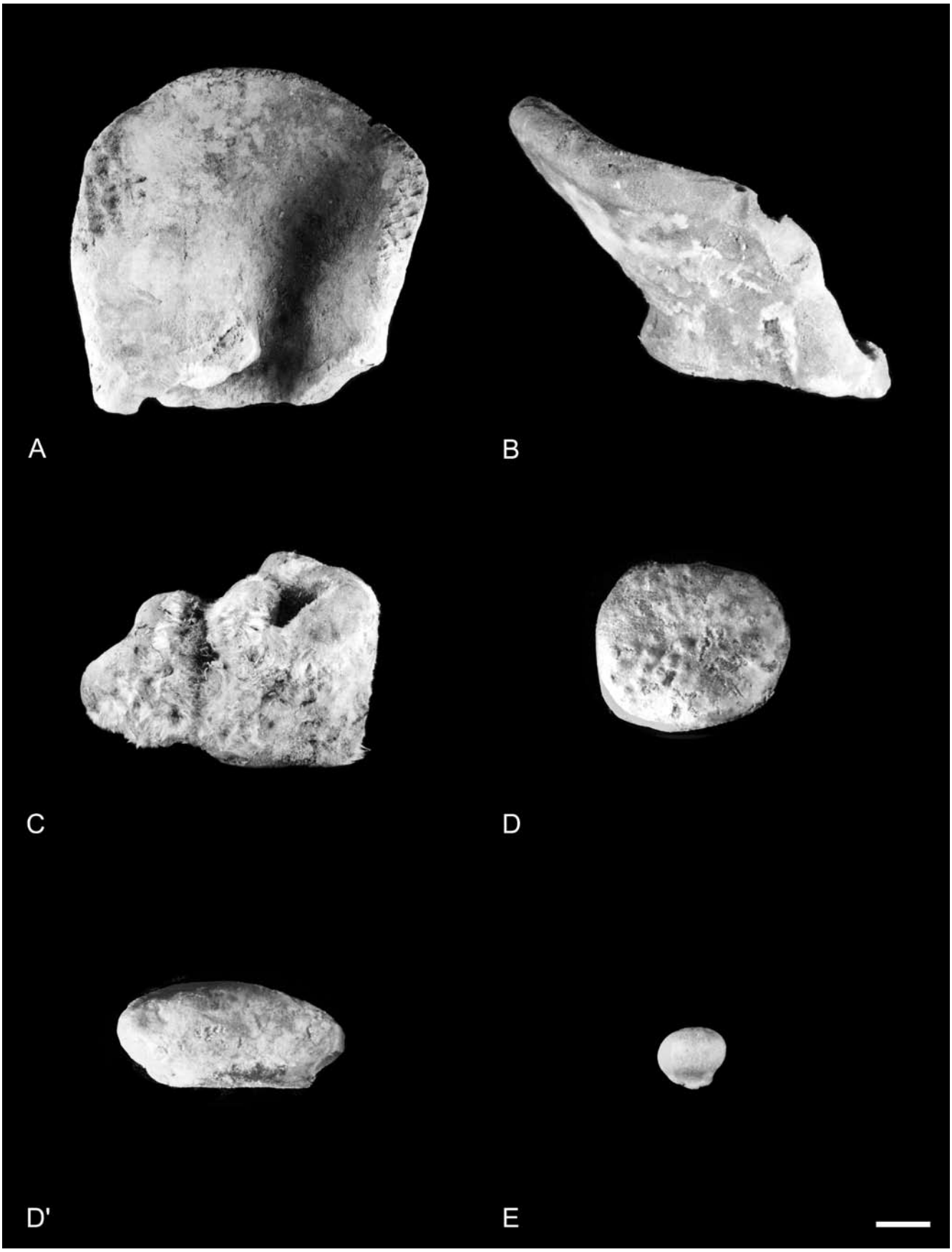


Figure 21. A, B ***Pleroma turbinatum*** Sollas, 1888; **C** ***P. menoui*** Lévi & Lévi, 1983; **D** ***P. aotea*** Kelly, 2003.

Megascleres (Table 19) – choanosomal desmas are smooth megaclones with a light brown granular core and a monoaxial crepis, with 3–6 clones emanating from both sides of a relatively long epirhabd (Fig. 22A,E). The zygomes are oval saddle- shaped expansions (Fig. 22E). Long fine oxeas extend through the ectosome. Dichotriaenes have very short protoclads and long deuteroclads. Kelly (2003) noted that the distal end of the rhabd is rounded in New Zealand specimens.

Microscleres in two forms, a regular microspined spiraster ((Table 19, Ms 1; Fig. 22I) and a smaller microspined spiraster/streptaster (Table 19, Ms 2; Fig. 22K) with rays of uneven length and orientation. These latter microscleres, in some specimens, have very thick rays. Microxeas are roughened and fusiform, straight and centrally thickened.

REMARKS: No additional material has been collected since the original description of New Zealand specimens in Kelly (2003

KEY DIAGNOSTIC CHARACTERS:

- Very thick, stony, ear-shaped.
- Easily be confused with *Herengeria vasiformis* or species of *Neoschrammeniella* but the smooth desmas are characteristic.

Pleroma menoui Lévi & Lévi, 1983 (Figs 21, 22)

Pleroma menoui Lévi & Lévi, 1983: 103; Kelly 2003: 119, figs 2C,D, 4, 6.

MATERIAL EXAMINED**:**

NIWA Stations: J953 (NIWA18347, NIWA25606, BMNH 1995.3.30.1); S562 (NIWA18345); S572 (NIWA18346); K826 (NIWA18350); K872 (NIWA18349); KAH0204/09 (NIWA18355, NIWA18356); KAH0204/27 (NIWA18353); KAH0204/30 (NIWA18354); KAH0204/44 (NIWA18357); TAN0205/20 (NIWA18351); TAN0205/60 (NIWA18352); TAN0413/085 (NIWA25054); TAN0413/093 (NIWA25053); X152 (NIWA18348); Z9263 (NIWA25059).
NMNZ Stations: NMNZ Por. 580; NMNZ Por. 591.
IRD Stations: LITHIST CP9 (IRDR1827; NIWA18522, NIWA18523); DW11 (NIWA18524).

DISTRIBUTION: South of New Caledonia (holotype), Éponge and Kaimon Maru Seamounts, south New Caledonian slope of Norfolk Ridge; western continental slope of Northland; west of Three Kings Ridge; Colville Ridge; southern South Fiji Basin; Wanganella Bank, northwestern New Zealand; Raukumara Plain, northern Bay of Plenty; Volcano E, Kermadec Ridge; West Cavalli, South Cavalli, and Cavalli Seamounts; west of White Island and Tuatoru Knoll, Bay of Plenty.

HABITAT: Attached to hard substrata on continental shelf banks. Found with a range of other lithistid sponges, molluscs, bryozoans, brachiopods, echinoderms, hydroids, and stylasterid hydrocorals (Kelly 2000). Depth range 179–1131 m.

DESCRIPTION (modified from Kelly 2003):
Morphology a highly irregular multilobate encrusting plate, occasionally tubular (Fig. 21C) or a thick fan composed of fused lobes. Immature sponges are thick flattened ear-shaped plates (see Kelly 2003).

Dimensions of most mature specimens are c. 21 cm long, 11 cm high, 14 cm wide.

Texture stony.

Surface extremely hispid with long oxeas protruding beyond 10 mm (Fig. 21C).

Colour in life beige, in preservative cream to beige.

Choanosomal skeleton composed of megaclone desmas (Fig. 22B,C) with cup- shaped zygomes, sitting on on top of the other (Fig. 22C). Extremely long oxeas protrude more than 10 mm from the sponge surface (Fig. 22B).

Ectosomal skeleton charged with strongylospirasters, microxeas, dichotriaenes, and long hair-like diactines (Fig. 22B).

Megascleres (Table 20) – megaclones are smooth with a laminated appearance and a pale brown granular core containing the monaxial crepis; 2–5 clones emanate from both sides of a thick epirhabd, but typically radiate in one direction (Fig. 22B,C,F) forming dipods,

Table 20. Spicule dimensions (μm) of *Pleroma menoui* Lévi & Lévi, 1983 (summarised from Kelly 2003).

	Desma (Clone L/T) Desma (Overall size)	Cladome (Max ø) Rhabd (L)	Diactines (L)	MO (L)	Ms1	Ms2
New Caledonia						
Lévi & Lévi (1983)	400/120–180 300–700	1200	12000	170–225	15–18 700–1400	10
New Zealand						
Kelly (2003)	375–700/125–200 575–1250	600–1250 1125–2325	12000	170–250	12–20	17

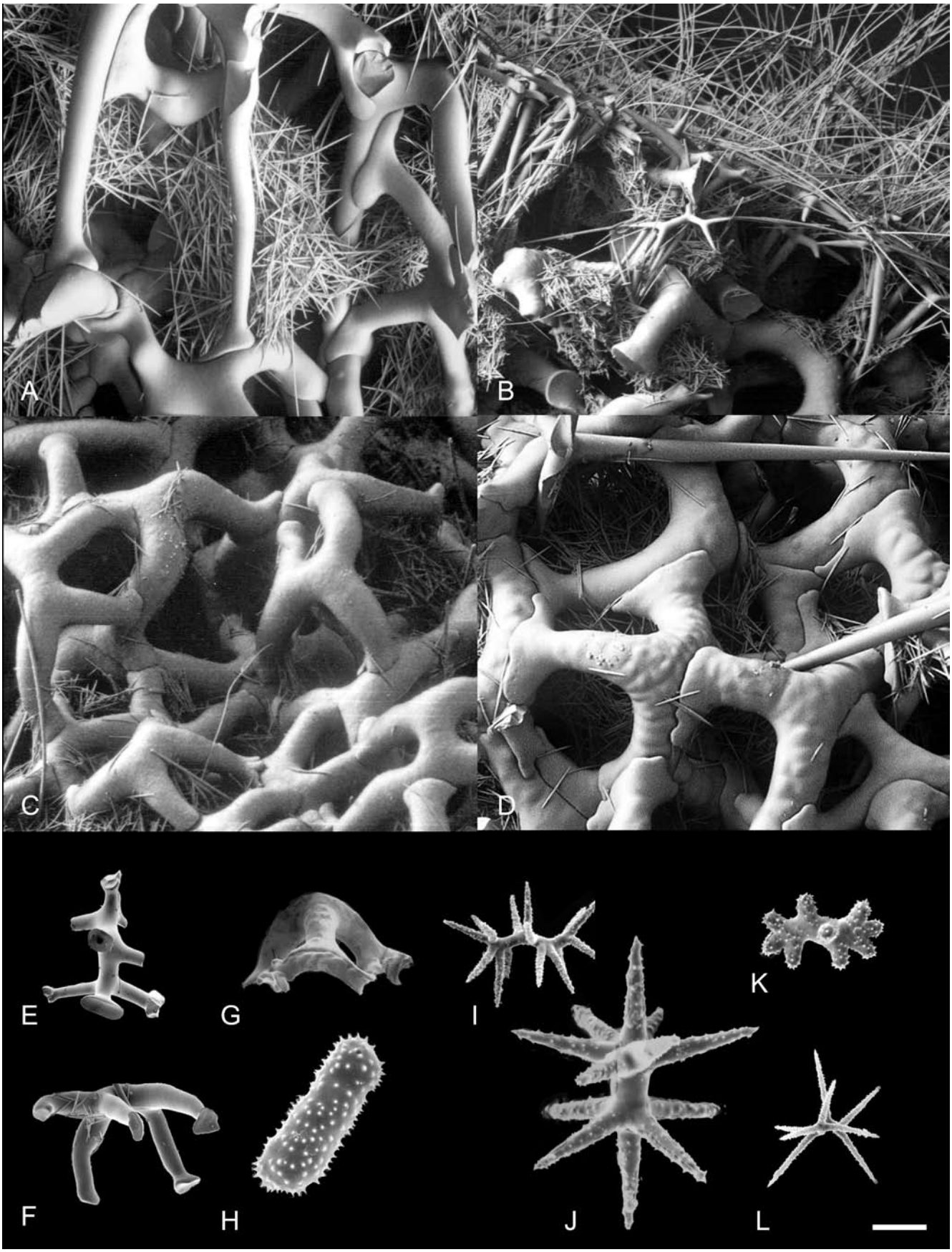


Figure 22. A, E, I, K *Pleroma turbinatum* Sollas, 1888; B, **C, F, H, L *P. menoui*** Lévi & Lévi, 1983; **D, G, L *P. aotea*** Kelly, 2003.

tripods, and quadripods (see also Lévi & Lévi 1983, pl. 2, figs 1–2). The epirhabd is slightly thicker than the clones. The zygomes are spherical and cup-shaped. Diactines are long and fine. Dichotriaenes are large, slender and curved, the deuteroclads and protoclads are quite long and fine (Fig. 22B).

Microscleres in two forms, a regular strongylospiraster derived from a spiraster with rays encased in additional silica (Table 20 Ms 1; Fig. 22H), and a smaller streptaster (Table 20 Ms 2; Fig. 22L). Roughened microxeas are thick and slightly angulate centrally.

REMARKS: Specimens of *Pleroma menoui* Lévi & Lévi are identical in New Zealand and New Caledonian specimens; the desmas are very large, arched, smooth and thick, with cup-shaped zygomes, and microscleres include characteristic strongylospirasters.

Since the revision and discussion by Kelly (2003), the species range has been extended to the Kermadec Ridge and Cavalli Seamounts of northeastern New Zealand.

KEY DIAGNOSTIC CHARACTERS:

- Stalked or convoluted plate sponge with thick walls, stony and very hairy.
- Desmas with distinctive smooth clones in the form of a tripod, dipod, or quadripod, ends of clones have sucker-like zygomes.
- Microscleres include acanthose bean-like spicules.

Pleroma aotea Kelly, 2003 (Figs 21, 22)

Pleroma aotea Kelly, 2003: 123, figs 2E–I, 5, 6.

MATERIAL EXAMINED**:**

NIWA Stations: AUT 137; I97 [NIWA holotype H-807 (NIWA7613)], [NIWA paratype P-1276 (NIWA5097, BMNH 2002.3.4.2)]; KAH0204/08 (NIWA18358); KAH0204/44 (NIWA18359, NIWA18360, NIWA18361); KAH9907/50 (NIWA18362); S568 [NIWA paratype P-1278 (NIWA5101)]; TAN0413/016 (NIWA25052); U591 [NIWA paratype P-1277 (NIWA5098)]; Z9262 (NIWA25607).

DISTRIBUTION: Challenger Plateau, northern slope; Wanganella Bank, West Norfolk Ridge (holotype); Tui Seamount, Three Kings Ridge; western flank of Three Kings Ridge; Cavalli and South Cavalli Seamounts; west of White Island, and Whakatane Seamount, Bay of Plenty.

HABITAT: Attached to hard substrata on seamounts. Depth range 230–1538 m.

DESCRIPTION (modified from Kelly 2003):
Morphology of immature sponges comprisinge spherical knobs with a restricted base of attachment. As the sponge matures it flattens and the apical surface becomes slightly concave with one or more oscular depressions. Immature sponges usually have a single apical oscule and slightly depressed vestibule beneath this oscule, whereas the largest have numerous oscules spread across the surface (Fig. 21D).

Dimensions of mature specimens can reach up to 80 cm diameter by 35 mm high, but the majority of specimens in the collection average 40 mm diameter by 30 mm high.

Texture stony.

Surface smooth and granular.

Colour in life cream to beige (4A3).

Choanosomal skeleton composed of tripod-like nodulose megaclones (Fig. 22D). Centrotylote microxeas are abundant in the outer choanosome and ectosome along with 2 forms of microscleres. Large oxeas may protrude a short distant from the surface.

Ectosomal skeleton with abundant centrotylote microxeas and two forms of microscleres line the surface. Dichotriaenes are also abundant in the ectosome.

Megascleres (Table 21) — megaclones are irregular with 2–4 clones emanating from a short, slightly bulbous epirhabd (Fig. 22D, G) containing a monaxial crepis. The surface of the desma has relatively well-defined low mounds or nodules. The clones emanating from the epirhabd are often shorter and thinner than the epirhabd and are frequently dichotomous. The zygomes are enormous with an oval profile and they are occasionally dichotomous with irregular indented margins (Fig. 22G). Dichotriaenes are robust with a broad cladome, the protoclads are thick and straight, and the deuteroclads are sturdy and often split at the extreme end (Fig. 22D). Large oxea are common and protrude a short distance from the surface.

Microscleres are amphiaster/streptasters in two size categories (Table 21, Ms 1, 2; Fig. 22J) with very fine sharply pointed rays. Roughened microxeas are thick, straight, and cigar-shaped (see Fig. 22D) and often centrotylote.

Table 21. Spicule dimensions (μm) of *Pleroma aotea* Kelly, 2003 (summarised from Kelly 2003).

	Desma (Clone L/T) Desma (Overall size)	Cladome (Max ø) Rhabd (L)	Diactines (L)	MO (L)	Ms1	Ms2
New Zealand						
Kelly (2003)	375 (275–500)/125–225902 703 (475–950) – 1086 (825–1325)	(725–1125) 1096 (700–1375)	2000–3000	130–160	20–22	10

REMARKS: *Pleroma aotea* is relatively easy to recognise in the field as it is mushroom- shaped and very stony. The desmas are very characteristic of the species and differ considerably in both size and shape from those of both *P. turbinatum* and *P. menoui*.

Kelly *et al*. (2003) reported the discovery of numerous fossil sponges from the Late Eocene–Early Oligocene Ototara Limestone at Kakanui, North Otago, that were considered to be indistinguishable from *P. aotea* at the gross morphological level. Because the sponges are now solid calcite, a full confirmation of this species identity is not possible. However, desmas very similar to those of *P. aotea* were also reported from the Tutuiri Greensand (Late Paleocene) of Chatham Island (Kelly & Buckeridge 2005), confirming a southern distribution in New Zealand during this time.

KEY DIAGNOSTIC CHARACTERS:

- Small mushroom-like sponges with a restricted base and slightly concave bumpy surface.
- Desmas are highly characteristic with the nodulose surface and saddle-shaped zygomes.

Family **ISORAPHINIIDAE** Schrammen, 1910

Helomorinidae Schrammen, 1910: 128.
Isoraphiniidae Schrammen, 1924a: 38; de Laubenfels 1955b: E51.

Lithistid demosponges with smooth, linear oxea-like sinuous heloclones bearing lateral notch-like zygoses, plagiotriaenes, and/or dichotriaenes, and accessory diactines. Microscleres are acanthose microxeas, amphiaster/strepasters, and micropolyrhabds (modified from Pisera & Lévi 2002l).

REMARKS: The Isoraphiniidae is based on two species of the Recent genus *Costifer* — the type species *C. vasiformis* Wilson, 1925 from the Philippines and *C. wilsoni* Lévi 1993 from New Caledonia (Pisera & Lévi 2002l). The family is represented by numerous Mesozoic genera. Several new specimens of *C. wilsoni* from New Zealand and one from New Caledonia, described here, add to knowledge of this previously rare genus.

Costifer Wilson, 1925

Costifer Wilson, 1925: 461.

Vase-shaped, lamellar, or auricular lithistid demosponges; surface hispid, texture incompressible, slightly flexible. Choanosomal desmas are heloclones in two categories — those of the deep choanosome have irregular expansions and restrictions along the spicule, the ends are bulbous strongylote or attenuated, and they have lateral notch-like zygoses; the desmas of the outer choanosome are like sinuous oxeas. Other megascleres include long sinuous projecting diactines, plagiotriaenes, and/or dichotriaenes. Choanosomal microscleres are microxeas, amphiasters, or streptasters; ectosomal microscleres are micropolyrhabds.

Type species: *Costifer vasiformis* Wilson, 1925.

Costifer wilsoni Lévi, 1993 (Figs 23, 24)

Costifer wilsoni Lévi, 1993: 20, fig. 5B, pl. 2, fig. 2, pl. 9, figs 1–2.

MATERIAL EXAMINED:

NIWA Stations: KAH0204/08 (NIWA18364, NIWA18365, NIWA18366); S572 (NIWA18363); Z9262 (NIWA25617, NIWA25618).
NMNZ Stations: NMNZ Por. 597, NMNZ Por. 712.
IRD Stations: LITHIST CP9 (NIWA18525).

DISTRIBUTION: South New Caledonian slope (holotype), Stn CP105, and Éponge Seamount, south New Caledonian slope of the Norfolk Ridge; Challenger Plateau, northern slope; Wanganella Bank, West Norfolk Ridge; West of Three Kings Ridge; Cavalli Seamount, northeastern New Zealand.

HABITAT: Attached to hard rocky substrata in seamount environments. IRD Stn CP9 was extremely diverse with sea fans and numerous *Herengeria vasiformis*, *Neoaulaxinia* spp., *Geodia* spp., and *Pleroma menoui* (Kelly unpubl.). Depth range 206–904 m.

DESCRIPTION:

Morphology a thick, heavy ear-shaped or semicircular lamella attached to the substratum by a short stem 30–40 mm wide and c. 10 mm high that projects from the back of the sponge base (Fig. 23A); margin of lamella curved.

Dimensions 400 mm wide, 160 mm high, 40 mm thick (IRD Stn CP9). New Zealand specimens 70–200 mm wide, 40–130 mm high, 20–25 mm thick.

Texture tough but slightly flexible, not stony.

Surface generally smooth but furry or granular to the touch.

Colour in life peach-coloured (6A6), in preservative dark mustard-brown (5E8).

Choanosomal skeleton composed of large thick heloclones that are abundant throughout the choanosome, arranged randomly and sometimes radially at the surface (Fig. 23B). Heavily notched desmas appear to be commoner in the sponge interior, while the oxeote desmas are commoner on the exterior projecting through the ectosome. Microxeas are abundant and pack the choanosome.

Ectosomal skeleton packed with micropolyrhabds.

Megascleres (Table 22) — heloclone desmas in two morphologies: (1) outer choanosomal desmas are long, smooth, sinuous, and oxea-shaped, attenuated at the tips, frequently bent over at one end (Table 22 D1, Figs 23B,E, 24A,B); (2) deeper choanosome desmas are shorter irregularly polytylote with strongylote, truncate or bulbous attenuated ends and lateral saddle-shaped notches (Table 22 D2; Fig. 23C,D, 24C). Some desmas have a hollow axial canal extending the full length of the spicule, and others have a fine axial crepis that ends in a series of small branches in some spicules. Ectosomal triaenes are plagiotriaenes or dichotriaenes in equal numbers (Fig. 23E). The protorhabd of the dichotriaene cladome is much longer than the two deuteroclads on each of the three clads that make up the cladome. Plagiotriaenes have a much broader cladome than dichotriaenes, and shorter rhabds. Long fine diactines project from the surface; these are impossible to measure as they are broken, but appear on some specimens to be greater than 10 mm long.

Microscleres — microxeas, very finely roughened with a small central swelling, slightly curved or angled from midpoint of spicule (Fig. 23B, 24A,D); micropolyrhabds (Table 22, Ms 1, Fig. 24D,E) acanthose, irregular, with bulbous projections, curved or linear or stepped in length. Some are irregularly spiraster- shaped. Acanthose amphiaster/streptasters (Table 22, Ms 2, Fig. 24E) with fine rays.

Remarks: There is some minor variation between the spicule dimensions of the New Caledonian holotype material and the New Zealand material but the New Zealand specimens conform to the holotype description in all other aspects. Further to Lévi's (1993) description, the ratio of plagiotriaenes to dichotriaenes can vary from specimen to specimen; in NIWA18366, plagiotriaenes are more abundant, while in NMNZ Por.

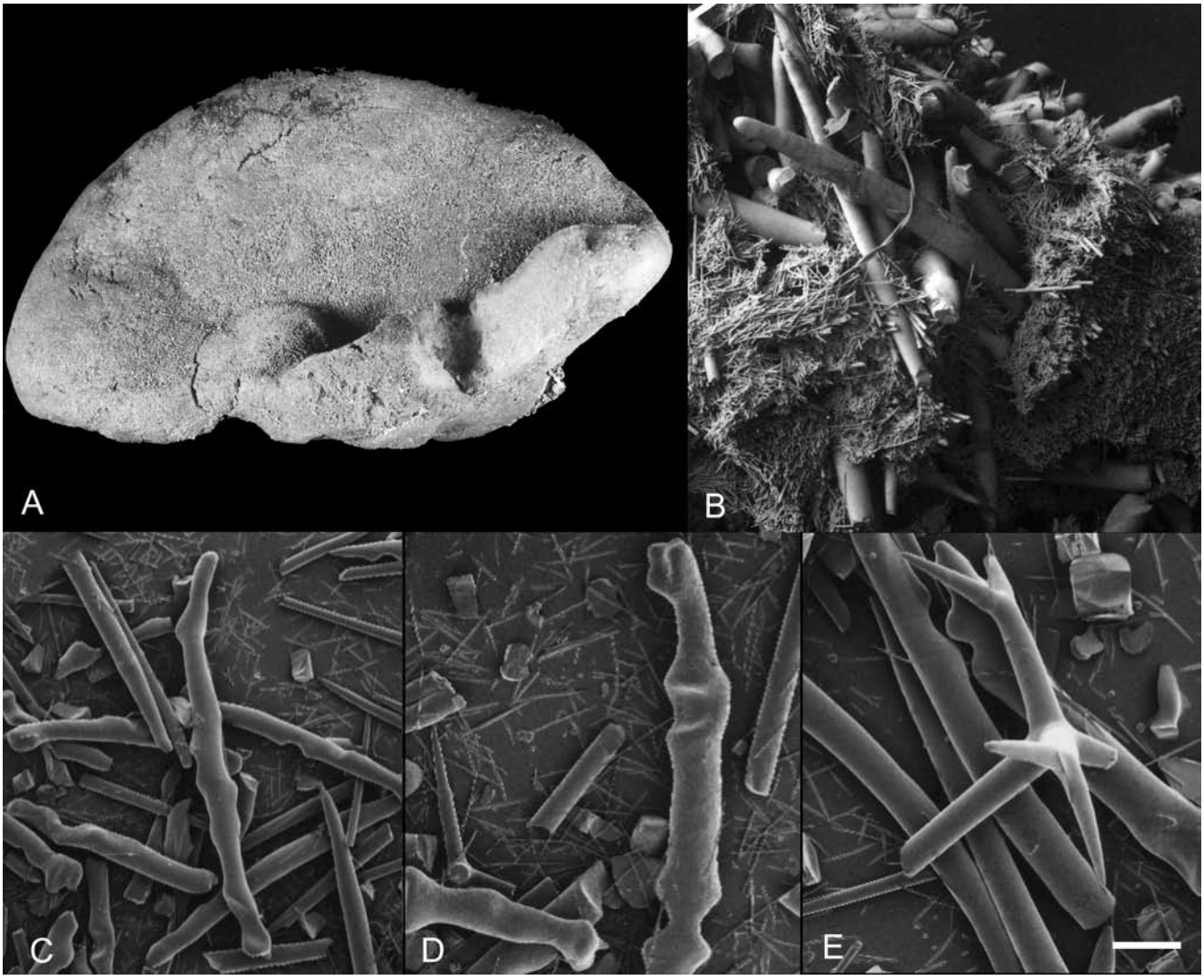


Figure 23. ***Costifer wilsoni*** Lévi, 1993.

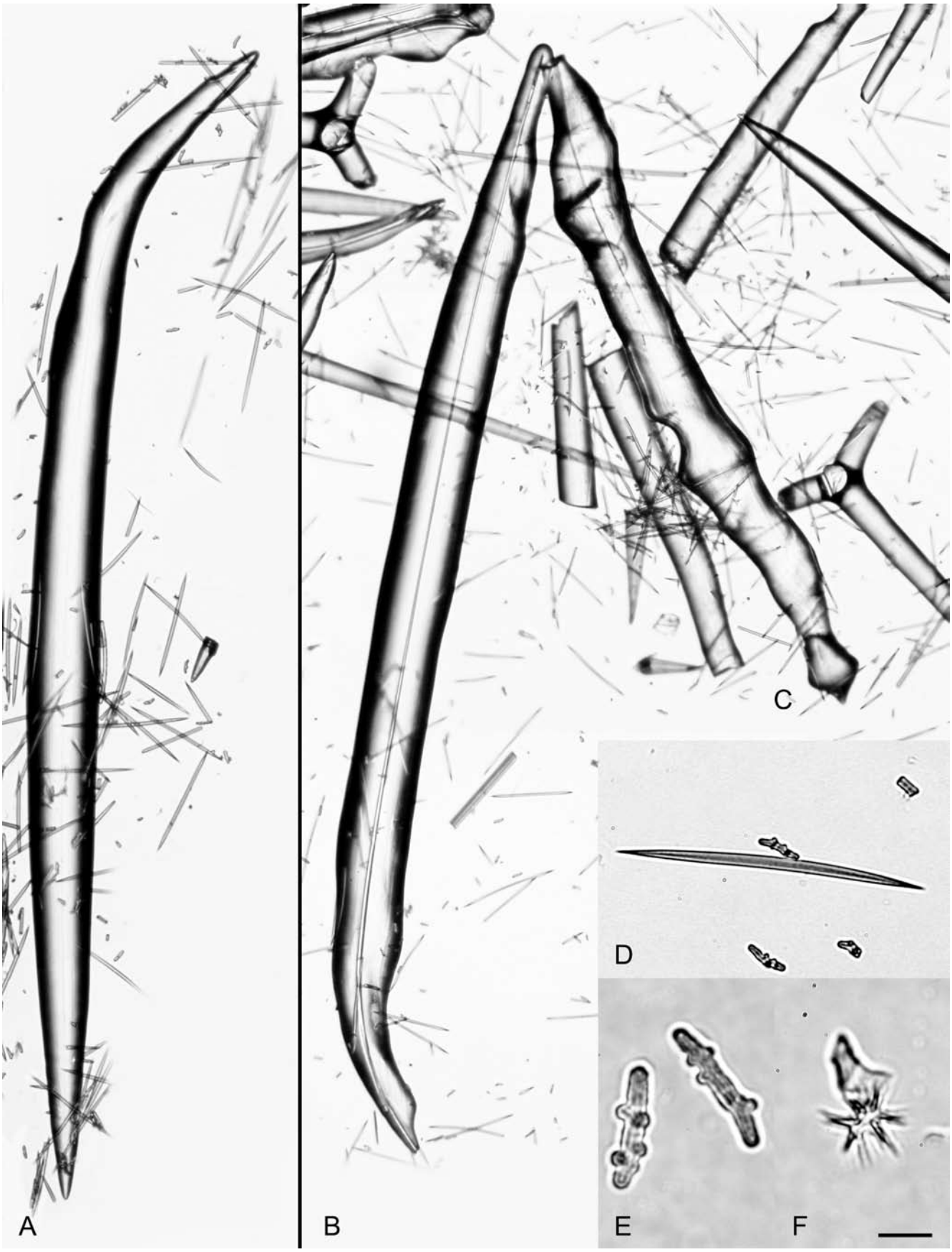


Figure 24. ***Costifer wilsoni*** Lévi, 1993.

Table 22. Comparison of the spicule dimensions (μm) of *Costifer wilsoni* Lévi, 1993 with the type species *C. vasiformis* Wilson, 1925 (P cladome = plagiotriaene dimensions, D cladome = dichotriaene dimensions).

	D 1 (L) (W)	D 2 (L) (W)	D Cladome (Max ø) Rhabd (L) P Cladome (Max ø) Rhabd (L)	Microxeas (L)	Ms 1 (L)	Ms 2 (L)
New Caledonia						
Lévi (1993)	1500–4000	—	600–1000	130–220	30	12
(holotype)	40–120	—	800–1000			
New Zealand						
NMNZ Por. 597	2488 (2000–3000)	1907 (1550–2550)	1468 (1250–1650)	211 (175–232)	24	15
	100 (70–150)	152 (100–200)	813 (650–1000)			
			1750			
			1125			
NIWA18366	2438 (1650–2700)	2469 (2375–2600)	1375–1625	183 (100–220)	29	15
	200–225	100–125	2375			
			1937 (1500–2250)			
			1775 (1625–1700)			
Philippines						
C. vasiformis	1880–2370	—	525–830	90–165	18–25	15
(Wilson, 1925)	220–280		850–1310			

597 dichotriaenes dominate. Furthermore, the desmas are in two recognisable categories — the desmas of the outer choanosome are predominantly long, smooth, sinuous, and oxea-shaped, and frequently bent over at one end, while the deeper choanosomal desmas are generally shorter and more irregular with uneven expansions and contractions along the axis and with strongylote, truncate or bulbous ends. Along the axis of these latter spicules are conspicuous lateral saddle-shaped notches indicating the proximity of adjacent spicules. Desmas may have a hollow axial canal extending the full length of the spicule, or a fine axial crepis. Either form of desma may have a hollow or thread-like axial morphology.

Pisera and Lévi (2002l) suggested that *C. wilsoni* is very similar to the genus holotype *Costifer vasiformis* Wilson, 1925 and that it differs only in the possession of dichotriaenes and in the absence of lateral notches in the heloclones. Examination of this new material has afforded a clearer differentiation (see Table 22) between the two species; the microxeas, heloclones and plagiotriaenes of *C. vasiformis* are considerably smaller than those of *C. wilsoni*, and the morphology of the former is vase-shaped with a rough irregular surface. This contrasts considerably with *C. wilsoni*, which is smooth and ear-shaped. Note that lateral notches are certainly present in New Caledonian material (NIWA18525); contrary to what Pisera and Lévi (2002l) suggested, these desmas with notches are perhaps commoner in the deeper choanosome.

Microfossil heloclones indistinguishable from those of extant *Cosfiter wilsoni* were found in the Tutuiri Greensand (Teurian–basal Waipawan) in the Chatham Islands (Buckeridge & Kelly 2005), confirming a more southern distribution for this genus during the Paleogene.

KEY DIAGNOSTIC CHARACTERS:

- Large, heavy, ear-shaped; may be mistaken for *Pleroma turbinatum* but the former is flexible while the latter is stony.
- Presence of heloclones in choanosome.

Family **SCLERITODERMIIDAE** Sollas, 1888

Scleritodermiidae Sollas, 1888: 346; Wilson 1925: 463; de Laubenfels 1936: 165.

Massive-amorphous, encrusting, flabellate, ear-, cup-, or vase-shaped. Desmas are thorny or tuberculate rhizoclones; ectosomal spicules when present are irregular curved smooth or acanthose spicules with strongylote ends, some are polyrhabdose, or larger acanthose tylostrongyles; microscleres when present are sigmaspires. (Modified from Pisera and Lévi 2002b).

REMARKS: A partial rhizoclone desma skeleton, very similar to those in extant species of Scleritodermidae, was found in the Tutuiri Greensand (Teurian–basal Waipawan) in the Chatham Islands (Buckeridge & Kelly 2005), confirming a more southern distribution for this family during the Palaeogene.

Microscleroderma Kirkpatrick, 1903

Microscleroderma Kirkpatrick, 1903: 173.
Taprobane Dendy, 1905: 103; Dendy 1922: 7; Wilson 1925: 468.

Cup- or ear-shaped with a hirsute, smooth, or tuberculate concave surface; desmas are thorny rhizoclones; choanosome also may contain long oxeote diactines; ectosomal megascleres absent; microscleres are sigmaspires. (Modified from Pisera & Lévi 2002b).

TYPE SPECIES: *Microscleroderma hirsutum* Kirkpatrick, 1903.

Microscleroderma novaezelandiae n. sp.
(Fig. 25; Table 23)

MATERIAL EXAMINED**:**

Type material: Holotype NIWA18367 from NIWA Stn Z7190; paratype NIWA18368 from NIWA Stn Z7187.

DISTRIBUTION: Unfortunately, no information is available on the collection localities for these two specimens, other than that they were collected in New Zealand waters. Collection details are limited to those in Appendix 3.

HABITAT: Attached to rocky or coral substrata. Depth range unknown.

DESCRIPTION:

Morphology comprising shallow curved circular lamellae joined to form a tubular flared vase-like structure; margin of lamellae smooth, rounded, more hirsute than the flat surfaces (Fig. 25A). Immature specimens form slightly concave circular lamellae attached to the substratum at the base (Fig. 25B).

Dimensions 45 mm high, 60 mm wide and 30 mm thick, lamella thickness 5–7 mm.

Texture stony, but easily snapped.

Surface smooth, velvety on both surfaces, but more on the concave surface.

Colour ivory (4B3) in life and in ethanol.

Choanosomal skeleton a reticulation of very spiny rhizoclone desmas (Fig. 25C).

Ectosomal skeleton with fine diactines projecting beyond both surfaces, diactines are longer on the margin of the lamella. C-shaped, S-shaped, and spiralled sigmaspires are abundant in the outer 500 μm of the ectosome and are less common in the deep choanosome.

Megascleres (Table 23)—rhizoclone desmas (Fig. 25C), simple, arched, with numerous elongate single or bifud spines arising from the arch, usually from the outward curved side. The lower extremities of the arch may divide into 2–3 short clones that are involved with zygosis (Fig. 25D, upper right). The appearance of ladder-like "fibres" is given by zygosis of the clones with adjacent desmas at each end of the spicule. These align in parts of the skeleton to form what appear as the longitudinal beams of a ladder, the arch or "beam" forming the rungs. Long oxeote diactines in two size categories, the longer and thicker confined to the margin of the lamella, and the shorter and finer confined to the concave surface. These latter diactines have fine fusiform whip-like ends.

Microscleres (Table 23) comprise spined S-shaped and C-shaped sigmaspires (Fig. 25C,D).

REMARKS: Several characters differentiate *Microscleroderma novaezelandiae* from the Indo-Pacific *M. herdmani* (Dendy, 1905) and New Caledonian *M. stoneae* Lévi

Table 23. Comparison of the spicule dimensions (μm) of *Microscleroderma novaezelandiae* n. sp., *M. stonae* Lévi & Lévi, 1983, and *M. herdmani* (Dendy, 1905).

	Desma 1 (L)/ Clone (Thickness) Desma 2 (L)/ Clone (Thickness)	Diactines 1 (L)	Diactines 2 (L)	Sigmaspires (L)
M. stonae				
New Caledonia	300/30 150/5	900-1000/5-13	—	7-10
M. novaezelandiae				
NIWA 18367 (holotype)	300/30 —	<2500/15	532(300-775)/1-2	13(10-15)
M. herdmani				
Philippines (Wilson 1925)	200-300 —	2-6 mm	—	6-8
New Caledonia (Lévi & Lévi 1983)	200/30 —	900-1500	—	10-12

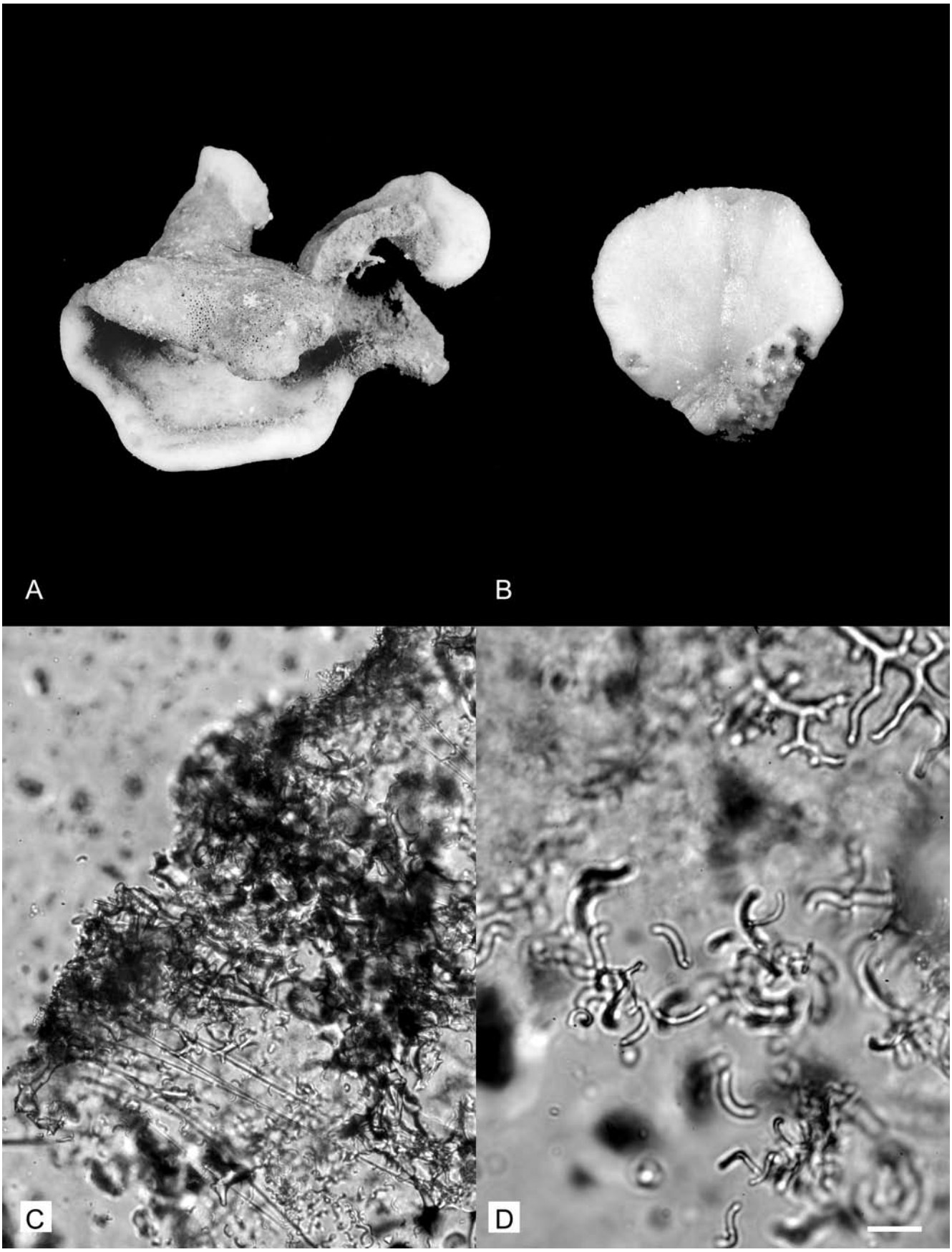


Figure 25. ***Microscleroderma novaezelandiae*** n. sp.

& Lévi, 1983. *Microscleroderma* forms a curved folded lamella that is spherical in general outline; *M. herdmani* is vase-shaped and the lamellae of mature specimens roll inward along the vertical plane to form a complex of vases. Both surfaces of *M. novaezelandiae* are smooth and velvety, unlike the concave surfaces of *M. herdmani* and *M. stonae,* which are hirsute and have mamillate projections (Dendy 1905; Wilson 1925; Lévi & Lévi 1983). The sigmaspires are larger in *M. novaezelandiae* than those described for *M. herdmani* by Dendy (1905) and in New Caledonian material (Lévi & Lévi 1983) (see Table 23), and it has two size categories of diactines, with the thicker longer diactines on the margin of the sponge.

While *M. novaezelandiae* is more similar to *M. stoneae* Lévi & Lévi, 1983, which forms a simple shallow bowl, careful surface scrapes did not reveal the highly ramified superficial desmas that typify this New Caledonian species.

KEY DIAGNOSTIC CHARACTERS:

- Small thin-walled cup or plate.
- S- or C-shaped sigmaspires and thin diactines in two size categories.

Scleritoderma Sollas, 1888

Scleritoderma Sollas, 1888: 315.

Massive, flabellate, encrusting, or plate-like, with nodes or are cup-shaped; desmas are spinose rhizoclones; ectosomal spicules are faintly S- or C-shaped acanthorhabds with strongylote or faintly tylote ends, microscleres are sigmaspires. (Modified from Pisera and Lévi 2002b).

TYPE SPECIES: *Scleritoderma flabelliformis* Sollas, 1888.

Scleritoderma flabelliformis Sollas, 1888

(Fig. 26)

Scleritoderma flabelliformis Sollas, 1888: 316, pl. 35, figs 26–50; Lévi & Lévi 1989: 47, fig. 15, pl. 2, fig. 3.

MATERIAL EXAMINED**:**

NIWA Station: S572 (NIWA18369).

DISTRIBUTION: Kei Islands, Indonesia (holotype); Philippines; west of Three Kings Ridge, New Zealand.

HABITAT: Attached to hard substrata. An undescribed species of *Hamacantha* (Poecilosclerida, Hamacanthidae) encrusts the surface in small patches. Depth range 403–530 m.

DESCRIPTION:

Morphology a thick plate attached to the substratum by a broad ridge; upper surface verrucose with meandering flattened ridges and nodules (Fig. 26A), with regularly scattered oscules that have slightly raised edges; lower surface is ridged and flatter than upper surface.

Dimensions 60 mm by 30 mm wide, 20 mm high in middle of specimen (including basal ridge), 10–12 mm thick at margin.

Texture stony.

Surface granular, with flattened ridges and nodules.

Colour dark mustard brown (5E8) in life and in preservative.

Choanosomal skeleton a dense reticulation of desmas, being more cavernous on the external surfaces.

Ectosomal skeleton dark brown and membranous and contains a relatively thick oblique to tangential layer of acanthorhabds (Fig. 26B). These microscleres are also present within the outer choanosome but become less common deeper within. Sigmaspires are present in the outer choanosome and ectosome, but these are not very common.

Megascleres (Table 24) thorny rhizoclone desmas, elongate with short, branched termini.

Microscleres acanthorhabds (Table 24; Fig. 26C), slightly centrally thickened, with strongylote or faintly tylote ends, straight, curved or faintly S-shaped; sigmaspires C- or S-shaped (Fig. 26D).

REMARKS: The single New Zealand specimen conforms reasonably closely to the type species *Scleritoderma flabelliformis* Sollas, 1888, although the morphology is slightly different (not strictly flabelliform). Sollas (1888) mentioned that "the sponge is sometimes in its most irregular and incurved form, attached by the convex side of the folded plate." This latter morphology better describes the New Zealand specimen. Other species of *Scleritoderma* include *S. nodosum* Thiele, 1900 from Ternate and Tulear, Madagascar, but this has deep channels and columns that appear as nodes on the surface of the sponge and is quite different from the plate-like morphology of *S. flabelliformis*. *Scleritoderma camusi* Lévi & Lévi, 1983 from New Caledonia forms a deep-blue shallow cup sponge of regular morphology.

The rare exotyles mentioned by Lévi and Lévi (1989) were absent in the New Zealand specimen and the holotype. These Philippine specimens differ significantly from the holotype morphology; the figured specimen is heavily digitate with rounded nodular tips (Lévi & Lévi 1989, pl. 2, fig. 3), extending knowledge of the range of morphologies in this species, if indeed it is *S. flabelliformis*.

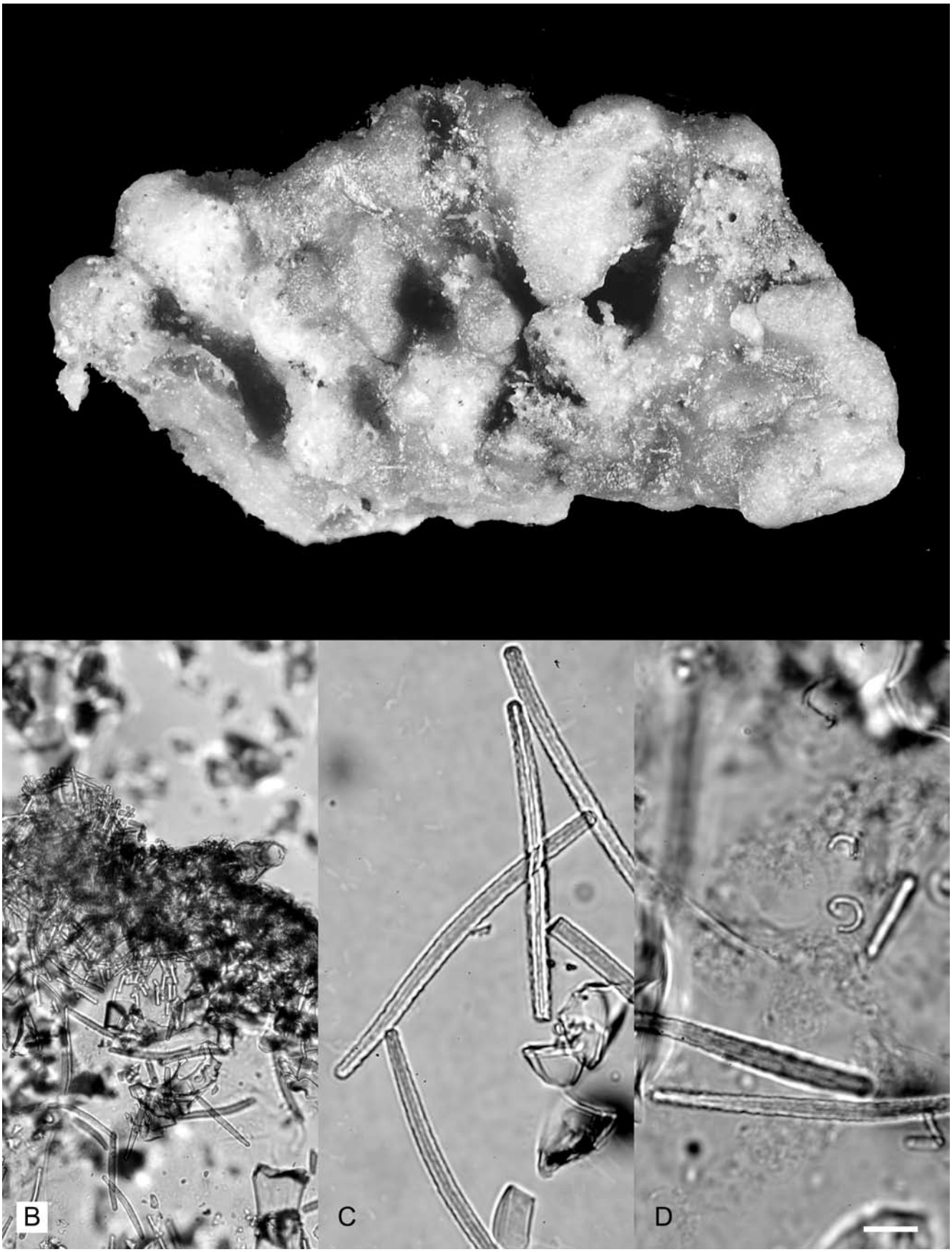


Figure 26. ***Scleritoderma flabelliformis*** Sollas, 1888.

Table 24. Spicule dimensions (μm) of *Scleritoderma flabelliformis* Sollas, 1888.

	Desmas (L) Clone (Thickness)	Acanthorhabd (L) (Thickness)	Exotyles (L)	Sigmaspires (L)
Indonesia				
(Sollas 1888)	240–500	80–90	—	10
(holotype)	39	13		
Philippines				
(Lévi & Lévi 1989)	—	60–95	160 (rare)	8–10
		5–7	2	
New Zealand	200–400	75 (60–90)	—	9–10
NIWA18369	30–45	5–7		

The rare occurrence of *S. flabelliformis* in New Zealand probably indicates the southernmost limit of this species, which is commoner in the Indo-Pacific.

KEY DIAGNOSTIC CHARACTERS:

- Massive plate with a verrucose (corrugated and nodular) upper surface.
- Presence of curved, weakly S- or C-shaped acanthorhabds with faintly bulbous (tylote) ends, and sigmaspires.

Aciculites Schmidt, 1879

Aciculites Schmidt, 1879: 29.

Cushion-shaped, with raised or tubular oscules, encrusting, or massive-columnar with blind digits; choanosomal desmas are rhizoclones with spinose zygomes; ectosomal megascleres are curved strongyles to tylostrongyles with one or both ends acanthose, arranged tangentially or paratangentially in the ectosome; microscleres absent. (Modified from Pisera and Lévi 2002b).

TYPE SPECIES: *Aciculites higginsi* Schmidt, 1879.

Aciculites pulchra Dendy, 1924 (Fig. 27, 28)

Aciculites pulchra Dendy, 1924: 315, pl. 6, fig.1–1a; Bergquist 1968: 63, fig. 30, pl. 10a.

MATERIAL EXAMINED:

NIWA Stations: E636 (NIWA18377); F993 (NIWA18372); I14 (NIWA18370); J954 (NIWA18375, NIWA25609); KAH0011/30 (NIWA18378); KAH0011/40 (NIWA18379, NIWA18380); KAH0011/41 (NIWA18381); KAH9301 (NIWA25610); KAH9907/48 (NIWA18382, NIWA18383, NIWA18384); P8 (NIWA25608, NIWA25646); RAPUHIA2-15 (NIWA25779); TAN0413/068 (NIWA25040); TAN0413/092 (NIWA18389); TAN0413/099 (NIWA18390); TAN0413/109 (NIWA18386); TAN0413/111 (NIWA18391); TAN0413/118 (NIWA18387, NIWA18388); TAN0413/170 (NIWA18385); TAN0413/173 (NIWA18392); TAN0413/174 (NIWA18393); TAN9915/3B (NIWA25528); V473 (NIWA18373); X128 (NIWA18374); Z8487 (NIWA18371); Z9041 [NIWA18376, NIWA25033]; Z9742 [NIWA18823 (0CDN6692-J)]; Z9747 (NIWA25060 (fragment of 0CDN6730-Y]); Z9890 (NIWA25616); Z9892 (NIWA25615).
NMNZ Stations: NMNZ Por. 308; NMNZ Por. 562; NMNZ Por. 563; NMNZ Por. 564; NMNZ Por. 570; NMNZ Por. 571; NMNZ Por. 573; NMNZ Por. 620.

DISTRIBUTION: West Norfolk Ridge; southern Three Kings Ridge; western continental slope, Northland; west of Pandora Bank; North Cape; Louisville Seamount Chain; Kermadec Ridge; Cavalli Seamount; Ngunguru Bay, Northland; outer Bay of Islands; off Tutukaka; Rungapapa, Tumokemoke, Mahina, and Tuatoru Knolls, west of White Island, and Mayor Island, Bay of Plenty; east of Gisborne; south of East Cape; Mahia Peninsula.

HABITAT: CRRF specimens were dredged from 'coarse sand and rubble', and 'rocky reef substrate'. The base of the sponge encrusts hard substrata. Depth range 80–1050 m.

DESCRIPTION:

Morphology vase-shaped with foliose lamellae (Fig. 27A,B), or ear-shaped with a flat lamella (Fig. 27C, D).

Dimensions 50–200 mm wide, 10–15 mm thick, up to 30 mm at the base of some specimens.

Texture stony.

Surfaces sharply differentiated; the exhalent surface, usually the concave surface, is smooth and crowded with numerous regularly dispersed low hemispherical oscular projections c. 0.5 mm high; the other (inhalent) surface is smooth, granular, and irregular growth rings may be visible.

Colour in life — reddish-brown exterior (9E6) and

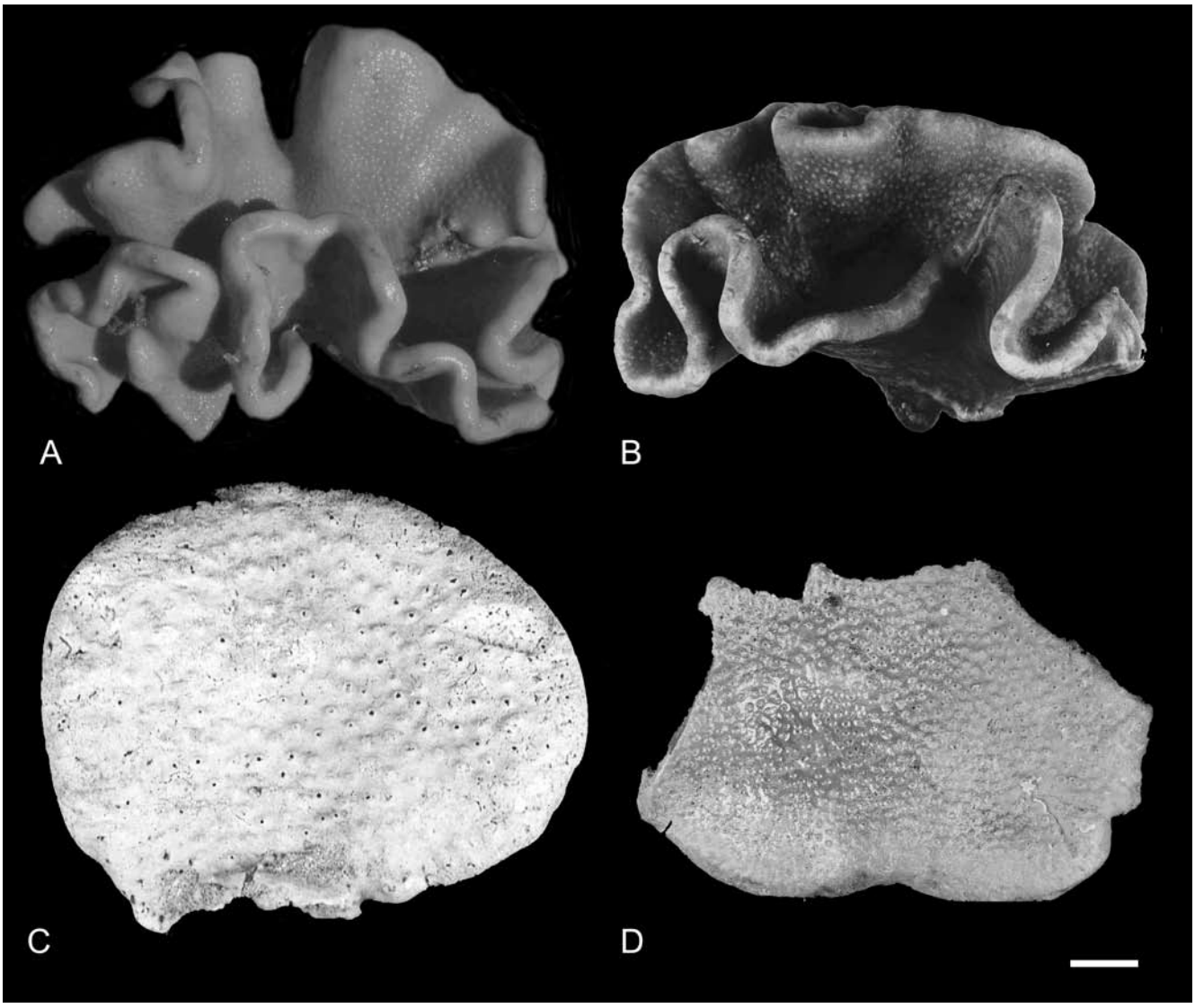


Figure 27. ***Aciculites pulchra*** Dendy, 1924.

pinkish interior (9B4); in preservative light brown.

Choanosomal skeleton a dense reticulation of rhizoclone desmas (Fig. 28B); these are less complex in the outer choanosome of both surfaces.

Ectosomal skeleton on the inhalent surface consists of radially arranged tylostrongyles that arise from a region of maturing desmas (Fig. 28A). On the exhalent surface these megascleres gradually become obliquely and then tangentially layered around the curved margin of the lamella where tylostrongyles form a thick tangential layer over the exhalent surface.

Table 25. Spicule dimensions (μm) of *Aciculites pulchra* Dendy, 1924.

	Desmas (L)	Tylostrongyles (L) Clone (Thickness)	Diactines (L) Thickness
New Zealand			
Dendy (1924)	340	340	—
(holotype)	—	12	
Bergquist (1968)	361 (300–387)	368 (314–411)	566 (510–663)
		10 (6–13)	23-30
NIWA18371	210–300	285 (200–400)	—
	20–30	7–13	
NIWA18372	300–400	440 (300–580)	—
	20–30	5–10	

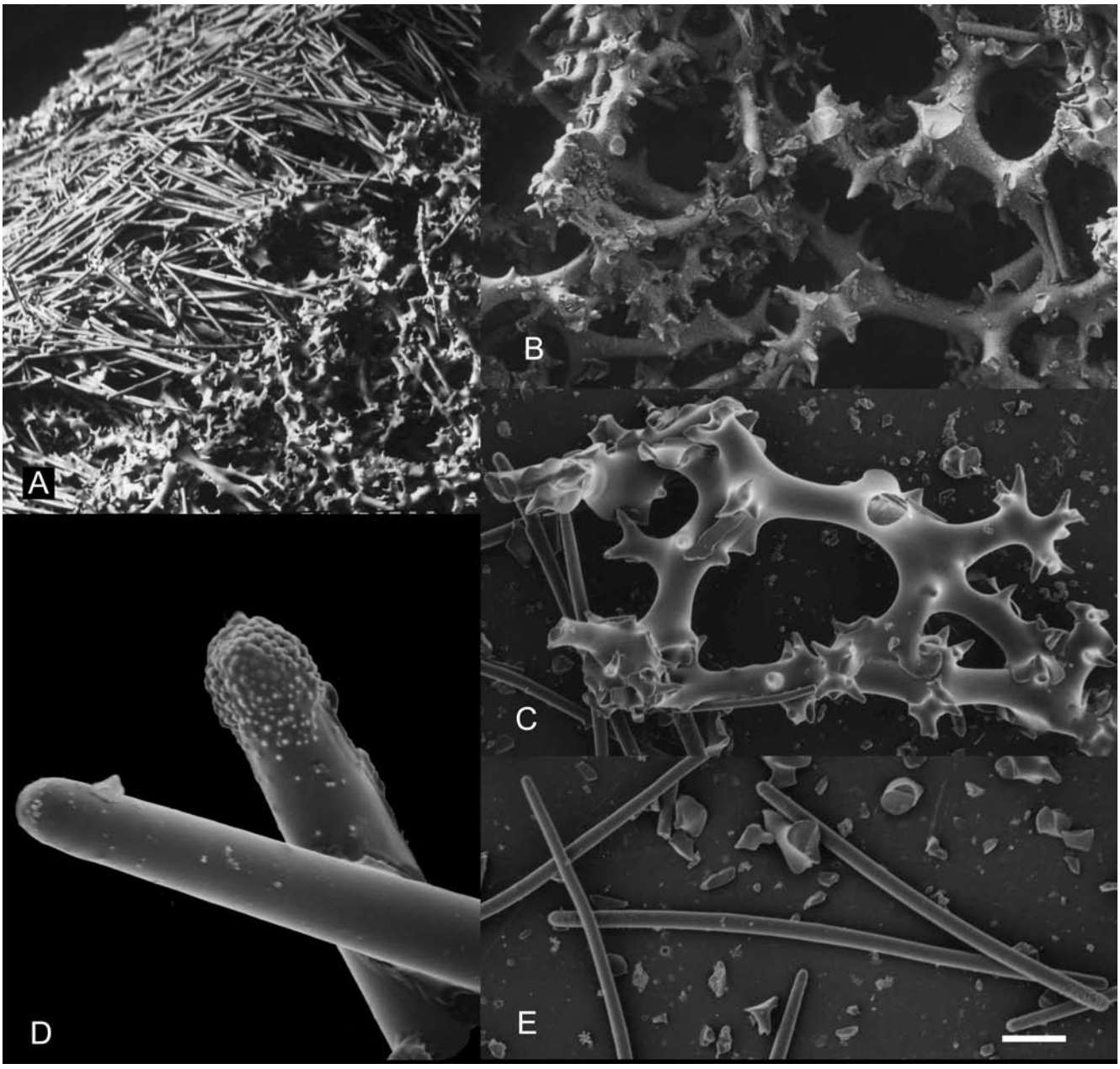


Figure 28. ***Aciculites pulchra*** Dendy, 1924.

Megascleres — thorny rhizoclone desmas (Table 25; Fig. 28A–C) with long crepi, terminating in 1- to 3-spined cladi, spines single or bifurcate; zygosis is lateral and terminal and may involve the spinose projections (Fig. 28C); tylostrongyles (Fig. 28D,E) ('rhabdi' of Dendy 1924: 316), curved or straight with slightly tylote acanthose proximal head and smooth strongylote distal terminus. Most megascleres are strongylote with one end acanthose.

Microscleres absent.

Remarks: Bergquist (1968) found large stout 'oxeas' in addition to the typical tylostrongyles in specimens off Mahia Peninsula. These oxeas were described as being radially disposed and arranged singly or in groups of up to four just below the oscular surface. Occasional spicules fitting this description were found in a new spicule preparation of Bergquist's specimen. However, large 'true' oxea were not described from Dendy's holotype and have not been found in any of the specimens examined in this study.

There is considerable variation in the dimensions and morphology of the tylostrongyles; in Bergquist's Mahia specimen, the tylostrongyles are markedly tylote, almost bulbous at the proximal end, and faintly tylote hammer-like at the distal end. In some specimens

oxeote diactines have been found but they are rare and probably derived from the tylostrongyle megasclere; they are syringe-like with a thick hollow inception channel, and one or both ends are slightly sinuous and elongate-fusiform. Some also have faintly tylote ends. These "diactines" are no longer than the tylostrongyles. Some specimens have tylostrongyles that taper distally to an oxeote point and it may be these that were seen in Bergquist's specimen.

The spiculation of this species is thus quite variable. However, the vase-like morphology with raised oscules, coupled with the presence of a range of tylostrongyles (dimensions and morphology) is diagnostic.

Aciculites pulchra Dendy is almost identical morphologically to the Indo-Pacific *A. ciliata* Wilson, 1925 with reddish-brown colouration, a vase-like foliose or ear-shaped lamella, and raised oscular projections on the exhalant surface. Examination of numerous specimens from the Philippines and Papua New Guinea (courtesy of CRRF) reveal that the tylostrongyles in *A. ciliata* are much longer (up to 540 μm long) and are irregularly bulbous at one end, however. The spicules also taper to a fine blunt distal point. This species also possesses much longer fine tylostrongyles that resemble oxeas, up to 850 μm long; these are radially arranged along the inhalant surface. The outer choanosome in *A. ciliata* Wilson is highly cavernous with elongate immature desma.

KEY DIAGNOSTIC CHARACTERS:

- Vase- or ear-shaped lamella with differentiated surfaces.
- Reddish-brown colouration.
- Presence of tylostrongyles with one end roughened.
- Could be mistaken for *Neoscrammeniella fulvodesmus* but that species does not have raised oscules.

Aciculites manawatawhi n. sp. (Fig. 29)

MATERIAL EXAMINED**:**

Type material: Holotype BMNH 2005.9.15.1 from NIWA Station Z9747 [fragment of 0CDN6740-L]; paratype NIWA18394 from NIWA Stn J953.
NIWA Station: P14 (NIWA25623).
NMNZ Station: NMNZ Por. 583.

TYPE LOCALITY: West of Pandora Bank, northwestern New Zealand.

DISTRIBUTION: West Norfolk Ridge; west of Pandora Bank, and Middlesex Bank, northwest of Three Kings Islands; western continental slope, northeastern New Zealand.

HABITAT: Coarse sandy rubble. Depth range 198–319 m.

DESCRIPTION:

Morphology tree-like with one or more thick, sometimes hollow columns fused along the stem or above where the digits emerge; stem circular in profile or flanged if more than one stem is present (Fig. 29A). Some specimens present a more columnar shape (Fig. 29B). The stem flares and gives rise to numerous branches that may be hollow at the base, each diverging to form one or more smaller branches. These terminate in a rounded or pointed blind tip (Fig. 29C). The overall impression is of an irregular squat tree with an irregularly truncate top that is compressed in one plane. Oscules are not apparent, although there are soft areas at the tips of the sponge that may function as exhalant areas.

Dimensions of the holotype are 100 mm wide at the apex, 50 mm thick, 70 mm tall, and 50 mm wide at the base. NMNZ Por. 583 is 85 mm wide at the apex, 60 mm thick, 110 mm tall, and 30 mm wide at the base. Secondary branches are c. 15 mm thick, smaller branches c. 5–10 mm thick.

Texture of the stem and lower branches is stony, tips are fragile and soft.

Surface granular, rough, encrusted by numerous epizoites including other sponges, bryozoans, and tubeworms (Fig. 29A).

Colour in life dark grayish-blue (20E4), in preservative light golden brown (5B7). Tips of branches are paler than the digits of the apex.

Choanosomal skeleton composed of thorny rhizoclone desmas that are less complex and dense in the outer choanosome.

Ectosomal skeleton composed of tylostrongyles arranged obliquely to paratangentially over most of the body surface and radially at the growing tips of the sponge.

Megascleres (Table 26) rhizoclone desmas are elongate and arched with short clads at the ends of the desma (Fig. 29D). Ornamented with short thick bifurcate spines; overall a thick, robust spicule. Zygosis appears to be predominantly terminal. Tylostrongyles or 'oxytyles' with pronounced acanthose bulbous heads and strongylote or tylote acanthose distal ends in some spicules the proximal end is bent sharply as in a rhabdostyle (Fig. 29E).

Microscleres absent.

ETYMOLOGY: Named for the largest island in the Three Kings group, Manawa Tawhi (Great Island), the type locality. *Manawa tawhi* (New Zealand Māori) means 'heart food' (*manawa*, heart, breath, emotions), but it may mean 'the heart beckons' (*tawhi*, food, beckons) (Weno Iti & Guy Penny pers. comm.).

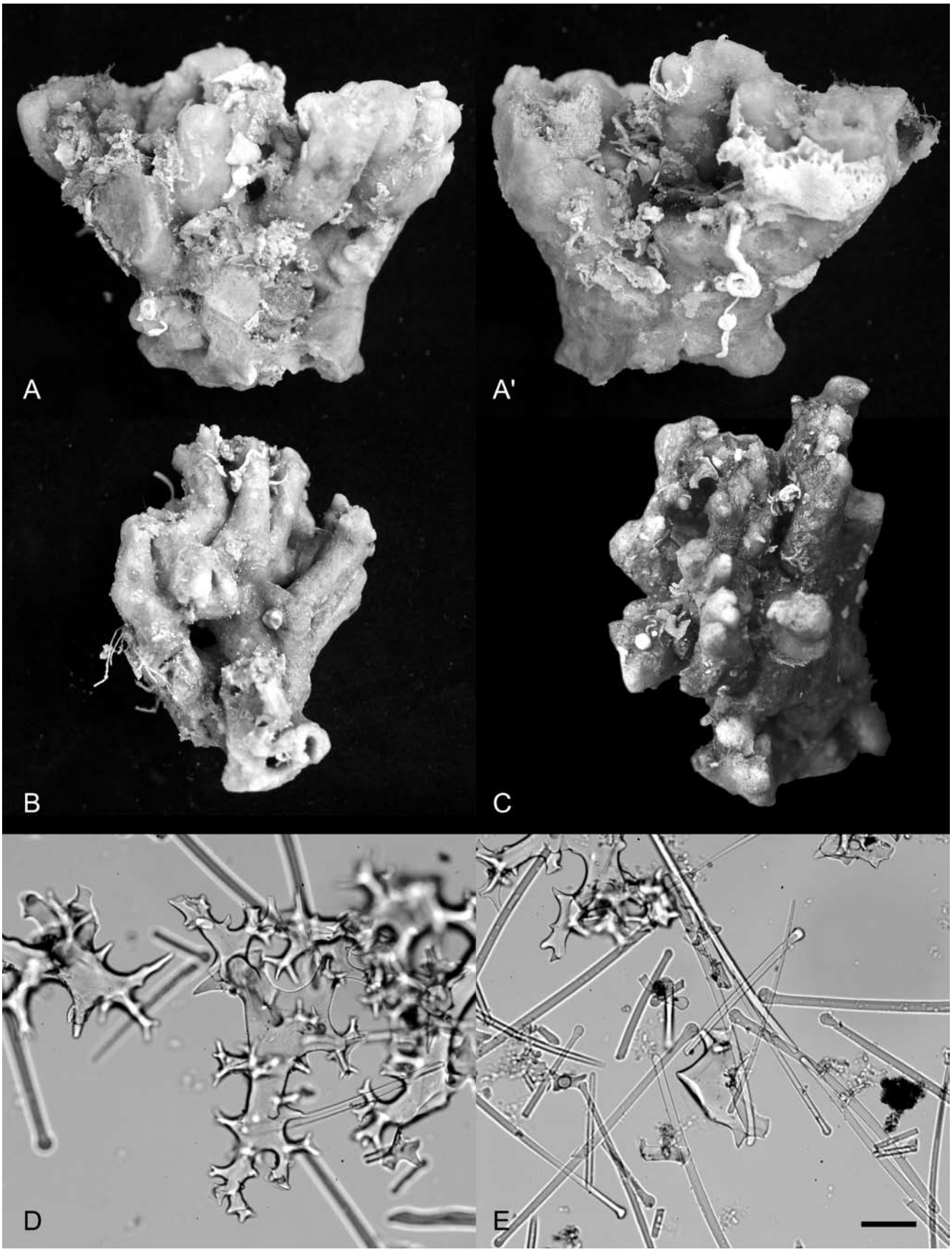


Figure 29. ***Aciculites manawatawhi*** n. sp.

Table 26. Spicule dimensions (μm) of *Aciculites manawatawhi* n. sp.

	Desmas (L) Clone (Thickness)	Oxytyles (L) Thickness
New Zealand		
BMNH 2005.9.15.1	200–400	380 (300–500)
(holotype)	30–40	8–10
NIWA18394	300–400	345 (280–430)
	50	8–12
	51	
NMNZ Por. 583	250–300	390 (340–500)
	20–40	8–10

REMARKS: *Aciculites manawatawhi* is unique in the genus in terms of gross morphology and is easily differentiated from other Indo- and Southwest Pacific species, which are ear- or cup-shaped (*A. pulchra* Dendy, 1924 from New Zealand, *A. ciliata* Wilson, 1925 from New Caledonia, and *A. tulearensis* Vacelet & Vasseur, 1965 from Madagascar) or spherical papillate masses (*A. orientalis* Dendy, 1905 from Sri Lanka and *A. papillata* Lévi & Lévi, 1983 and *A. oxytylota* Lévi & Lévi, 1983 from New Caledonia). *Aciculites spinosa* Vacelet & Vasseur, 1971, also from Madagascar, forms tiny cushions and is found in deep reef tunnels and caves.

The oxytyles of *A. manawatawhi* are also quite different from those in other species with their bulbous acanthose heads, but similar to those of *A. oxytylota* Levi & Levi, 1983 from New Caledonia. Like *A. manawatawhi*, *A. oxytylota* also has tubular surface features, but these arise from a cushion base while *A. manawatawhi* is columnar with blind digits.

Levi and Levi (1983) compared A. *oxytylota* to the genus *Siphonidium* (Siphonidiidae), specifically with *S. capitatum* Sollas, 1888 from Indonesia, as it also has tubular oscules, but this species is columnar, and more similar, in fact, to *A. manawatawhi*. However, in addition to the similarly shaped 'oxytylotes' (Sollas 1888), *S. capitatum* has distinctive planar ectosomal desmas, and the oxytyles are exotylote in arrangement — the spicule lies perpendicular to the sponge surface with the tylote head facing outwards and the oxeote end pointing into the interior (Sollas 1888). *Aciculites manawatawhi* and *A. oxytylota* have an irregular but distinct layer of oxytyles that are strewn tangentially and paratangentially in the surface. This layer is not as thick or distinct as in *A. pulchra*, for example, but it is definitely present and the arrangement is certainly not exotylote.

Aciculites manawatawhi and *A. oxytylota* can also be compared the siphonidiid *Gastrophanella,* but this genus also has exotyles [the acanthose subtylostyles and tylostrongyles protrude 'head-first' through the surface, an architecture that is well described by Pisera and Levi (2002f) and Muricy and Minervino (2000)], which do not form a tangential layer, and the species typically forms club-shaped columns with a deep broad cavity. Pisera and Levi (2002f) noted that *Gastrophanella* also has long smooth styles and long oxeas, absent from *A. manawatawhi* and *A. oxytylota*. The diagnosis of *Aciculites* has been expanded to include species with oxytylotes in a paratangential layer.

It is clear that the dimensions of tylostrongyles and desmas cannot be used as a species-level differentiator in *Aciculites* as the lengths of these spicules in the different species are very similar, ranging from about 200–500μm, and the full range often present in some species. (A notable exception is *A. spinosa*, which has quite small tylostrongyles ranging from 125 to 275 μm.) The shape of the tylostrongyle appears to be more diagnostic; *A. oxytylota* and *A. manawatawhi* have oxytyles with pronounced bulbous heads, but the latter species has tylote bulbs on both ends of many spicules. The proximal end is also frequently sharply bent in the shape of a rhabdostyle. This new species is also notable for the large overall size of these megascleres.

While some authors recognise oxea-like spicules in some species, others appear to lack a second megasclere category. Perhaps a more careful study of all species will reveal anatomically differentiated categories.

KEY DIAGNOSTIC CHARECTERS:

- Tree-like morphology with small finger-like branches of uneven length, surface covered in epizoites.
- Deep bluish-gray on the main body, paler branch tips.
- Long tylostrongyles with pronounced bulbous heads.

Aciculites sulcus n. sp. (Fig. 30)

MATERIAL EXAMINED**:**

Type material: Holotype NIWA18395 from NIWA Stn KAH9907/48; paratype NIWA18821 from NIWA Stn Z9748.
NIWA Stations: I372 (NIWA25648); RAPUHIA2-15 (NIWA25778).

TYPE LOCALITY: North Cape and Doubtless Bay; west of White Island, Bay of Plenty.

DISTRIBUTION: Bay of Plenty.

HABITAT: Encrusting rocky substrata. Depth range 211–250 m.

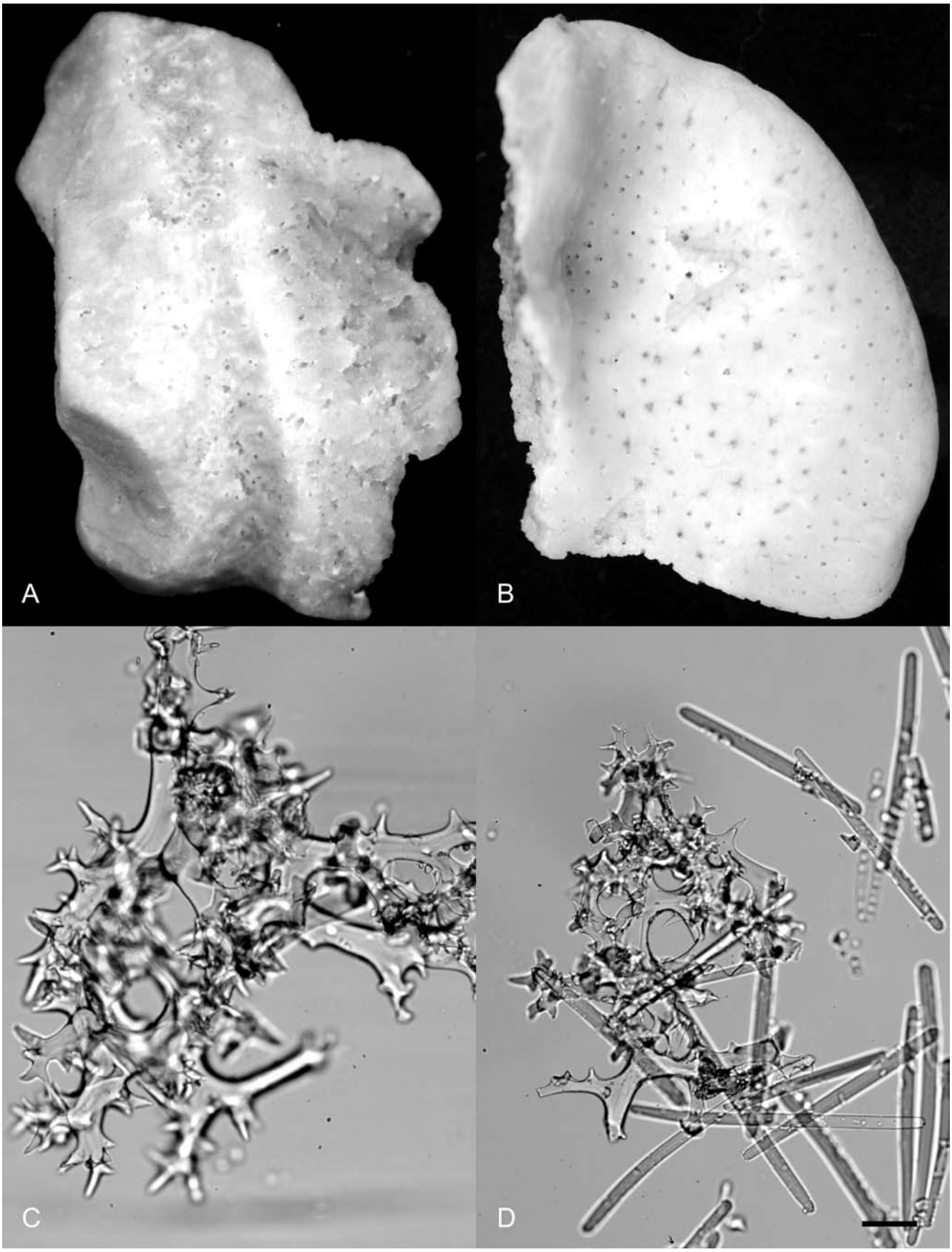


Figure 30. ***Aciculites sulcus*** n. sp.

DESCRIPTION:

Morphology of holotype an encrusting arched elongate-ectangular 'tongue' attached to the substratumlong one half of the base (Fig. 30A). Arching along the longest axis of the upper surface of the sponge is a deep furrow that contains abundant, regularly dispersed, slightly raised, oscules that are c. 0.5 mm diameter. On one side of the 'tongue' is a semicircular indentation that resembles a smooth window that is permeated by numerous tiny pores or inhalant ostia. The paratype is a fragment of a thick ear-haped semicircular plate (Fig. 30B).

Dimensions 35 mm long, 23 mm at widest point, 15 mm at the extremities of the sponge, arched 13 mm high in the centre of the sponge, tapering to about 5 mm at each end of the sponge. Furrow is 3–7 mm wide and 1–5 mm deep. Inhalant cavity indented c. 5 mm.

Texture stony, inner surface of furrow and lateral indentation flakey.

Surface smooth, granular.

Colour of putty (4B2) in life and in preservative.

Choanosomal skeleton mass of relatively delicate rhizoclone desmas.

Ectosomal skeleton of anisostrongyles, arranged obliquely to paratangentially within the upper surface furrow and obliquely between the ostia on the surface of the lateral inhalant cavity.

Megascleres comparatively small, delicate rhizoclone desmas (Table 27; Fig. 30C,D) with short bifurcate spines and relatively thin clones. Diactinal megascleres are acanthose anisostrongyles, slightly thinner on the distal end than the proximal end, both ends acanthose, proximal end may be occasionally slightly tylote (Fig. 30D). These megascleres are frequently quite sharply bent in the middle of the spicule and often have a tylote bulge midway along the spicule.

Microscleres absent.

Table 27. Spicule dimensions (μm) of *Aciculites sulcus* n. sp.

	Desmas (L) Clone (Thickness)	Anisostrongyles (L) Thickness
New Zealand		
NIWA18395 (holotype)	150–200 20	228 (210–310) 10–12
NIWA18821 (paratype)	180–200 25	300 (210–400) 15

ETYMOLOGY: Named for the specialised exhalant oscular furrow that runs along the surface of the sponge (Latin, *sulcus*).

REMARKS: *Aciculites sulcus* differs in gross morphology and spiculation from other Indo- and Southwest Pacific species of *Aciculites* in that it is cushion-shaped, with depressed inhalant trough-shaped semicircular inhalant areas. In general, the morphology of this new species is quite similar to that of *A. orientalis* Dendy, 1905, which forms a massive, compact cushion-shaped irregular plate that is attached to calcareous substrata on a broad base. However, unlike *A. sulcus*, which presents specialised aquiferous areas, the upper surface of *A. orientalis* is flakey with oscules and ostia scattered over a slightly corrugated surface (Dendy 1905). Ear-shaped specimens are clearly differentiated from *A. pulchra* Dendy by the absence of raised pimple-like oscules.

Aciculites sulcus is more similar to *A. spinosa* Vacelet & Vasseur, 1971, a cushion-shaped sponge with specialised inhalant areas, but these are circular and the overall sponge is extremely small (5 mm diameter, 2–3 mm thick), and the tylostrongyles are much smaller (125–275 μm long, 7–10 μm thick) and acanthose along the entire spicule.

KEY DIAGNOSTIC CHARACTERS:

- Small, thick, arched ear.
- Specialised exhalant furrow along sponge surface.
- Specialised semicircular inhalant depression on side of sponge.
- Flush oscules.

Family **AZORICIDAE** Sollas, 1888

Azoricidae Sollas, 1888: 319; Leiodermatidae Lendenfeld, 1903: 145.

Foliose vase-shaped or massive conical sponges with strongly spined rhizoclones; surface diactines may emerge beyond sponge surface; microscleres, if present, are raphides. (After Pisera and Lévi 2002h).

REMARKS: Azoricidae Sollas, 1888 is based on very few characters and the family contains only two valid genera, recently reviewed by Pisera and Lévi (2002h). Species of *Leiodermatium* Schmidt, 1870 have only desmas and diactinal megascleres, and the single known species of *Jereicopsis* Lévi & Lévi, 1983 has raphide microscleres in addition to desmas and diactines. The type and ornamentation of rhizoclones and the presence of diactinal megascleres suggests a relationship with *Microscleroderma* in particular (Scleritodermidae) and this arrangement is supported by 18S rDNA sequence analysis (Kelly-Borges & Pomponi 1994). Pisera and Lévi (2002h), however, concluded that, although there are similarities, the absence of ectosomal rhabds and microscleres in *Leiodermatium* and the presence of raphides in *Jereicopsis* distinguish the groups.

Leiodermatium Schmidt, 1870

Leiodermatium Schmidt, 1870: 22; Sollas 1888: 352; Wilson 1925: 465; Pisera & Lévi 2002h: 353.
Azorica Carter, 1873: 439.
Heterophymia Pomel, 1872: 143.

Plate-like, ear-shaped, foliose, or vase-shaped with smooth faintly hispid surface; oscules may be visible. Desmas are strongly spined rhizoclones; there are no special ectosomal spicules and no microscleres. Accessory megascleres are whip-like diactines. (Modified from Pisera and Lévi 2002h).

TYPE SPECIES: *Leiodermatium lynceus* Schmidt, 1870.

REMARKS: The genus *Leiodermatium* is best known from the type species *Leiodermatium lynceus* Schmidt, 1870 (Atlantic) and *L. pfeifferae* (Carter, 1873) and variants (Atlantic, Southeast Asia), with additional data being provided by much Pacific material (Sollas 1888; Wilson 1925).

With relatively few characters available to differentiate *Leiodermatium* at the species level, the discovery of two new Southwest Pacific taxa — *L. linea* n. sp. from New Zealand and *L. dampieri* n. sp. from the Lord Howe Seamount Chain — has provided an opportunity to examine here the genus as a whole. This revision has resulted in the recognition of Southeast Asian specimens of *Leiodermatium pfeifferae* [Sollas's (1888) morphotype '*Azorica pfeifferae intermedia*' and *Leiodermatium pfeifferae sensu* Wilson (1925)] as *L. intermedia* n. comb., and in the recognition of a new taxon from Micronesia and the west central pacific, *L. colini* n. sp.

Leiodermatium intermedia (Sollas, 1888)

(Fig. 31)

Azorica pfeifferae intermedia Sollas, 1888: 319, pl. 36, figs 1–29.
Leiodermatium pfeifferae: Wilson 1925: 465, pl. 43, figs 4, 8, pl. 51, figs 4–7; Lendenfeld 1903: 148.

MATERIAL EXAMINED**:**

Type material: Holotype USNM21321 of *Leiodermatium pfeifferae* (Carter, 1873) and *L. pfeifferae* f. *striata* Wilson, 1925; tangential and vertical sections; paratype BMNH 2005.9.15.2, west side of Uchelbeluu Reef, Mutremdiu, Koror, Palau, Micronesia (07°16.27′ N, 134°31.37′ E), collected by Patrick L. Colin, Coral Reef Research Foundation (Manned submersible *Deep Worker 2000*), 21 March 2001, 240 m [fragment of 0CDN7878-W].

TYPE LOCALITY: Ambon Island, Moluccas, Indonesia, 27–46 m (Sollas 1888).

DISTRIBUTION: Patinti Strait between Halmahera and Bacan Islands, Moluccas, Indonesia; Banda Sea; Palau, Micronesia.

HABITAT: Sand and coral boulder slopes. Depth range 27–46 m (Sollas 1888); 375 m (Wilson 1925); 240 m (Palau).

DESCRIPTION:

Morphology a convoluted mass of thin flaring folded lamellae that may form tubes, with rounded incised margins (Wilson 1925; Sollas, 1888) (Fig. 31A,B). The external surface of the Palau specimen BMNH 2005.9.15.2 [0CDN 7878-W] has patches of tiny (< 0.5 mm diameter) ostial pits and the inner surface is completely covered in regularly and closely distributed oscules (< 0.5 mm diameter). Cup margin in all specimens is thick and rounded, sometimes indented or incised.

Dimensions of Patinti Strait specimens 50–90 mm high, 70–130 mm wide, cup wall 0.5–2.5 mm thick (Wilson 1925); Ambon specimen 77 mm high, 110 mm wide, lamellae 3.2–4.0 mm thick (Sollas 1888); Palau specimen forms a mass c. 500 mm diameter, wall 2.5 mm thick.

Texture stony, dense.

Surface smooth and granular with low irregular horizontal ridges, internal osculiferous surface slightly furry with brishes of projecting diactines.

Colour tan (Palau); topaz (5C5) to putty-like (4B2).

Skeleton of thorny rhizoclone desmas dominate the choanosome and fine diactinal spicules project from the ectosome. Diactines are longer on the margin.

Megascleres (Table 28) rhizoclone desmas (Fig. 31C,D) with a straight or curved axis, clones with dis-

Table 28. Spicule dimensions (μm) of *Leiodermatium intermedia* (Sollas, 1888).

	Desmas (LxW) Clone (Thickness)	Diactines (L) Thickness
Moluccas, Indonesia		
L. pfeifferae sensu Wilson 1925		
USNM 21321	340	(1) 350–420
(holotype)	35	(2) ? 6
Azorica pfeifferae	160–350	(1) ?
intermedia Sollas, 1888	20–25	(2) 750 8
Palau, Micronesia		
BMNH 2005.9.15.2	340–500(linear forms)	(1) 240–500
(paratype)	35	(2) >1000 1–8

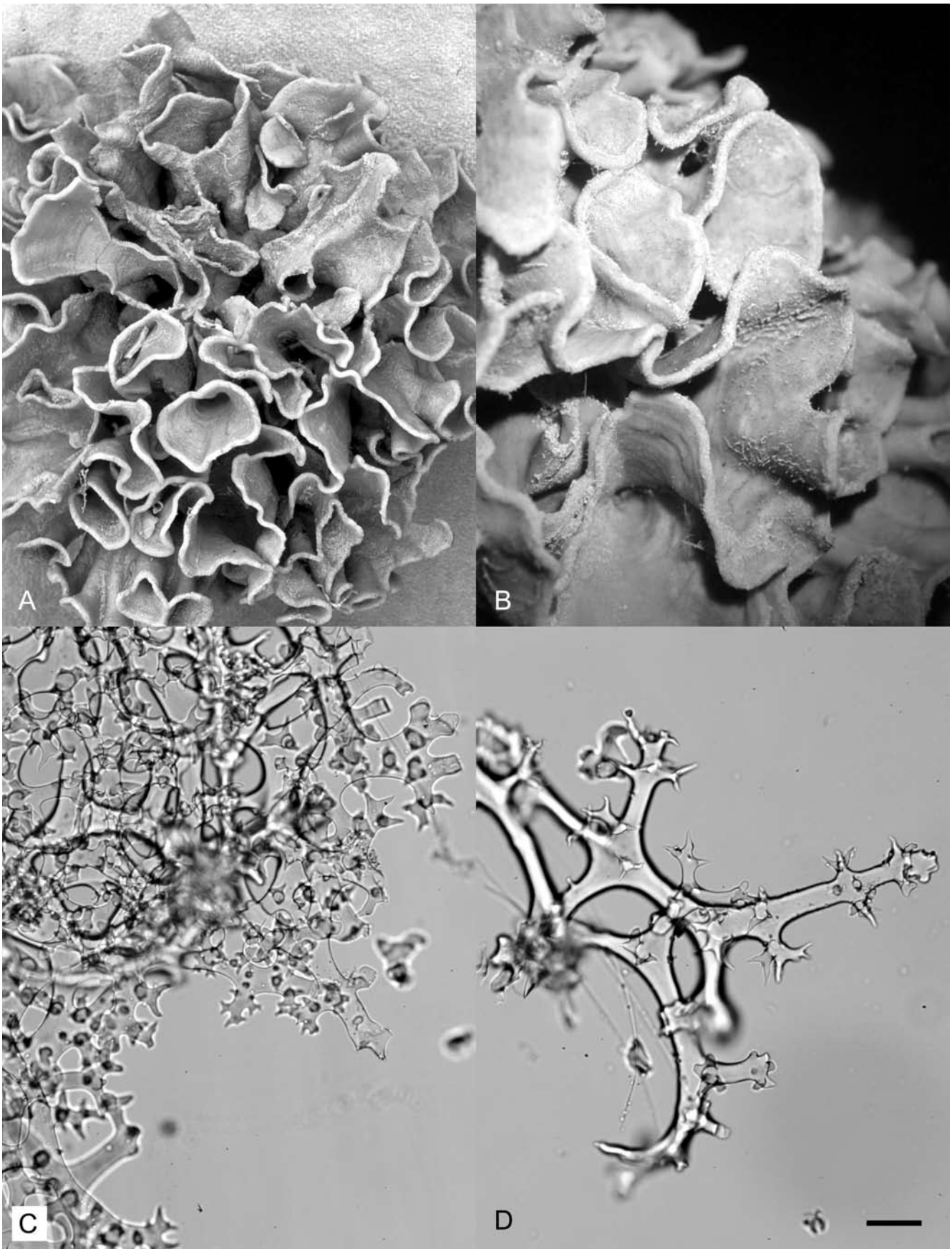


Figure 31. ***Leiodermatium villosa*** n. sp.

crete single or bifurcate spines, the tips of which are often bifid, sinuous, or dendritic. On the outer surface of the sponge the rhizoclones are smaller and more intricate, slightly flattened and with numerous short blunt spines. Diactines (Fig. 31D) in two size categories, the smallest are fine and hair-like, confined to osculiferous face of sponge, whereas thicker longer spicules are confined to the margin of the sponge.

Microscleres absent.

Remarks: *Leiodermatium pfeifferae* Carter, 1873 was first described from Portugal in the northern Atlantic Ocean, from 684 m. Carter (1876) considered *L. pfeifferae* to be very similar to the type species *L. lynceus* Schmidt, 1870, also from Portugal, but upheld the separation of his new species because of the presence of oscules on the outside of the lamellae rather than on the inside, as in *L. pfeifferae* and most other planar sponges. Moreover, Carter (1876) considered the differences in the distribution of the fine diactines (abundant and restricted to the margin of *L. pfeifferae* as a fringe, as opposed to "isolated diactines around the margin of *L. lynceus*") to be significant and thus diagnostic for the two species (Table 29). A recent illustration of *L. lynceus* by Pisera and Lévi (2002h) shows blunt denticulate spines on the desmas whereas Sollas (1888) described the desmas as terminating in bifurcate spines with bifid rounded ends. The ornamentation of these termini is clearly an important diagnostic indicator of species differences (as in other lithistid genera) and careful comparison of the ornamentation and morphology of the desmas using SEM is required to confirm or otherwise the integrity of *L. pfeifferae* and *L. lynceus*.

Sollas (1888) assigned to *L. pfeifferae* a range of specimens collected by H.M.S. *Challenger* (1873–1876) from various Atlantic localities including Bermuda (795 and 1965 m), Cape Verde Islands (183–234 m), and Brazil (no depth given), but his description of the species (Sollas 1888: 320) was based on a specimen collected off Ambon Island in the Moluccas Archipelago, Indonesia (Table 29). This was the only specimen found to be in the living state upon collection, and Sollas's description was based upon this specimen. All of the Atlantic specimens were dead and denuded skeletons when collected.

Sollas (1888, p. 322) recognised differences among the Atlantic specimens and between those and the Indonesian specimen. Within the Atlantic complex he recognised at least three morphological 'groups' (Table 29) that included (1) '*Azorica pfeifferae*' — sponges with comparatively thick walls, large marginate oscules, and slender smooth desmas (the holotype specimen of the type species and a specimen from the Cape Verde Islands); (2) '*Azorica pfeifferae tenui-laminaris*' — sponges with comparatively thin walls, small closely spaced oscules, and slender smooth desmas (specimens from Bahia); (3) '*Azorica pfeifferae tenui-laminaris osculis disjunctis*' — sponges with comparatively thin walls, small remotely distributed oscules confined to the sponge margin (specimen from Bermuda); and this was differentiated quite clearly from (4) '*Azorica pfeifferae intermedia*' — sponges with relatively thick walls, small closely spaced oscules, and thick, highly tuberculate desmas (specimen from Ambon Island, Indonesia). While revision of these Atlantic specimens is beyond the scope of this work, it appears that the major differences described are within the range of characters expected from sponges collected from widespread locations. Whether or not the species name *pfeifferae* can be applied to these specimens or not will be largely dependent on the ornamentation of the desmas as other details such as the distribution of the diactines are lost.

Wilson (1925) also attributed several specimens from the 375 m in Patinti Strait, Moluccas, to *L. pfeifferae*, and these are very similar to the *Challenger* specimen from nearby Ambon Island.

A specimen collected more recently from Palau (240 m), by the Coral Reef Research Foundation (Table 29), is very similar to Wilson's and Sollas's Indonesian material.

All of the above Southeast Asian sponges are united in the possession of a relatively thin-walled foliose habit, diactines on all surfaces including the sponge margin, and large richly tuberculate desmas with thick clones. They are clearly separate morphologically and biogeographically from Atlantic *L. pfeifferae*, and are segregated here as *L. intermedia* by raising Sollas's (1888) "variety" to full species. Interestingly, this species is the only known source of two new selectively cytotoxic macrocyclic lactones, and these are the first secondary metabolites reported in the literature to date (Sandler *et al*. 2006).

Key diagnostic characters:

- Convoluted mass of thin, flaring, folded lamellae that may form tubes.
- Oscules and ostia inconspicuous.
- Sponge surface slightly furry.
- Rhizoclones are relatively smooth with numerous discrete bifurcate, bifid, dendritic spines.

Table 29 *(below and opposite)***.** Comparison of *Leiodermatium* from Atlantic, Southeast Asian, Micronesian, west Central Pacific, and Southwest Pacific waters.

Species	Locality and depth	Gross morphology	Wall thickness	Surface	Texture	Desma morphology and size	Diactines — distribution and size
West Central and North Atlantic							
***Leiodermatium lynceus* Schmidt, 1870**							
Type species	Portugal and St Iago (Carter 1876)	Ear-shaped or hollow cylinder with a deep incision in margin	3–4 mm	Oscules large (500–750 µm) and elevated on exterior margin	Stony	Smooth with long branched spines and multidentate tips (180–300 µm)	190–230 µm, wispy thin (8 µm), isolated on margin (Schmidt 1870)
***Leiodermatium pfeifferae* (Carter, 1873)**							
Azorica pfeifferae Carter, 1873 Holotype	Madeira, Portugal, off Cape St Vincent, 684 m	Stalked vase with highly infolded wall	5 mm	Oscules small, remotely distributed	Stony	Slender and smooth	c. 1785 µm, wispy, thin (8 µm), restricted to the margin forming a fringe
Azorica pfeifferae: Sollas 1888	Porta Praya, St Iago, Cape Verde Islands, 183–234 m	Thin plate with infolded margin	Comparatively thick (5 mm)	Oscules large and marginate	Stony	Slender and smooth	Unknown (specimen deciduous)
Azorica pfeifferae tenuilaminaris Sollas, 1888	Bahia, depth unknown	Lamella?	Comparatively thin (3 mm)	Oscules small and closely distributed	Stony	Slender and smooth	Unknown (specimen deciduous)
Azorica pfeifferae tenuilaminaris osculis disjunctis Sollas, 1888	Bermuda, 795–1965 m	Lamella?	Comparatively thin (3 mm)	Oscules small, marginate, remotely distributed	Stony	Slender and smooth	Unknown (specimen deciduous)
Southeast Asia and Micronesia							
***Leiodermatium intermedia* (Sollas, 1888)**							
Azorica pfeifferae intermedia Sollas, 1888	Ambon Island, Moluccas, Indonesia, 27–46 m	Thin highly folded plate with rounded margin	3.2–4.0 mm	Oscules small and closely distributed	Stony	160–350/20–25 µm wide, richly tuberculate; spines are bifurcate with rounded ends	750/8 µm marginate; no mention of smaller diactines but notes a generally hispid surface.
L. pfeifferae sensu Wilson (1925)	Patinti Strait, Moluccas, Indonesia, 375 m	Conical, cup-shaped and lamellate	0.5–2.5 mm	Oscules and ostia inconspicuous	Stony	340/35 µm, smooth clones, termini richly tuberculate with single, bifurcate and bidentate tips	350-420/3–6 µm, covering both surfaces, but more abundant on concave surfaces
BMNH 2005.9.15.2	Palau, 240 m	Vase/tube-forming, frilly	2.5 mm	Oscules and ostia inconspicuous	Stony	340/35 µm, smooth clones, termini richly tuberculate with single, bifurcate and bidentate tips	240–500 µm, covering both surfaces, but more abundant on concave surface; marginate diactines > 1000 µm

Table 29. *(continued)*

Species	Locality and depth	Gross morphology	Wall thickness	Surface	Texture	Desma morphology and size	Diactines — distribution and size
Micronesia and West Central Pacific							
***Leiodermatium colini* n. sp.**							
BMNH 2005.3.14.2 BMNH 2005.3.14.1	Found in holes in reef near Blue Corner, 28–31 m, West Barrier Reef, Palau, Micronesia	Ear- or shallow vase-shaped with occasional undulations in lamella; surface and margin shaggy	8–10 mm	Oscules and ostia inconspicuous, the latter in meandering grooves	Stony	100–300/50–100 µm, small desmas with thick clones and short irregular solitary spines	Very long diactines (> 2000 µm) extending in tufts from the margin, smaller (250–500 µm) finer diactines cover osculiferous surface only
BMNH 2005.3.14.3 BMNH 2005.3.14.4	Robert's Reef, Kimbe Bay, West New Britain, Papua New Guinea, under overhang, 18–46 m	As above	6–8 mm				
Southwest Pacific and New Zealand							
***Leiodermatium linea* n. sp.**							
	Bay of Plenty, New Zealand, 232–302 m	Frilled cup (no peduncle)	3–4 mm	Oscules and ostia inconspicuous, aligned in parallel or circular channels	Stony, slightly flexible in plane of lamella	Small desmas (120–200)/20 µm; discrete long single or bifurcate spines with bifid or trifid tips	Fine hair-like diactines (250–300 µm)
***Leiodermatium dampieri* n. sp.**							
	Dampier Ridge, Lord Howe Seamount Chain, 420 m	Chalice- to cup- shaped with a short peduncle	2.5–4 mm	Oscules and ostia inconspicuous; ostial pits on some parts of the outer surface	Stony	250-350/20–30 µm, smooth clones, termini richly tuberculate with single, bifurcate and bidentate tips	300–450 µm, covering both surfaces, but more abundant on concave surface; marginate diactines 675 µm

Leiodermatium colini n. sp. (Fig. 32)

MATERIAL EXAMINED**:**

Type material: Holotype BMNH 2005.3.14.1, cave off Blue Hole Caverns, West Barrier Reef, Palau, Micronesia, 07º08.10′ N, 134º13.90′ E, 22 May 2000, 28 m [fragment of 0CDN7069-S]; paratype BMNH 2005.3.14.2, cave off Blue Hole Caverns, West Barrier Reef, Palau, Micronesia, 07º08.10′ N, 134º13.90′ E, 26 June 1997, 31 m [fragment of 0CDN5026-W]; paratype BMNH 2005.3.14.3, Robert's Reef, Kimbe Bay, West New Britain, Papua New Guinea, 05º25.66′ S, 150º22.65′ E, 17 November 1992, 18 m [fragment of 0CDN0779-G]; paratype BMNH 2005.3.14.4, Nomundo Reef, Kimbe Bay, West New Britain, Papua New Guinea, 05º27.64 S, 150º06.28′ E, 5 July 2003, 46 m [fragment of 0CDN9062-K]. All specimens collected by P.L. Colin, Coral Reef Research Foundation, by SCUBA.

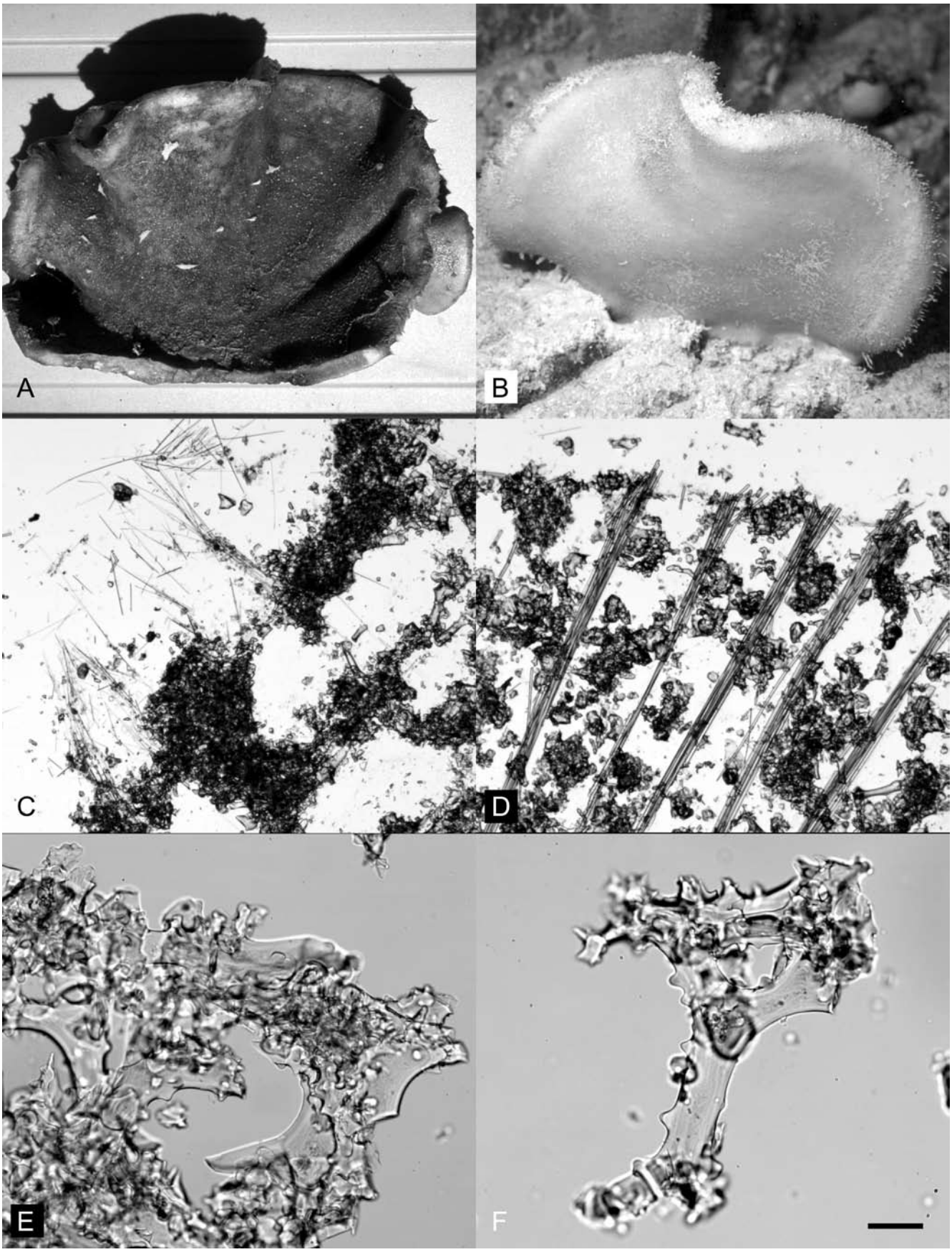


Figure 32. ***Leiodermatium colini*** n. sp.

DISTRIBUTION: West New Britain (18–46 m), Papua New Guinea; Palau (28–31 m), Micronesia.

HABITAT: Found on hard bottom in the entrances or interiors of submarine caves or attached to coral rock on moderately silty, steep reef slope with overhangs, all on fore-reefs experiencing oceanic conditions, 18–46 m; BMNH 2005.3.14.2 and BMNH 2005.3.14.1 were found approximately 60 horizontal metres within a cave inside Blue Hole Cavern, Palau, vertical depth 28–31 m. Depth range 18–46 m.

DESCRIPTION:

Morphology of the mature sponge a shallow semicircular plate or cup with broad undulating margins (Fig. 32A), or a vertically orientated semicircular plate with broadly rounded and undulate margin (Fig. 32B).

Dimensions of lamella typically 8–10 mm thick, sponge 100–150 mm diameter, BMNH 2005.3.14.3 has a thinner lamella (6–7 mm).

Texture stony.

Surface (osculiferous) furry to shaggy in sections and on margin, osculiferous face with inconspicuous oscules, < 1 mm diameter, closely regularly scattered over entire surface; ostial face with ostia in meandering shallow grooves.

Colour in life beige (4C3) to tan (6E6), in ethanol putty-like (4B2).

Skeleton of thick heavy rhizoclone desmas dominate the choanosome (Fig. 21C,D); fine hair-like diactinal spicules project from the ectosome on the ostial surface (Fig. 32C), while thicker diactines form a margin fringe (Fig. 32D) and dominate the oscular surface.

Megascleres (Table 30) small rhizoclone desmas with very short thick epirhabd and clones that are covered in low irregular (tuberculate, flattened, incipient bifurcation) spines (Fig. 32E,F); diactines with sinuous fine termini, in two size categories, the larger confined to the margin (Fig. 32D) and the osculiferous surface of the sponge, the smaller confined to the ostial surfaces (Fig. 32F).

Microscleres absent.

ETYMOLOGY: Named for Dr Patrick Colin, Director of the Coral Reef Research Foundation, Palau, Micronesia, whose deepwater collections and photographs of lithistid sponges around the Indo-Western Pacific have significantly increased knowledge of lithistid diversity and distribution.

REMARKS: During the course of this revision, examination of numerous specimens provided by Coral Reef Research Foundation revealed a distinct species group in Palau and from the north coast of Papua New Guinea (Table 29). These sponges are comparatively thick-walled (c. 10 mm) compared to *L. intermedia*; they are ear-shaped or form shallow vases with occasional undulations, have 1 mm diameter oscules, and the oscular surface is shaggy with long projecting diactines (> 10 mm), particularly on the margin. The desmas are small but the clones are comparatively thick and short, and they are covered in low stubby spines, as opposed to the dendritic bifurcate, denticulate spines in *L. intermedia*. Whilst approaching *L. crassiuscula* (Sollas, 1888) from the Kei Islands, Indonesia (256 m) in terms of having a comparatively thick lamella (7 mm), this latter species forms multiple ear-shaped lamellae, not vases, does not have a shaggy surface, and the desmas have long multifurcate spines and the desmas are uniaxial. The diactines in *L. crassiuscula* reach 1193 µm.

The recognition of a second Indo-Pacific species that is clearly separate from *L. intermedia* in terms of gross morphology, desma ornamentation, and geographic location warrants its inclusion, for comparative purposes, in this monograph of New Zealand taxa.

KEY DIAGNOSTIC CHARACTERS:

- Thick lamella with a shaggy, fringed, concave surface.
- Restricted geographically thus far to Palau and northern Papua New Guinea,

Table 30. Spicule dimensions (µm) of *Leiodermatium colini* n. sp.

Thickness	Desmas (LxW)	Diactines 1 (L) Clone	Dactines 2 (L) Thickness (Thickness)
Leiodermatium colini			
BMNH 2005.3.14.1	150–300	< 5 mm	250–400
(holotype)	50–100	5–13	1–3
BMNH 2005.3.14.2	100–200	5000	300–500
(paratype)	50–80	8–10	1–3
BMNH 2005.3.14.3	150–250	> 1000	300–400
(paratype)	50	8	1–3

Leiodermatium dampieri n. sp. (Fig. 33)

MATERIAL EXAMINED:

Type material: Holotype NIWA18400 from NIWA Stn P925; paratype NIWA18401, NIWA18402, NIWA18403.
NIWA Stations: P925 (NIWA18404: 37 specimens from the same collection, all dried and mostly deciduous).

TYPE LOCALITY: Dampier Ridge, Lord Howe Seamount Chain.

DISTRIBUTION: Dampier Ridge, Lord Howe Seamount Chain.
HABITAT: Attached to rocky substrata. Depth range 420 m.

DESCRIPTION:

Morphology of chalice-shaped or flared plates with a short peduncle by which the sponge attaches to the substratum (Fig. 33A). As the sponge grows in diameter, the walls appear to flatten into an undulating plate and younger specimens are more distinctly chalice-shaped. The base of the peduncle is often flanged and flared at the point of attachment. The cup margin in all specimens is thick and rounded, sometimes indented or incised. Oscules are inconspicuous but visible under magnification and confined to the concave surface, excluding the sponge margin (Fig. 33B).

Dimensions — width 10–30 mm wide, overall height 6–20 mm, peduncle height 1–6 mm, peduncle width 8–15 mm; wall thickness 2.5–4 mm. It is not known if these are juvenile sponges and grow much larger as adults.

Texture stony, pumice-like (deciduous and dead upon collection).

Surface smooth and granular, slightly undulating, convex surface occasionally knobbed or ridged.

Colour putty-like (4B2) in the dry state.

Skeleton of thorny rhizoclone desmas that dominate the choanosome; fine diactinal spicules project from the ectosome.

Megascleres (Table 31) — rhizoclone desmas (Fig. 33C,D) with a straight or curved axis, clones smooth with occasional rounded to oval prominences, often emerging in an angle to the clone, some tubercles bifurcate at the extreme tip forming tiny spines. Diactines in two size categories — the smallest are fine and hair-like, confined to osculiferous face of sponge; thicker longer spicules are confined to the margin of the sponge.

Microscleres absent.

ETYMOLOGY: Named for the type locality.

REMARKS: The collection of small cup sponges from the Dampier Ridge in the Lord Howe Seamount Chain is interesting as it presents a full range of morphologies from the smallest chalice-shaped individuals to cups with flattened undulating walls, yet it is not known whether these are adults or juveniles. The large number of specimens collected from one location, in one or two size classes, suggests that they may be immature sponges.

Superficially, these specimens resemble the Asian-Pacific species *L. intermedia* and *L. colini* described in this volume, but careful inspection of the desmas reveals that they differ in ornamentation; the desmas of *L. intermedia* are large, arched and thorny with long bifurcate spines, those of *L. colini* are quite thick and coarse with low flat non-bifurcate spines, while those of *L. dampieri* are more delicate and complex in zygosis, with rounded protuberances that bifurcate at the very tip. The diactines in *L. intermedia* and *L. colini* are also extremely long compared to those of *L. dampieri.*

Until further material of *L. dampieri* is collected from the remote Dampier Ridge or other seamounts in the region, it remains to be seen whether these specimens include fully mature individuals; the majority are quite small and appear to be juvenile.

Table 31. Spicule dimensions (μm) of *Leiodermatium dampieri* n. sp.

	Desmas (LxW) Clone (Thickness)	Diactines (L) Thickness
Leiodermatium dampieri		
NIWA18400	150–350	(1) 450
(holotype)	10–20	(2) 600+
NIWA18402	200–325	none visible
	10–30	
NIWA18403	250–425	(1) 300–450
	20–30	(2) 675
		1–8

KEY DIAGNOSTIC CHARACTERS:

- Chalice- to plate-shaped tiny sponges.
- Rhizoclones are relatively smooth with smooth rounded protuberances that may bifurcate at the tips.
- May be mistaken for *Reidispongia coerulea* in the juvenile and mature form, but the desma morphology is completely different and this species lacks unique megascleres in the surface of the sponge.

Leiodermatium linea n. sp. (Fig. 34)

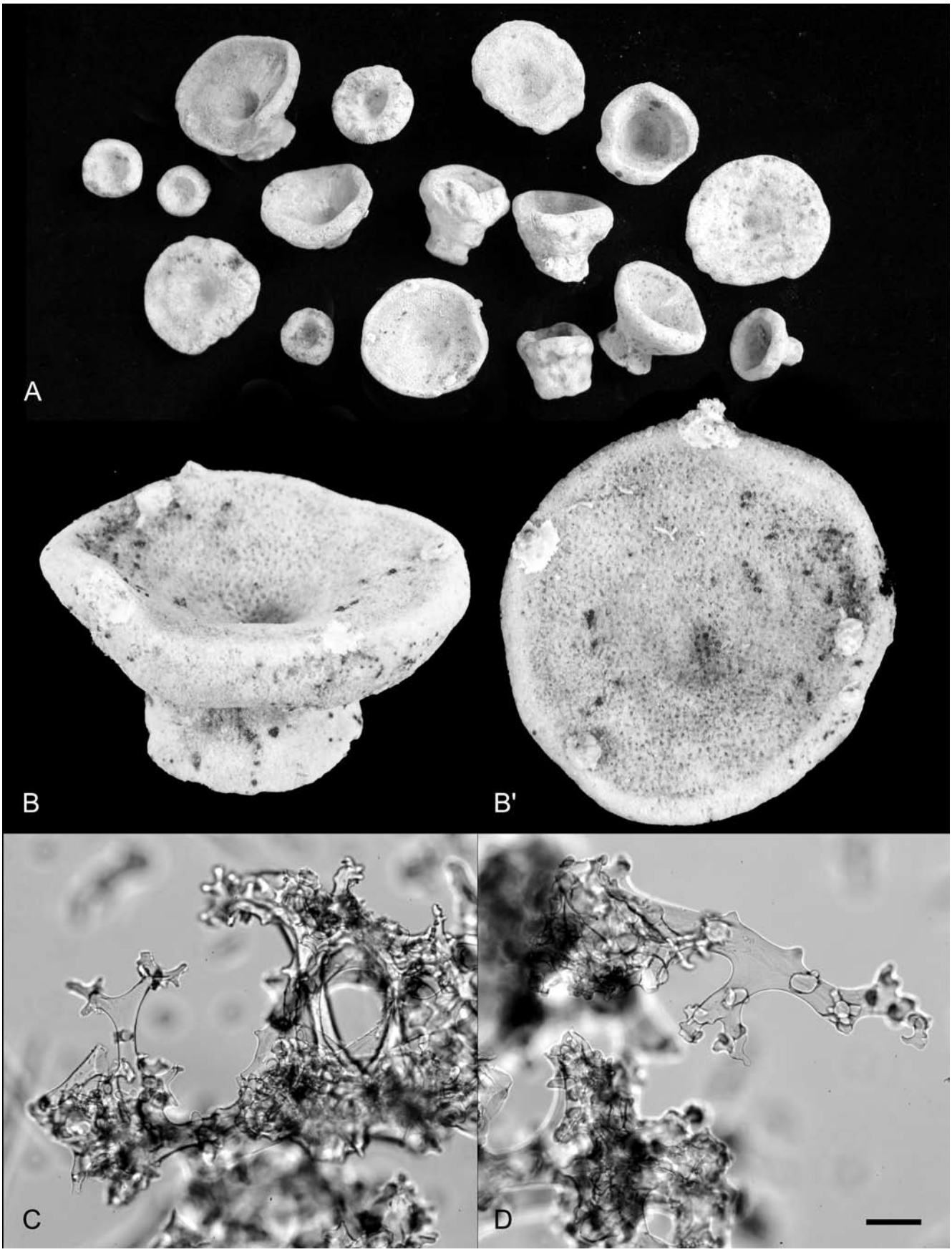


Figure 33. ***Leiodermatium dampieri*** n. sp.

MATERIAL EXAMINED**:**

Type material: Holotype NIWA18820 and paratype NIWA18399 from NIWA Stn KAH0011/30; paratype NIWA25048 from TAN0413/118.

TYPE LOCALITY: Rungapapa Knoll, Bay of Plenty.

DISTRIBUTION: Bay of Plenty.

HABITAT: Encrusting basalt substrata. Depth range 159–165 m.

DESCRIPTION:

Morphology (holotype) is a frilled shallow cup with a slightly expanded rim (Fig. 34A); undulations in the wall may anastomose to form a tube. The paratype is a thin basal plate 15 mm diameter and 1 mm thick, from which arises a 3 mm thick undulating wall (Fig. 34B). Oscules and ostia are inconspicuous. Under magnification, oscules and ostial pits are c. 0.1 mm diameter. On the concave surface, the oscules are aligned in clearly visible shallow aquiferous channels 0.1 mm wide that meander from the base of the lamella, stopping short of the margin. On the convex side, ostial pits are connected in oval interconnecting aquiferous channels. Margin slightly thicker than lamella.

Dimensions 55 mm wide and long, 22 mm high (holotype); walls 3–4 mm thick.

Texture stony.

Surface smooth, slight growth rings visible, particularly under the margin, some slight bulges, but otherwise very smooth; slightly furry to the touch with hair-like projecting diactines. Parallel and circular aquiferous channels visible on concave and convex surfaces.

Colour in life cream (4A3), putty-like (4B2) in ethanol.

Skeleton (choanosome) packed with thorny rhizoclone desmas; hair-like diactinal spicules are arranged radially in the ectosome, protruding slightly from the edge of the sponge.

Megascleres (Table 32) — rhizoclone desmas (Fig. 34C) with an arched or straight longitudinal axis; 3–6 clones arise from either side of a straight or curved axis and are covered in well separated discrete single or multiple spines; the apex of these spines may be bifid or trifid but not dendritic (Fig. 34 D,E). Desmas are very fine and comparatively small. Diactines are extremely fine and raphide-like.

Microscleres absent.

Table 32. Spicule dimensions (μm) of *Leiodermatium linea* n. sp.

	Desmas (LxW) Clone (Thickness)	Diactines (L) Thickness
Leiodermatium linea		
NIWA18820	170 (120–200) x 130 (100–150)	250–300
(holotype)	20	1
NIWA18399	158 (120–200) x 100 (80–130	250
(paratype)	10–20	

ETYMOLOGY: Named for the aquiferous channels that form visible lines on the lamellae of the sponge, running from the base to the margin (Latin, *linea*).

REMARKS: The discovery of *Leiodermatium* in New Zealand waters is interesting in that it is the southernmost record of the genus, which has not been reported from New Caledonia despite numerous collections on the northern seamounts of the Norfolk Ridge. Although *L. linea* is similar in gross morphology to *L. intermedia* n. sp., subtle differences separate these species (see Table 29). *Leiodermatium linea* has characteristic surface aquiferous channels that run parallel from the base of the lamella to the margin, and are just visible with the unaided eye. On the ostial surface, these lines anastomose to form ovals. The desmas and diactines of this species are the smallest yet described, and the ornamentation of the desmas is unique, having short conical bifid or trifid spines.

KEY DIAGNOSTIC CHARACTERS:

- Thin-walled cup that may be easily mistaken for *Reidispongia coerulea*, although the latter is blue.

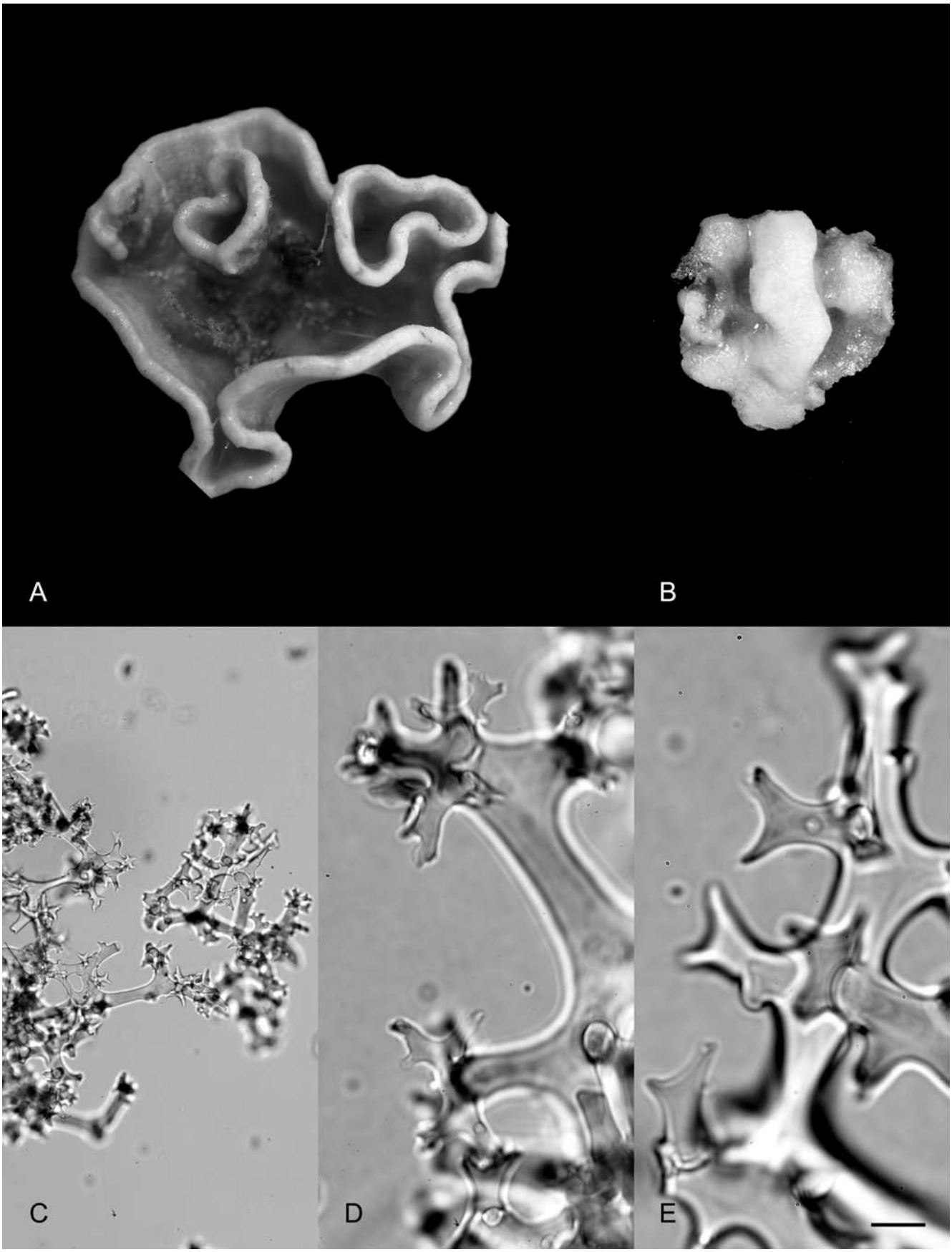


Figure 34. ***Leiodermatium linea*** n. sp.

DISCUSSION

In total, 282 lithistid specimens were recovered from dredge and SCUBA collections resulting from several hundred NZOI/NIWA voyages in the New Zealand EEZ (Gordon 2000). The area covered extends from 24° to 74° S and 155° E to 178° W, covering parts of the Lord Howe Rise, Dampier Ridge, South Fiji Basin, parts of the Norfolk Ridge, the Southwest Pacific Basin, Chatham Rise and subantarctic slope, and the Ross Sea, Antarctica (Appendix 3). In the north, the area includes Norfolk Island, Lord Howe Island, and the Kermadec Islands. Specimens were dredged from 80 to 1680 m, but were commonest between 200 and 800 m. Some of the shallowest sites (140–200 m) were volcanically active seamounts and knolls in the Bay of Plenty (Rungapapa, Tuatoru, Tumokemoke, Mahina Knolls) and the crustal rocks of the Cavalli seamount cluster. The shallowest sites (80 m and 103 m) are off Ngunguru Bay and in the Cavalli seamounts off Northland.

Prior to 1991, only two species of lithistid had been formally reported from New Zealand waters, although several species were known to exist (Bergquist pers. comm.). The present work recognises 9 families, 18 genera (one of which is new to science), and 30 species (12 of which are new to science), representing a high diversity for this group in a global context. Of the 18 genera, only eight have more than one species (*Aciculites*, *Awhiowhio*, *Herengeria*, *Leiodermatium*, *Neoaulaxinia*, *Neoschrammeniella*, *Neosiphonia*, and *Pleroma*), confirming the 'relict' nature of the group. New species of the previously monospecific phymatellid and corallistid genera *Herengeria*, *Neoaulaxinia*, and *Neosiphonia* are described, increasing understanding of the diagnostic characters of these genera and the extent of their morphological boundaries. *Awhiowhio* n. gen., closely related to *Herengeria* in the Corallistidae, was recognised during the process of character discrimination. This work also records the first polar lithistid species, *Neoschrammeniella antarctica*, from the Ross Sea. The description of two new speceis of *Leiodermatium* in New Zealand waters provides the first record of this genus further south than the Philippines.

Fourteen lithistid species are endemic to New Zealand waters, 18 are endemic to the New Caledonian region, and 14 are 'regional' species (Table 33). Several genera with species in New Caledonia, viz. *Anaderma*, *Corallistes*, *Isabella*, *Jereicopsis*, and *Neophrissospongia*, are not known in New Zealand waters but are found in Southeast Asia and the western Central Atlantic. *Awhiowhio*, *Herengeria*, and *Neoschrammeniella* (Corallistidae) and *Neoaulaxinia*, *Neosiphonia*, and *Reidispongia* (Phymatellidae) are endemic to the New Zealand-New Caledonian region. *Awhiowhio* and *Lepidothenea* are endemic to New Zealand.

Despite examination of the entire NIWA and NZNM collections that span the last 20 years of oceanographic voyages (Gordon 2000), only a single lithistid species was recorded south of the Chatham Rise (*Neoschrammeniella antarctica* from the Ross Sea, Antarctica), and only a single specimen (*Reidispongia coerulea* Lévi & Lévi, 1988) was recovered from western New Zealand, on the Challenger Plateau (see Fig. 1). In oceanographic terms, New Zealand lithistid sponges are not found south of the Subtropical Convergence, just south of the Chatham Rise (Shackelton & Kennett 1975; Nelson & Cooke 2001), and are thus restricted to relatively 'warm' waters on seamounts, continental margins, and carbonate banks, and to hydrothermally active areas.

Microfossil spicules very similar to those of living lithistids have been recorded further south than the present-day Subtropical Convergence, in the Oamaru Diatomite (c. 35 Ma; Hinde & Holmes 1892), and in the Tutuiri Greensand, Chatham Island (c. 56–53 Ma; Kelly & Buckeridge 2005). During the Cenozoic, water temperatures in the southern parts of the New Zealand region were sufficiently warm to permit establishment of populations of lithistid sponges that today are found only in warmer waters north of the Chatham Rise (Campbell *et al*. 1993). Body-fossils attributed to lithistid sponges have also been recorded from the Ototara Limestone, Kakanui (c. 33.7 Ma; Kelly *et al*. 2003) and the Red Bluff Tuff of Chatham Island (Buckeridge & Kelly 2006).

A preliminary and qualitative comparison of the spicules of species reported in this work with the Oamaru Diatomite and Tutuiri Greensand material of Chatham Island in Kelly *et al*. (2003), Kelly (2003), and Kelly and Buckeridge (2005) indicates that the distribution of Recent lithistid sponges differs considerably from the distribution of fossil lithistids. This disjunct distribution between extant and fossil lithistid sponges is paralleled in other demosponges and several non-siliceous invertebrate groups such as barnacles (Buckeridge 1983, 1996, 1999), bryozoans (Gordon 1984, 1989), and crinoids (Lee 1987; Lee *et al*. 1997). The typical depth distribution of lithistids today (400–1680 m) is in marked contrast to the inferred depth range of 50–150 m of lithistid sponges in the warm shallow waters of southern New Zealand in the Paleogene (35–56 Ma; Lee *et al*. 1997), with the exception of those areas that are today volcanically active, such as the Bay of Plenty, which harbours almost half of New Zealand's known lithistid species.

Table 33. Checklist of lithistid species described from the New Zealand--New Caledonian region. Note that this list excludes *Neoschrammeniella antarctica* from the Ross Sea, Antarctica (SEA, Southeast Asia; IO, Indian Ocean).

Species	NZ	NC	Other
Aciculites orientalis Dendy, 1905		✓	IO
Aciculites oxytylota Lévi & Lévi, 1983		✓	
Aciculites papillata Lévi & Lévi, 1983		✓	
Aciculites pulchra Dendy, 1924	✓		
Aciculites sulcus n. sp.	✓		
Aciculites manawatawhi	✓		
Anaderma rancureli Lévi & Lévi, 1983		✓	
Callipelta punctata Lévi & Lévi, 1983	✓	✓	
Corallistes australis Schlacher-Hoenlinger, Pisera & Hooper, 2005		✓	
Corallistes multituberculatus Lévi & Lévi, 1983		✓	
Corallistes undulatus Lévi & Lévi, 1983		✓	
Costifer wilsoni Lévi, 1993	✓	✓	
Discodermia proliferans Lévi & Lévi, 1983	✓	✓	
Awhiowhio osheai n. sp.	✓		
Awhiowhio sepulchrum n. sp.	✓		
Awhiowhio unda n. sp.	✓		
Herengeria auriculata Lévi & Lévi, 1988	✓	✓	
Herengeria vasiformis Schlacher-Hoenlinger, Pisera & Hooper, 2005	✓	✓	
Homophymia pollubrum Schlacher-Hoenlinger, Pisera & Hooper, 2005		✓	
Homophymia stipitata Kelly, 2000	✓		
Isabella mirabilis Schlacher-Hoenlinger, Pisera & Hooper, 2005		✓	
Jereicopsis graphidophora Lévi & Lévi, 1983		✓	
Leiodermatium dampieri n. sp.	✓		
Leiodermatium linea n. sp.	✓		
Lepidothenea incrustans (Dendy, 1924)	✓		
Macandrewia spinifoliata Lévi & Lévi, 1983	✓	✓	
Microscleroderma herdmani (Dendy, 1905)		✓	IO
Microscleroderma novaezealandiae n. sp.	✓		
Microscleroderma stonae Lévi & Lévi, 1983		✓	
Neoaulaxinia clavata Lévi & Lévi, 1988	✓	✓	
Neoaulaxinia persicum n. sp.	✓		
Neoaulaxinia zingiberadix n. sp.	✓		
Neopelta plinthosellina Lévi & Lévi, 1988		✓	
Neopelta pulvinus n. sp.	✓		
Neophrissospongia microstylifer Lévi & Lévi, 1983		✓	
Neoschrammeniella castrum Schlacher-Hoenlinger, Pisera & Hooper, 2005		✓	
Neoschrammeniella fulvodesmus Lévi & Lévi, 1983	✓	✓	
Neoschrammeniella moreti (Lévi & Lévi, 1988)		✓	
Neoschrammeniella norfolkii Schlacher-Hoenlinger, Pisera & Hooper, 2005		✓	
Neosiphonia superstes Sollas, 1888	✓	✓	
Neosiphonia motukawanui n. sp.	✓	✓	
Pleroma aotea Kelly, 2003	✓		
Pleroma menoui Lévi & Lévi, 1983	✓	✓	
Pleroma turbinatum Sollas, 1888	✓	✓	
Reidispongia coerulea Lévi & Lévi, 1988	✓	✓	
Scleritoderma camusi Lévi & Lévi, 1983		✓	
Scleritoderma flabelliformis Sollas, 1888	✓	✓	SEA
TOTAL	**29**	**32**	**3**

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APPENDIX 1

Key to diagnostic characters for massive, spherical, club-shaped and small encrusting lithistid sponges in New Zealand waters

This key differentiates massive, spherical, and club-shaped sponges, or small encrusting or cushion-shaped sponges on their gross morphology, a character that can be used reasonably reliably in the field. Where the morphology of species is similar, diagnostic microscopic characters (mic) are given for a final confirmation. For very closely related species in the genera *Neoaulaxinia* and *Neosiphonia*, a full microscopic examination of the spicules will be required.

Small stony nubbin sponges with tufts of long spicules emerging from the top (Fig. 11A,B) *Herengeria auriculata*

Small nodulose branches or irregular tuberose mass 1

1. Stony texture with surface discotriaenes (mic) (Fig. 2A,D) ..... *Discodermia proliferans*

   Comparatively soft with short-rhabd dichotriaenes (mic) (Fig. 4A,B) ..... *Neoaulaxinia zingiberadix*

Club-shaped with apical region expanding from a narrow base 2

2. Parsnip-shaped with a grey-blue apical oscular depression (Fig. 16A,B)..... *Homophymia stipitata*

   Thin elongate club with a single oscule at the apex (Fig. 3A,B) ..... *Neoaulaxinia clavata*

   Tree-like with small finger-like branches of uneven length, surface covered in epizoites (Fig. 29A–C) .... *Aciculites manawatawhi*

Small mushroom-shaped bulbous body with an apical depression and short stalk 3

3. Small stony squat spherical body with a restricted base and slightly concave bumpy surface (Fig. 21D,E) .... *Pleroma aotea*

   Squat body elevated on a short stem, deep roofed apical depression, comparatively soft and crumbly (Fig. 6A)..... *Neosiphonia superstes*

Egg-shaped, to spherical block-like masses, surface flakey, granular or conulose in places 4

4. Spherical to egg-shaped with a single apical oscule, short dichotriaene rhabd (mic) (Fig. 5A–C) .... *Neoaulaxinia persicum*

   Typically block-shaped with apical cavity and 'parchment' roof, long dichotriaene rhabd (mic.) (Fig. 7A,B) . ..... *Neosiphonia motukawanui*

Tiny nodules and cushions 5

5. Columnar sponges (<20 mm diamater) with apical oscule, with surface pseudophyllotriaenes (mic) (Fig. 17A) ..... *Callipelta punctata*

   Cushion-like encrustation with surface scale-like discs (mic) (Fig. 18A)..... *Neopelta pulvinus*

Thin flat silvery encrustation..... 6

6. Surface has feather-like triaenes and curved strongylote oxeas (mic) (Fig. 20 C,D) ..... *Macandrewia spinifoliata*

   Surface has scale-like discs and acanthose microrhabds (mic) (Fig. 19) ..... *Lepidothenea incrustans*

APPENDIX 2

Key to diagnostic characters for cup-, vase-, tube- or plate-shaped lithistid sponges in New Zealand waters

This key differentiates cup-, vase-, funnel-, tube-, plate- (flat or frilled), and ear-shaped sponges on key diagnostic spicule characteristics rather than on gross morphology, because the shape of these sponges is not a reliable field character. In most cases, immature sponges of all species have very similar shapes and many cup-shaped sponges occur in an ear-shaped or plate form and vice versa. While some species have characteristic surface features (pimpled, dimpled, lines of oscules, concentric lines across the face, and thick or thin margin) and textures (velvety, granular, fringe of spicules), these characters are also generally unreliable, unless in combination with particular spicule characteristics. The presence (or absence) of diagnostic spicule types differentiates between genera in this key, and the range of shapes and sizes within the microsclere categories differentiates species within a genus. Where a particular morphological or surface characteristic is diagnostic in combination with the primary spicule characters (e.g. in *Reidispongia coerulea*), this character is also employed.

Microscleres include two types of amphiasters (Fig. 8F), mature sponge a vivid blue frilly mass (Fig. 8A,B) ..... *Reidispongia coerulea*

Microscleres include sigmaspires 1

1. Surface crust of acanthorhabds present (Fig. 26B) ..... *Scleritoderma flabelliformis*

   Acanthorhabds absent (Fig. 25C) ..... *Microscleroderma novaezelandiae*

Megascleres include tylostrongyles with roughened ends 2

2. Tongue- or ear-shaped, oscules flush with aquiferous 'slits' emanating from oscule (Fig. 30). *Aciculites sulcus*

   Oscules raised on tubercles on one surface, reddish-brown (Fig. 27A-D) ..... *Aciculites pulchra*

   Thick, furry ear (Fig. 23 A); desmas are long, notched heloclones (Fig. 24) ..... *Costifer wilsoni*

Desmas are smooth megaclones with saddle-shaped zygomes 3

3. Desmas are distinctive smooth 'fat' dipods, tripods, or quadripods (Fig. 22B,C,F) ..... *Pleroma menoui*

   Desmas are slim smooth 'slender' quadripods or multipods (Fig. 22A,E), usually a thick stony ear sponge (Fig. 21A,B) ..... *Pleroma turbinatum*

Microscleres include two types of spiraster (robust and fine-rayed) and a very large fine-rayed streptaster 4

4. Thin-walled (4–8 mm) shallow or tall cup-shaped sponges with flared margin (Fig. 9A–C) ..... *Neoscrammeniella fulvodesmus*

   Thick-walled tall conical cup with fringed internal margin (Ross Sea only) (Fig. 10A) ..... *Neoscrammeniella antarctica*

Microscleres include 2 types of spiraster (robust and fine-rayed), an ectosomal polyrhabd and acanthose centrotylote microxeas 5

5. Polyrhads very irregular (Fig. 12G) ..... *Herengeria vasiformis*

   Polyrhabds centrotylote with bulbous ends (Fig. 13G), acanthose microxeas absent, one surface pimpled (Fig. 13A–C) ..... *Awhiowhio osheai*

   Polyrhabds spiraster-shaped, acanthose microxeas absent, sponge with wavy walls (Fig. 14A,D,E) ..... *Awhiowhio unda*

   Sponge a large thick flat plate (Fig. 15) ..... *Awhiowhio sepulchrum*

Microscleres absent 6

6. Thin-walled cup with parallel vertical lines on the surface (Fig. 34A) ..... *Leiodermatium linea*

APPENDIX 3

STATION DATA

NIWA/NZOI (New Zealand Oceanographic Institute) Stations

NIWA Stn	Geographic location	Latitude	Longitude	Depth (m)	Date
A527	Ross Sea, Antarctica	74°10.00′ S	178°17.0′ W	352	02.07.1960
B314	Eastern edge of Challenger Plateau	39°22′ S	171°50.0′ E	236	25.10.1960
E636	Bay of Plenty	37°28.49′ S	177°13.0′ E	190	10.10.1966
E731	Bay of Plenty	37°23.50′ S	177°12.0′ E	602–503	25.03.1967
F993	South Three Kings Ridge	34°24′ S	173°10.3′ E	249–212	15.10.1968
I14	Cavalli Seamount, Northland	35°35.9′ S	174°39.7′ E	103	04.05.1975
I92	Norfolk Ridge, south of Norfolk Island	29°24.8′ S	168°13.2′ E	578–570	23.07.1975
I96	Wanganella Bank, West Norfolk Ridge	32°10.8′ S	167°21.2′ E	356	05.02.1975
I97	Wanganella Bank, West Norfolk Ridge	32°22.9′ S	167°28.2′ E	544–540	25.07.1975
I372	Doubtless Bay, North Cape	34°32.20′ S	173°29.50′ E	215–211	23.11.1977
J953 (I807)	Western continental slope, Northland	34°39.6′ S	172°13.1′ E	270–260	18.06.1981
J954 (I808)	Western continental slope, Northland	34°38.8′ S	172°13.5′ E	204–192	18.06.1981
K826	Southern South Fiji Basin	28°48.0′ S	177°48.0′ W	490–390	25.07.1974
K872	Colville Ridge, southeastern South Fiji Basin	31°20.4′ S	178°49.2′ W	280–235	02.08.1974
KAH0011/30	Rungapapa Knoll, Bay of Plenty	37°32.98′ S	176°58.84′ E	165–159	04.11.2000
KAH0011/40	Rungapapa Knoll, Bay of Plenty	37°32.99′ S	176°58.25′ E	280–155	05.11.2000
KAH0011/41	Rungapapa Knoll, Bay of Plenty	37°33′ S	176°58.23′ E	260–154	05.11.2000
KAH0011/44	Rungapapa Knoll, Bay of Plenty	37°33.14′ S	176°58.09′ E	348–181	05.11.2000
KAH0204/02	Knights Terrace, east of Poor Knights Islands	34°57.62′ S	175°10.79′ E	581	13.04.2002
KAH0204/07	Cavalli Seamount, Northland	34°7.16′ S	174°9.15′ E	800	14.04.2002
KAH0204/08	Cavalli Seamount, Northland	34°6.91′ S	174°8.70′ E	640–610	14.04.2002
KAH0204/09	Cavalli Seamount, Northland	34°6.68′ S	174°8.29′ E	600–562	14.04.2002
KAH0204/27	Cavalli Seamount, Northland	33°09.39′ S	179°57.2′ E	667–613	16.04.2002
KAH0204/29	West Cavalli Seamount, Northland	34°9.79′ S	173°57.75′ E	790–782	17.04.2002
KAH0204/30	West Cavalli Seamount, Northland	34°8.79′ S	173°57.79′ E	825–800	17.04.2002
KAH0204/32	West Cavalli Seamount, Northland	34°9.72′ S	173°57.71′ E	810–780	17.04.2002
KAH0204/38	West Cavalli Seamount, Northland	34°09.52′ S	173°57.78′ E	800–780	18.04.2002
KAH0204/40	West Cavalli Seamount, Northland	34°09.85′ S	173°57.84′ E	820–805	18.04.2002
KAH0204/44	South Cavalli Seamount, Northland	34°15.94′ S	174°06.19′ E	850–840	18.04.2002
KAH0204/47	Seamount 441, Cavalli Seamount region	34°02.55′ S	174°49.02′ E	880–792	19.04.2002
KAH0204/52	Seamount 441, Cavalli Seamount region	34°03.30′ S	174°48.49′ E	910–820	19.04.2002
KAH9301	Bay of Plenty to Wairarapa shelf	36°57.24′ S	176°15.19′ E		31.12.1992
		to 41°01.62′ S	176°24.87′ E		27.01.1993
KAH9907/48	West of White Island, Bay of Plenty	37°28.15′ S	177°06.71′ E	250	05.06.1999
KAH9907/49	West of White Island, Bay of Plenty	37°28.21′ S	177°07.03′ E	320–220	05.06.1999
KAH9907/50	West of White Island, Bay of Plenty	37°28.14′ S	177°06.97′ E	318–230	05.06.1999
P8	West Norfolk Ridge	32°40.8′ S	167°26.80′ E	757–660	25.01.1977
P10	West Norfolk Ridge	32°40.00′ S	167°28.40′ E	378–352	25.01.1977
P14	West Norfolk Ridge	31°47.20′ S	167°51.6′ E	319–316	25.01.1977
P925	Dampier Ridge, Lord Howe Seamount Chain	27°59.60′ S	155°37.50′ E	420	11.12.1979
RAPUHIA2-15	[NIWA Stns U545–U624, cruise to study manganese crusts; depths 406–3354 m]				
	Challenger Plateau to southern Norfolk Ridge	40°16.5′ S	165°59.0′ E		29.01.1988
		to 30°20.0′ S	172°60.0′ E		14.02.1988
S562	Eastern continental slope, Northland	35°49.20′ S	172°54.00′ E	600–505	05.08.1983
S568	Western flank of Three Kings Ridge	30°10.00′ S	171°20.20′ E	900–650	13.08.1983
S571	Three Kings Ridge	30°47.30′ S	172°45.20′ E	509–480	15.08.1983
S572	West of Three Kings Ridge	30°45.50′ S	172°47.70′ E	530–403	15.08.1983
T226	North of Raoul Island, Kermadec Ridge	28°33.00′ S	177°49.99′ W	800–930	22.03.1982
TAN0104/001	Graveyard Seamount, Chatham Rise	42°45.60′ S	179°59.26′ W	979–770	15.04.2001
TAN0104/002	Graveyard Seamount, Chatham Rise	42°45.93′ S	179°59.34′ W	875–757	15.04.2001
TAN0104/048	Diabolical Seamount, Chatham Rise	42°47.17′ S	179°59.12′ W	993–900	16.04.2001
TAN0104/148	Morgue Seamount, Chatham Rise	42°42.84′ S	179°57.51′ W	980–893	18.04.2001
TAN0104/194	Scroll Seamount, Chatham Rise	42°47.27′ S	179°59.81′ W	1042–880	18.04.2001
TAN0104/288	Graveyard Seamount, Chatham Rise	42°45.64′ S	179°59.27′ W	972–890	19.04.2001

NIWA/NZOI (New Zealand Oceanographic Institute) Stations

NIWA Stn	Geographic location	Latitude	Longitude	Depth (m)	Date
TAN0104/289	Graveyard Seamount, Chatham Rise	42°45.89′ S	179°59.16′ W	800–757	19.04.2001
TAN0104/394	Graveyard Seamount, Chatham Rise	42°45.68′ S	179°59.33′ W	920–771	21.04.2001
TAN0107/124	Rumble III Seamount, Bay of Plenty	35°44.36′ S	178°30.25′ E	620–435	20.05.2001
TAN0107/232	Rumble V Seamount, Bay of Plenty	36°08.73′ S	178°11.98′ E	750–570	24.05.2001
TAN0205/20	Volcano E, Kermadec Ridge	33°44.18′ S	179°49.90′ W	619–490	14.04.2002
TAN0205/32	East slope of Kermadec Ridge	33°10.25′ S	179°58.21′ W	999–643	16.04.2002
TAN0205/60	Cavalli Seamount, Northland	30°11.87′ S	178°28.75′ W	1131–1073	21.04.2002
TAN0205/75	Volcano L, Kermadec Ridge	30°01.37′ S	178°42.88′ W	240–154	23.04.2002
TAN0413/016	Whakatane Seamount, Bay of Plenty	36°47.50′ S	177°25.52′ E	1538–1503	08.11.2004
TAN0413/068	Tuatoru Knoll, Bay of Plenty	37°28.28′ S	177°12.30′ E	295–200	11.11.2004
TAN0413/070	Tuatoru Knoll, Bay of Plenty	37°28.12′ S	177°12.40′ E	330–218	11.11.2004
TAN0413/074	Tuatoru Knoll, Bay of Plenty	37°28.19′ S	177°13.20′ E	200–175	12.11.2004
TAN0413/077	Tuatoru Knoll, Bay of Plenty	37°28.26′ S	177°12.89′ E	180–177	12.11.2004
TAN0413/085	Tuatoru Knoll, Bay of Plenty	37°28.25′ S	177°13.35′ E	216–207	12.11.2004
TAN0413/092	Tuatoru Knoll, Bay of Plenty	37°29.14′ S	177°12.92′ E	400–225	12.11.2004
TAN0413/093	Tuatoru Knoll, Bay of Plenty	37°28.58′ S	177°12.94′ E	180–179	13.11.2004
TAN0413/099	Rungapapa Knoll, Bay of Plenty	37°32.80′ S	176°58.85′ E	151–141	13.11.2004
TAN0413/109	Rungapapa Knoll, Bay of Plenty	37°32.93′ S	176°59.27′ E	142–136	13.11.2004
TAN0413/111	Rungapapa Knoll, Bay of Plenty	37°32.79′ S	177°00.22′ E	337–256	13.11.2004
TAN0413/112	Rungapapa Knoll, Bay of Plenty	37°32.11′ S	176°58.26′ E	217–169	13.11.2004
TAN0413/117	Rungapapa Knoll, Bay of Plenty	37°32.16′ S	176°58.25′ E	188–182	13.11.2004
TAN0413/118	Rungapapa Knoll, Bay of Plenty	37°33.22′ S	176°58.13′ E	190–154	13.11.2004
TAN0413/120	Mahina Knoll, Bay of Plenty	37°21.14′ S	177°04.70′ E	520	14.11.2004
TAN0413/170	Tumokemoke Knoll, Bay of Plenty	37°27.69′ S	176°54.23′ E	376–295	16.11.2004
TAN0413/173	Mahina Knoll, Bay of Plenty	37°21.04′ S	177°05.96′ E	434–272	16.11.2004
TAN0413/174	Mahina Knoll, Bay of Plenty	37°20.09′ S	177°04.58′ E	502–430	16.11.2004
TAN9915/3B	Ngunguru Bay, off Taiharuru Head, Northland	35°41.80′ S	174°38.90′ E	80	13.12.1999
U591	Tui Seamount, Three Kings Ridge	30°50.60′ S	172°48.30′ E	486	07.02.1988
U594	West of Three Kings Ridge	30°20.10′ S	172°59.60′ E	406	07.02.1988
U606	South Norfolk Basin	31°54.70′ S	172°47.40′ E	1100–1085	10.02.1988
V473	South of East Cape	38°50.92′ S	178°36.75′ E	800–365	05.06.1994
X128	Bay of Plenty	37°24.40′ S	176°59.40′ E	405	25.11.1989
X140	Bay of Plenty	37°11.40′ S	176°58.30′ E	860–745	27.11.1989
X152	Raukumara Plain, off East Cape	36°09.70′ S	176°48.40′ E	940–820	28.11.1989
X201	Ngatoro Ridge, off East Cape	37°08.12′ S	177°17.82′ E	1050–700	06.12.1989
X207	East of Hikurangi Plateau	37°32.77′ S	176°57.70′ E	380	06.12.1989
X681	South Kermadec Ridge	35°24.91′ S	178°′39.23 E	1132–1125	13.02.1996
X768	Hikurangi Plateau	37°41.30′ S	179°00.75′ E	936	05.06.1999
Z2092	Lord Howe Seamount Chain	27°41.20′ S	155°08.80′ E	521–412	26.08.1967
Z2098	North of Three Kings Ridge	28°39.50′ S	173°01.00′ E	920	04.09.1967
Z2364	Bay of Plenty	37°25.00′ S	176°25.99′ E	277	00.00.1971
Z7187	New Zealand waters [89-BIP-1]				1989
Z7190	New Zealand waters [90-PUP]				1990
Z8487	Louisville Seamount Chain	37°40.00′ S	169°06.00′ W	1050–700	00.06.1996
Z9025	East of Three Kings Ridge	31°58.82′ S	174°15.87′ E	1680–677	00.02.1998
Z9041	Kermadec Ridge	32°10.90′ S	179°04.20′ W	260–128	05.04.1998
Z9262	Challenger Plateau, northern slope	37°29.04′ S	167°41.09′ E	904	10.09.1998
Z9263	Lord Howe Rise	34°09.20′ S	162°51.90′ E	791	18.09.1998
Z9400	Challenger Plateau, northern slope	37°18.06′ S	167°22.01′ E	755	30.09.1998
Z9742	~3 NM east of North Cape	34°24.82′ S	173°08.00′ E	210–133	19.04.1999
Z9748	Northwest of Volkner Rocks, Bay of Plenty	37°28.01′ S	177°07.00′ E	232	30.04.1999
Z9747	~17 NM west of Pandora Bank, Northland	34°38.91′ S	172°13.20′ E	208–198	21.04.1999
Z9751	Three Kings Islands	34°10.09′ S	172°12.04′ E	180	16.04.1999
Z9890	Western continental slope	35°00.49′ S	172°31.82′ E	167–169	30.10.1999
Z9892	Western continental slope	35°02.10′ S	172°29.25′ E	194-174	23.10.1999

Museum of New Zealand Te Papa Tongarewa (NMNZ) Stations

NMNZ Reg. no	Geographic location	Latitude	Longitude	Depth (m)	Date
NMNZ Por. 308	~1 km off Table Cape, east of Mahia Peninsula	39°10.0′ S	178°06.0′ E	110	12.03.1957
NMNZ Por. 562	Major Island, Bay of Plenty	37°15.0′ S	176°12.0′ E	219–146	19.08.1956
NMNZ Por. 563	North of Major Island, Bay of Plenty	37°23.2′ S	176°26.15′ E	345–300	22.01.1993
NMNZ Por. 564	~1 km off Table Cape, east of Mahia Peninsula	39°10.0′ S	178°06.0′ E	110	12.03.1957
NMNZ Por. 570	Outer Bay of Islands	35°10.0′ S	174°11.0′ E	80	16.11.1974
NMNZ Por. 571	Between Tutukaka and Poor Knights Islands	35°34.5′ S	174°39.0′ E	102	15.02.1974
NMNZ Por. 573	Ranfurly Saddle, off East Cape	37°38.0′ S	178°42.2′ E	128–126	17.01.1979
NMNZ Por. 580	Wanganella Bank, Norfolk Ridge, E slope	32°35.3′ S	167°41.8′ E	437–422	29.01.1981
NMNZ Por. 583	Middlesex Bank, NW of Three Kings Islands	34°01.4′ S	171°45.2′ E	216–201	31.01.1981
NMNZ Por. 591	Wanganella Bank, Norfolk Ridge, E slope	32°35.3′ S	167°41.8′ E	437–422	29.01.1981
NMNZ Por. 597	Wanganella Bank, Norfolk Ridge, E slope	32°41.3′ S	167°38.1′ E	296–206	30.01.1981
NMNZ Por. 615	Wanganella Bank, Norfolk Ridge, E slope	32°41.3′ S	167°38.1′ E	296–206	30.01.1981
NMNZ Por. 620	~25 km due east of Gisborne	38°39.38′ S	178°31.62′ E	243	27.01.1995
NMNZ Por. 712	Wanganella Bank, Norfolk Ridge, E slope	32°35.3′ S	167°41.8′ E	437–422	29.01.1981

Institut de Recherche pour le Développement (IRD) LITHIST Stations

IRD Stn	Geographic location	Latitude	Longitude	Depth (m)	Date
CP8	Éponge Seamount, south New Caledonian slope	24°54.24′ S	168°21.35′ E	540	11.08.1999
CP9	Éponge Seamount, south New Caledonian slope	24°52.80′ S	168°21.78′ E	540–18	11.08.1999
DW5	Stylaster Seamount, south New Caledonian slope	23°38.25′ S	167°42.94′ E	433–00	10.08.1999
DW7	Éponge Seamount, south New Caledonian slope	24°55.36′ S	168°21.58′ E	530–04	11.08.1999
DW11	Kaimon Maru Seamount, south New Caledonian slop	24°46.69′ S	168°08.33′ E	254–83	11.08.1999

TAXONOMIC INDEX

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