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# Kermadec Biodiscovery Expedition 2011

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# Kermadec Islands sponge biodiversity: A review and description of a new species, *Suberea meandrina* sp. nov. (Demospongiae, Verongiida, Aplysiniellidae)

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## Abstract

Several sponges collected during the Kermadec Biodiscovery Expedition 2011 were identified as a new species of *Suberea* Bergquist (Verongiida, Aplysiniellidae), providing an opportunity to describe this new species, and to provide a first record of the genus in New Zealand waters. Verongiids are typically tropical to subtropical sponges, and are relatively common further north off New Caledonia and along the southern and eastern coasts of Australia. Prior to this collection, there was only one published record of the order Verongiida in New Zealand, named variously as *Druinella* sp. or *Aplysinella* sp. (Aplysinellidae) from the Poor Knights Islands.

Description of *Suberea meandrina* Kelly sp. nov. also provides an opportunity to review the known sponge fauna of the New Zealand Exclusive Economic Zone surrounding the Kermadec Islands, and to compare it with the fauna of coastal and deep waters off mainland northern New Zealand, and surrounding areas. To date, 66 species are known from the region, 46 (70%) of which are described, and 20 (31%) of which are new to science. A majority of poriferan orders are under-represented in the sponge fauna, but carnivorous sponges of the genera *Abyssocladia* Lévi, *Asbestopluma* Topsent and *Chondrocladia* Thomson (Poecilosclerida, Cladorhizidae), and the glass sponge genus *Farrea* Bowerbank (Hexactinosida, Farreidae) are notable components. Nine new genus records are recorded for New Zealand waters for the first time (*Corticium* Schmidt, *Chondrosia* Nardo, *Pachymatisma* Bowerbank, *Ancorella* Lendenfeld, *Neopetrosia* de Laubenfels, *Echinochalina* Thiele, *Suberea*, *Gymnorette* Ijima, and *Hexactinella* Carter). Thirteen percent of the overall fauna of the Kermadecs region is linked faunistically with that of the broader Indo-Pacific.

## Keywords

New Zealand; Kermadec Islands; Porifera: Verongiida; Aplysiniellidae; *Suberea meandrina*; new species.

## INTRODUCTION

The Kermadec Islands region comprises 13 volcanic islands and islets stretching along the Kermadec Ridge between New Zealand's Bay of Plenty and Tonga. The islands are very remote, being about 800–1000 km northeast of New Zealand's North Island, and the waters that surround them comprise New Zealand's largest subtropical marine reserve. The Kermadec Islands group extends the New Zealand EEZ into the subtropical/tropical waters of the South Pacific, and the general marine fauna has strong links with Lord Howe and Norfolk Islands to the west. The sponge fauna is considerably different from

that of the New Zealand mainland, but has some species links with northern New Zealand (Dendy 1924; Bergquist & Kelly-Borges 1991, Kelly-Borges & Bergquist 1997; Kelly 2007; Reiswig & Kelly 2011), the deep water fauna of the Norfolk Ridge seamounts south of New Caledonia (Lévi 1991, 1993; Lévi & Lévi 1982, 1983; Schlacher-Hoenlinger *et al.* 2005), and the broader South Pacific (Lévi, 1964; Kelly 2007).

The first sponges from the Kermadec Ridge and Trench regions were collected during the HMS *Challenger* Expedition of 1873–1876 (Ridley & Dendy 1886), and on the *Galathea* Expedition of 1950–1952 (Lévi, 1964). National Institute of Water & Atmospheric Research

(NIWA), and formerly the New Zealand Oceanographic Institute (NZOI) voyages since the 1960s have collected many deep water sponges, but the nearshore shallow water sponges surrounding the Kermadec Islands have been significantly understudied due to their great isolation and exposure. To date, only one shore collection is known, that of Kirk (1911), who described six species from a small collection of intertidal and beach-thrown sponges from Meyer and Sunday Islands, made by Dr W. R. B. Oliver between 29 February and 29 August 1908. In 1995, the sponges of the Kermadec Islands were discussed as part of a review of species systematics and information management priorities for tropical island region of Oceania, by Kelly-Borges & Valentine (1995).

In November 2004, a small collection of seven sponge species was made on SCUBA by NIWA and the Department of Conservation, amongst which was a new species of the genus *Suberea* Bergquist (Order Verongiida, Family Aplysinellidae), not previously known from New Zealand waters. Several additional specimens of this new species were collected during the recent Kermadec Biodiscovery Expedition 2011, carried out by the Auckland War Memorial Museum and the Australian Museum, Sydney (Keable & Reid 2015; Trnski *et al.* 2015), providing an opportunity to describe this new species. The aim of this paper is thus, to describe *Suberea meandrina* Kelly sp. nov. (Verongiida, Aplysinellidae) and to review our current knowledge of the fauna of the Kermadec Islands group and surrounding waters within the New Zealand Exclusive Economic Zone.

## MATERIAL AND METHODS

### Field

A small collection of sponges was provided to Dr Michelle Kelly by Dr Stephen Keable, Australian Museum, Sydney, from the Kermadec Biodiscovery Expedition 2011. Specimens were collected using SCUBA (Keable & Reid 2012) from stations K2011-99-10, K2011-94-5, and K2011-47-8 (Figs 1–3 in Trnski & de Lange, this volume), preserved in 10% formalin on the vessel, but later transferred to 70% ethanol back in the laboratory. A collection of shallow water specimens was made on SCUBA for marine natural products research, as part of a research voyage funded by NIWA and the Department of Conservation in 2004.

### Laboratory

Sponge specimens were prepared for histological examination by embedding sections of sponge in paraffin wax. A series of stained histological slides were taken through an individual sponge to examine the sequential formation of the fibres from the base to the ectosome, to determine whether dendritic or reticulate. Thin sections (7 µm) were cut and stained with Mallory-Heidenhain and Ehrlich's Haematoxylin-Eosin stains to examine histological detail. Species records used to compile Table 1 were sourced from the published literature and from NIWA's marine invertebrate collection database, *Specify*, resulting from identifications of material collected on

a number of research vessels between 1966 and 2011, including the NIWA research vessels RV *Tangaroa* and RV *Kaharoa*. Records were searched from an area that approximates the New Zealand EEZ surrounding the Kermadec Islands, i.e. between the latitudes 25°S and 35°S and longitudes 177°E and 174°W.

### Specimen Lodgement

Primary type materials are accessioned within the Auckland War Memorial Museum Marine Invertebrate Collection using the prefix AIM MA-, the Australian Museum, Sydney, using the prefix AM Z., and the NIWA Invertebrate Collection (NIC) at NIWA, Wellington, using the prefix NIWA-.

## RESULTS

### Systematics

#### Class DEMOSPONGIAE Sollas

#### Order VERONGIIDA Bergquist

#### Family APLYSINELLIDAE Bergquist

Genus *Suberea* Bergquist, 1995

*Suberea* Bergquist, 1995: 41.

**Type species:** *Suberea creba* Bergquist, 1995: 44, Fig. 24, 25.

**Diagnosis.** Aplysinellidae with coarse irregular dendritic fibres in which the bark and pith elements are present but the pith predominates. The bark is strongly laminated and very brittle. Fibres can be very thick and render the texture of the sponge interior very rough. Dense collagen reinforces the matrix, rendering the sponges hard to just compressible. The surface is smooth or conulose and the sponge form is massive, sometimes stalked or branching (after Bergquist 1995).

#### *Suberea meandrina* Kelly sp. nov.

**Material examined.** **Holotype**—AIM MA73392: Stn K2011-99-10, west side of L'Esperance Rock, Kermadec Islands, 31.354°S, 178.827°W, 12–20 m, collected on SCUBA by S. Keable, A. Reid from RV *Braveheart*, 26 May 2011; **Schizotypes**—AM Z.7029, NIWA 62416: K2011-99-10, west side of L'Esperance Rock, Kermadec Islands, 31.354°S, 178.827°W, 12–20 m, collected on SCUBA by S. Keable, A. Reid from RV *Braveheart*, 26 May 2011; **Paratypes**—AM Z.7028: K2011-94-5, west side of Stella Passage, Kermadec Islands, 30.539°S, 178.561°W, 13–15 m, collected on SCUBA by S. Keable, A. Reid from RV *Braveheart*, 25 May 2011; AM Z.7030: K2011-47-8, south west side of Nugent Island, Kermadec Islands, 29.232° S, 177.870° W, 15–23.7 m, collected on SCUBA by S. Keable, A. Reid from RV *Braveheart*, 17 May 2011; AIM MA73393 (part of Australian Museum paratype Z.7030): K2011-47-8, south west side of Nugent Island, Kermadec Islands, 29.232°S, 177.870°W, 15–23.7 m, collected on SCUBA by S. Keable, A. Reid from RV *Braveheart*, 17 May 2011.

**Other material.** NIWA 80511: Square Rock, Denham Bay, Raoul Island, Kermadec Islands, 29.257°S, 177.953°W, 6 m, collected on SCUBA by M. Page, 6 Nov 2004; NIWA 80512: Parson's Rock, Raoul Island, Kermadec Islands, 29.292°S, 177.899°W, 15 m, collected on SCUBA by M. Page, 8 Nov 2011.

**Type locality.** L' Esperance Rock, Kermadec Islands.

**Distribution.** Kermadec Islands.

**Description.** The sponge forms a large, spreading, meandering, labyrinthine mass of high narrow ridges (Fig. 1), and discrete hemispherical masses (Fig. 2), or may coalesce into a thick undulating mass. Individual specimens range from 3–7 cm diameter and 3–4 cm thick, and the spreading mass may reach greater than 1 m in total extent. The surface is usually conulose and heavily ridged with oscules aligned along the direction of the ridges (Fig. 1). Fine-hair-like unidentified kamptozoans can be seen attached to the surface of a specimen in Figure 2. The texture in life is compressible and rubbery, tough in the preserved condition; the surface feels fleshy to the touch. External colour in life is olive-tinged oak brown, but may be a pale gold around the oscule membranes, and on shaded regions of the base of the sponge (Fig. 1). The internal colour in life is pale gold to cream. The sponge turns deep purple on collection and in preservative.

**Skeleton.** The fibrous skeleton is made up of dendritic fibres composed of strongly laminated bark and granular pith, the latter of which accounts for 22–83% of the fibre cross section, but varying depending where the section crosses the fibre (Fig. 3). Concentric lamination of the fibres is obvious in thin sections. The fibres in the outer regions of the sponge are spherical to oval in cross section, typically ranging from 60–350 µm diameter, but are much thicker and oval or elongate in profile deeper within the sponge, where they may be joined to neighbouring fibres (Fig. 5, 6). When three or more fibres are joined by a common sheath of bark at the base of the sponge; the extent of such a structure may reach 2100 µm in broadest dimension. Thick rigid oval to elongate fibres emerge within the deeper choanosome (Fig. 5, 6), giving rise to more abundant thinner fibres in the outer regions of the sponge (Fig. 3, 4).

**Soft tissue organisation.** The strongly collagenous ectosome is clearly differentiated from the underlying cavernous choanosome, and ranges from 300 to 600 µm deep (Fig. 3). Horizontal swathes of fibrous collagen dominate the ectosome, while accumulations of heavily pigmented cells are particularly noticeable on the very surface of the sponge. The abundance of these cells reduces towards the base of the ectosome, and they are absent from the choanosome. The choanosome mesohyl is uniform and relatively cavernous (Fig. 6), with thick swathes of collagen fibrils and spherulous cells around aquiferous canals. Choanocyte chambers are spherical, 15–38 µm diameter.

**Substrate, depth range, and ecology.** Collected from walls, archways and the surfaces of huge boulders, between 12–24 m, occasionally with epizootic kamptozoans on the surface.

**Etymology.** Named for the meandering or labyrinthine growth morphology of the new species (*meandrina* = meandering, L.).

## DISCUSSION

### New Record of Genus *Suberea* In Kermadecs

*Suberea meandrina* Kelly sp. nov. conforms to the general skeletal characteristics of the genus, having a conspicuous collagen-rich ectosome and well separated fibres in which the pith ranges in cross sectional proportion of 50–80% in the majority of fibres. The fibre bark is heavily laminated and brittle, and the fibres are dendritic in overall arrangement, occasionally anastomosing with neighbouring fibres. *Suberea meandrina* Kelly sp. nov. is closely comparable to *S. creba* Bergquist, 1995 from Passe de St Vincent in the New Caledonian lagoon, but differs in several key features. The internal and external colouration of *S. creba* in life is clear bright buttercup yellow, while *S. meandrina* sp. nov. is olive-tinged oak brown, with an internal colouration of creamy gold. The morphology of *S. meandrina* sp. nov. is labyrinthine, with oscules aligned in rows along the apices of ridges, while *S. creba* has a low spreading habit with a smooth fleshy appearance and few surface conules reflecting the less robust fibre skeleton of this species. *S. meandrina* sp. nov. has a heavily ridged or conulose surface reflecting the larger, broader, more frequently anastomosing fibres ascending to the surface. The fibre diameter in *S. creba* falls within the range of 120–250 µm (Bergquist 1995), while those of *S. meandrina* sp. nov. reach 350 µm diameter, and when anastomosed can be over 2 mm thick.

*Suberea meandrina* Kelly sp. nov. is easily differentiated from the second known New Caledonian species, *S. labouti* Bergquist, 1995, which forms erect lobes with apical oscules, has a markedly conulose surface, and is dull brownish yellow, and notably brown in ethanol. The species has relatively abundant fibres, which are comparatively large (200–700 µm) (Bergquist 1998).

The only other encrusting species of *Suberea* comparable to *S. meandrina* sp. nov., are *S. etiennei* Van Soest, Kaiser & Van Syoc, 2011, from Clipperton Island in the East Pacific Ocean, *S. praetensa* (Row, 1911) and *S. purpureaflava* Gugel, Wagler & Brümmer, 2011, from the Red Sea. *Suberea etiennei* is described as encrusting to lumpy, reddish-brown, and up to 1 cm thick, with sharp surface conules, of which 15–20% is strongly laminated bark. The dendritic fibres have bark and pith components but are relatively thin for the genus at 55–97 µm diameter (Van Soest *et al.* 2011). *Suberea purpureaflava* has a marked differential colouration of dark red ectosome and light yellow interior, with rare dendritic fibres ranging in diameter from 110–165 µm (Gugel *et al.* 2011). *Suberea praetensa* (Row, 1911) from the Red Sea is a low lying sponge of indeterminate shape.

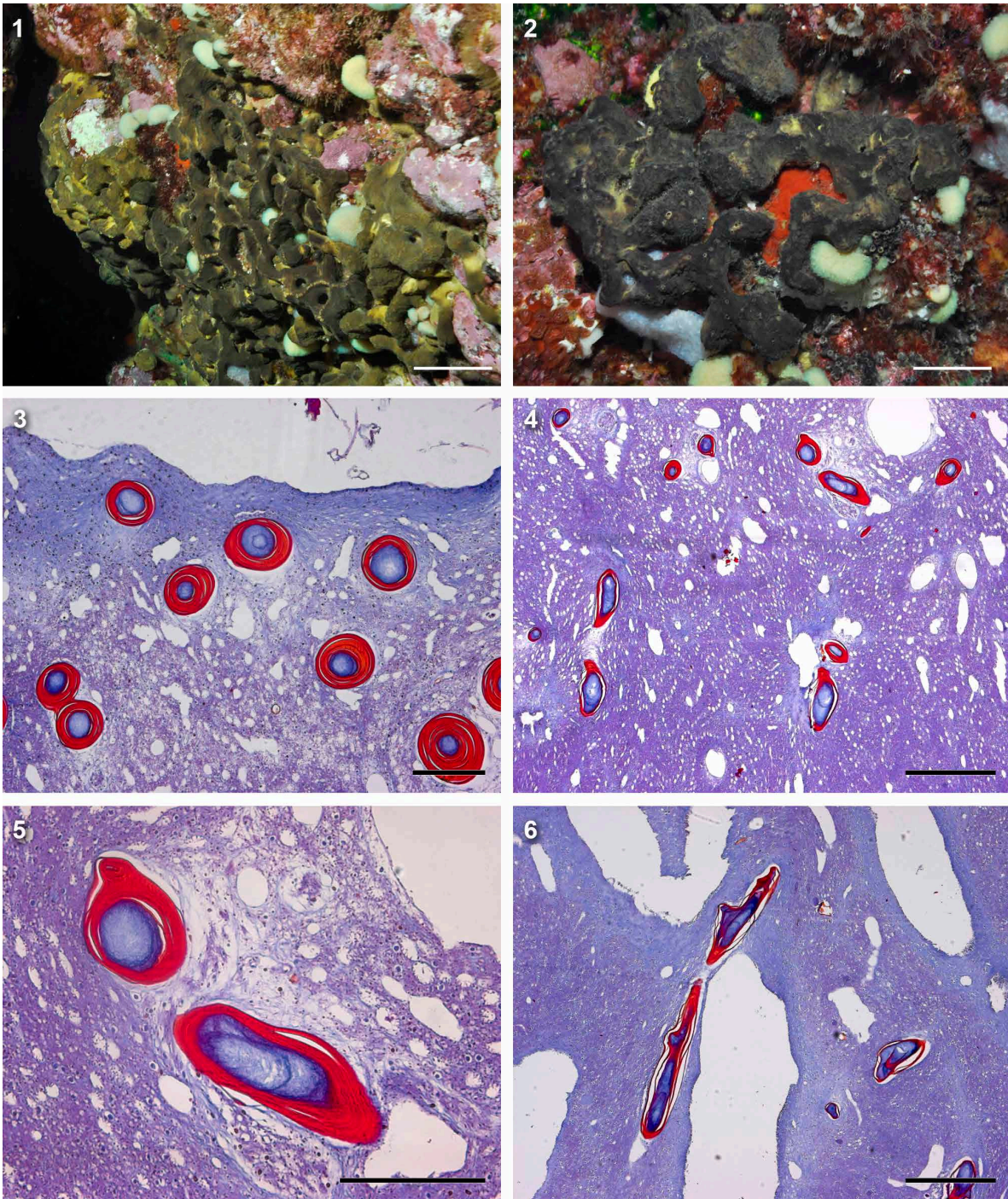


**Figure 1.** *Suberea meandrina* Kelly sp. nov., Nugent Island, Meyer Islets group off north-east Raoul Island. Scale = 67 mm. Image courtesy of Malcolm Francis, NIWA

**Figure 2.** *Suberea meandrina* Kelly sp. nov., Dayrell Island, Meyer Islets group off north-east Raoul Island. Scale = 53 mm. Image courtesy of Malcolm Francis, NIWA

**Figure 3.** Histological section perpendicular to surface of *Suberea meandrina* Kelly sp. nov., showing ectosome (upper layer of dense homogeneous blue material with dark pigmented cells) and choanosome (cavernous basal layer with fibre cross-sections, showing heavily laminated bark (red) and granular blue pith components), holotype AIM MA73392. Scale = 200µm.

**Figure 4.** Fibres deeper within the choanosome of *Suberea meandrina* Kelly sp. nov., holotype AIM MA73392. Scale = 500µm.

**Figure 5.** Large fibres of *S. meandrina* Kelly sp. nov. showing strongly laminated bark and granular pith, holotype AIM MA73392. Scale = 200µm.

**Figure 6.** Longitudinal section of dendritic fibre of *S. meandrina* Kelly sp. nov. in a highly cavernous deep choanosome, paratype AIM MA73393. Scale = 500µm.

The remaining species of *Suberea* are either pedunculate or club-shaped: *S. clavata* (Pulitzer-Finali, 1982) from the Great Barrier Reef, *S. elegans* (Lendenfeld, 1888), *S. ianthelliformis* (Lendenfeld, 1888) from Port Jackson on the south-east coast of Australia, *S. pedunculata* (Lévi, 1969) from the Vema Seamount on the Atlantic coast of South Africa, or digitate with erect lobes: *S. fusca* (Carter, 1880) from Sri Lanka and South India, *S. mollis* (Row, 1911) from the southern Red Sea, and *S. mollis* var. *aruensis* (Hentschel, 1912) from Indonesia. We concur with van Soest *et al.* (2011) that pedunculate *S. azteca* (Gomez & Bakus, 1992), from the Gulf of California and the Pacific Coast of México is probably correct as it was originally described, as a species of *Aplysina*, because the species has a strong reticulation of fibres typical of *Aplysina*, being dendritic only at the periphery of the sponge.

Bergquist *et al.* (1991) listed an undescribed species of *Druinella* (= *Pseudoceratina*; as per van Soest 2011) from the Poor Knights Islands, but later, considered it to be more closely comparable to species of Aplysinellidae, referring to it as a new, undescribed species of *Aplysinella* in Kelly *et al.* (2009). This specimen is now known to represent a new genus of Aplysinellidae characterised by dendritic fibres that have contorted, knotted, interlacing protruberances of the bark component, first characterised in Bergquist *et al.* (1991) (Bergquist, pers. comm.). Species in this undescribed genus often contain considerable amounts of detritus within the pith components of the fibres, and within the body of the sponge.

### Sponge Fauna of the Kermadec Islands Region

Sponges that have been identified or described from the Kermadec Islands, Kermadec Ridge and Volcanic Arc region are listed in Table 1. For the purpose of this review, we limit our detailed discussion to records from the New Zealand Exclusive Economic Zone (EEZ) surrounding the Kermadec Islands group, extending 200 km beyond the shores of the individual islands.

To date 66 species are known from the Kermadec Islands region of the New Zealand EEZ, 46 (70%) of which are described, and 20 (31%) of which are undescribed and new to science. The percentage of known species is relatively high compared to mainland New Zealand sites, largely because of the large number of recent NIWA voyages that have studied the region (Gordon *et al.* 2010), and comparable only with that of the Chatham Rise in terms of our knowledge of the sponge fauna. Most regional, coastal faunas are not known so well due to a lack of focussed collection (Kelly *et al.* 2009). Prior to Kirk (1911), only one species was known, but the total number of species was elevated to 13 with the publication of several Kermadec Trench species by Lévi (1964). From 2000 onwards, identifications steadily improved, bringing the total described species to 46 today. The biodiversity inventory for the region is expanded by some 128 published and undescribed species when collections from the international waters of the Kermadec Ridge/Volcanic Arc region are added (Kelly, unpublished data), bringing the total number of

described sponge species and those new to science, from the Kermadecs region, to 194.

The total number of published species in the New Zealand EEZ surrounding the Kermadec Islands has also been aided by the revision of specific taxa in two major reviews of recent years, the lithistid Demospongiae (rock sponges) (Kelly 2007) and the hexactinosid, aulocalyoid and lychniscosid Hexactinellida (glass sponges) (Reiswig & Kelly 2011). Of particular interest is that five of the six new species of globally ubiquitous genus *Farrea* Bowerbank (Hexactinosida, Farreidae) described by Reiswig & Kelly (2011) were from the Kermadec Islands. The Lyssacinosa and Amphidiscosida glass sponges are also an important component of the fauna, with at least seven known species from the same region (Table 1) presently being redescribed (Reiswig & Kelly, in prep). Similarly, a large number of carnivorous sponges of the genera *Abyssocladia*, *Asbestopluma*, and *Chondrocladia* (Poecilosclerida, Cladorhizidae) have been identified from the region, ten to date, with *Abyssocladia carcharias* Kelly & Vacelet, 2011 presenting globally unprecedented spicule forms (Kelly & Vacelet 2011). Three new species of *Abyssocladia* and *Chondrocladia* are also presently in the process being described.

A majority of major Demosponge orders including Astrophorida, Hadromerida, Halichondrida, Haplosclerida, Poecilosclerida, and Dictyoceratida are under-represented in the collection, when compared to the faunas of the northern Norfolk Ridge fauna (Lévi 1967, 1979, 1993, Lévi & Lévi 1982, 1983), and New Zealand mainland fauna (Bergquist & Fromont 1988, Bergquist & Warne 1980; Kelly *et al.* 2009). This may be a factor of the extreme isolation of the Kermadec region; sponge species numbers are known to decrease significantly with increasing isolation in the tropics and subtropics (Lori J. Bell, M. Kelly, unpublished data). However, the region boasts nine first sponge genus records for New Zealand EEZ: *Corticium* Schmidt (Homosclerophorida, Plakinidae), *Pachymatisma* Bowerbank (Astrophorida, Geodiidae), *Ancorella* Lendenfeld (Astrophorida, Pachastrellidae), *Chondrosia* Nardo (Chondrosida, Chondrillidae), *Neopetrosia* de Laubenfels (Haplosclerida, Petrosiidae), *Echinocalina* Thiele (Poecilosclerida, Microcionidae), *Suberea* Bergquist (Verongiida, Aplysinellidae), *Gymnorette* Ijima (Hexactinosida, Euretidae, in Reiswig & Kelly 2011), and *Hexactinella* Carter (Hexactinosida, Tretodictyidae, in Reiswig & Kelly 2011).

Seven of the species within the New Zealand EEZ surrounding the Kermadec Islands listed in Table 1 were first described from the seamounts of the Norfolk Ridge south of New Caledonia, or other South Pacific locations. When the 128 species known from the international waters of the Kermadec Ridge/Volcanic Arc region are added (Kelly, unpublished data), the number increases to 26 species (Table 2), 13% of the total species known to date (194) for the general Kermadec Islands, Ridge and Volcanic Arc region (Table 2). The documentation here, of numerous sponge species within the Kermadecs region with tropical to subtropical biogeographic links,

Table 1. Sponge diversity of the New Zealand EEZ surrounding the Kermadec Islands group.

- 1 unconfirmed species in draft manuscript on the Amphiprososida and Lyssacosida (Hexactinellida) of New Zealand by H. M. Reiswig & M. Kelly (2015);
- 2 unconfirmed species in draft manuscript on the Cladorhizidae (Demospongiae, Poecilosclerida) of New Zealand by J. Vacelet & M. Kelly (2015);
- 3 undescribed and/or unpublished species record, identified by Dr Michelle Kelly.

| Taxon                                                                  | Citation     | Locality                                                | Depth range (m) |        |          |           |       |
|------------------------------------------------------------------------|--------------|---------------------------------------------------------|-----------------|--------|----------|-----------|-------|
|                                                                        |              |                                                         | 0–50            | 50–200 | 200–1000 | 1000–2000 | +2000 |
| Class DEMOSPONGIAE                                                     |              |                                                         |                 |        |          |           |       |
| Order TETRACTINELLIDA                                                  |              |                                                         |                 |        |          |           |       |
| Family CORALLISTIDAE                                                   |              |                                                         |                 |        |          |           |       |
| <i>Awhiohia unda</i> Kelly, 2007                                       | Kelly (2007) | Southern South Fiji Basin                               |                 |        | x        |           |       |
| <i>Herengeria vasiformis</i> Schlacher-Hoenlinger <i>et al.</i> , 2005 | Kelly (2007) | Eastern Kermadec Ridge slope                            |                 |        | x        |           |       |
| Family NEOPELTIDAE                                                     |              |                                                         |                 |        |          |           |       |
| <i>Neopelta pulvinus</i> Kelly, 2007                                   | Kelly (2007) | Volcano L, Kermadec Ridge                               |                 | x      | x        |           |       |
| Family PHYMATELLIDAE                                                   |              |                                                         |                 |        |          |           |       |
| <i>Neaulaxinia persicum</i> Kelly, 2007                                | Kelly (2007) | North of Raoul Island, Rumble V Seamount                |                 |        | x        |           |       |
| <i>Neosiphonia superstes</i> Sollas, 1888                              | Kelly (2007) | Volcano E, Kermadec Ridge; Eastern Kermadec Ridge slope |                 |        | x        |           |       |
| Family PLEROMIDAE                                                      |              |                                                         |                 |        |          |           |       |
| <i>Pleroma menoui</i> Lévi & Lévi, 1983                                | Kelly (2007) | Volcano E, Kermadec Ridge; Southern South Fiji Basin    |                 | x      | x        |           |       |
| Family SCLERITODERMIDAE                                                |              |                                                         |                 |        |          |           |       |
| <i>Aciculites pulchra</i> Dendy, 1924                                  | Kelly (2007) | Kermadec Ridge                                          |                 | x      |          |           |       |
| Family ANCORINIDAE                                                     |              |                                                         |                 |        |          |           |       |
| <i>Stelletta phialimorpha</i> Lévi, 1993 <sup>3</sup>                  |              | Macauley Caldera, Kermadec Ridge                        |                 |        | x        |           |       |
| <i>Stelletta</i> sp. megaspicules <sup>3</sup>                         |              | Volcano E and L, Kermadec Ridge                         |                 |        | x        |           |       |
| <i>Stelletta</i> sp. smooth encrusting <sup>3</sup>                    |              | Volcano E & F, Kermadec Ridge                           |                 |        | x        |           |       |
| Family GEODIIDAE                                                       |              |                                                         |                 |        |          |           |       |
| <i>Geodia vestigifera</i> (Dendy, 1924) <sup>3</sup>                   |              | Macauley Caldera, Kermadec Ridge                        |                 | x      | x        |           |       |
| <i>Pachymatisma</i> sp. <sup>3</sup>                                   |              | Gill Seamount, Kermadec Ridge                           |                 |        |          | x         |       |
| Family PACHASTRELLIDAE                                                 |              |                                                         |                 |        |          |           |       |
| <i>Ancorella</i> sp. <sup>3</sup>                                      |              | Kermadec Ridge                                          |                 |        | x        |           |       |

| Taxon                                                                           | Citation    | Locality                                     | Depth range (m) | 2000+ |
|---------------------------------------------------------------------------------|-------------|----------------------------------------------|-----------------|-------|
| Order CHONDRILLIDA                                                              |             |                                              |                 |       |
| Family CHONDRILLIDAE                                                            |             |                                              |                 |       |
| <i>Chondrosia</i> sp. <sup>3</sup>                                              |             | Hazard Rock, Macaulay Island                 | x               |       |
| Order CLIONAIDA                                                                 |             |                                              |                 |       |
| Family CLIONAIDAE                                                               |             |                                              |                 |       |
| <i>Cliona</i> sp. cobblestone chocolate <sup>3</sup>                            |             | Denham Bay, Raoul Island                     | x               |       |
| <i>Cliona</i> sp. endolithic chocolate <sup>3</sup>                             |             | Smith's Bluff, Raoul Island                  | x               |       |
| Order POLYMASTIIDA                                                              |             |                                              |                 |       |
| Family POLYMASTIIDAE                                                            |             |                                              |                 |       |
| <i>Acanthopalmastias pisiformis</i> Kelly-Borges & Bergquist, 1997 <sup>3</sup> |             | Cone north of Volcano A, Kermadec Ridge      |                 | x     |
| <i>Tentorium</i> sp. <sup>3</sup>                                               |             | Volcano M3, Kermadec Ridge                   |                 | x     |
| Order SUBERITIDA                                                                |             |                                              |                 |       |
| Family SUBERITIDAE                                                              |             |                                              |                 |       |
| <i>Pseudosuberites</i> sp. <sup>3</sup>                                         |             | Volcano L, Kermadec Ridge                    |                 | x     |
| <i>Suberites pisiformis</i> Lévi, 1993 <sup>3</sup>                             |             | Volcano D (Sonne), Kermadec Ridge            |                 | x     |
| Order TETHYIDA                                                                  |             |                                              |                 |       |
| Family TETHYIDAE                                                                |             |                                              |                 |       |
| <i>Tethya bergquistae</i> Hooper & Wiedenmayer, 1994 <sup>3</sup>               |             | Macauley Caldera, Kermadec Ridge             | x               |       |
| <i>Tethya</i> sp. <sup>3</sup> as <i>T. lyncurium australis</i> in Kirk (1911)  | Kirk (1911) | Raoul Island; Meyer Island, Kermadec Islands | x               |       |
| Order HAPLOSCLERIDA                                                             |             |                                              |                 |       |
| Family CALLYSPONGIIDAE                                                          |             |                                              |                 |       |
| <i>Calyspongia</i> ( <i>Calyspongia</i> ) <i>fastulosa</i> (Kirk, 1911)         | Kirk (1911) | Denham Bay, Raoul Island                     | x               |       |
| <i>Calyspongia</i> ( <i>Toxochalina</i> ) <i>oliveri</i> (Kirk, 1911)           | Kirk (1911) | Coral Bay, Raoul Island                      | x               |       |
| <i>Calyspongia</i> sp. <sup>3</sup>                                             |             | Macauley Caldera, Kermadec Ridge             | x               |       |
| Family CHALINIDAE                                                               |             |                                              |                 |       |
| <i>Haliclona reversa</i> (Kirk, 1911)                                           | Kirk (1911) | Meyer Island, Kermadec Islands               | x               |       |

| Taxon                                                                                                                                 | Citation                                | Locality                                | Depth range (m) |         |           |       |   |
|---------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------|-----------------|---------|-----------|-------|---|
|                                                                                                                                       |                                         |                                         | 0–50            | 200–500 | 1000–2000 | 2000+ |   |
| <b>Family PETROSIIDAE</b>                                                                                                             |                                         |                                         |                 |         |           |       |   |
| <i>Petrosia</i> ( <i>Petrosia</i> ) <i>pluricristata</i> Lévi & Lévi, 1983 <sup>3</sup>                                               |                                         | Macaulay Caldera, Kermadec Ridge        | x               |         |           |       |   |
| <i>Petrosia</i> sp. <sup>3</sup>                                                                                                      |                                         | Volcano L, Kermadec Ridge               |                 | x       |           |       |   |
| <i>Neopetrosia</i> sp. <sup>3</sup>                                                                                                   |                                         | Monowai Caldera and cone                |                 | x       |           |       |   |
| <b>Order POECIOSCLERIDA</b>                                                                                                           |                                         |                                         |                 |         |           |       |   |
| <b>Family CLADORHIZIDAE</b>                                                                                                           |                                         |                                         |                 |         |           |       |   |
| <i>Abyssocladia bruuni</i> Lévi, 1964                                                                                                 | Lévi (1964)                             | Kermadec Trench                         |                 |         |           | x     |   |
| <i>Abyssocladia carcharias</i> Kelly & Vacelet, 2011                                                                                  | Kelly & Vacelet (2011)                  | Monowai caldera and cone                |                 |         | x         |       |   |
| <i>Abyssocladia</i> sp. <sup>2</sup>                                                                                                  |                                         | Brothers Seamount, Kermadec Ridge       |                 |         | x         |       |   |
| <i>Asbestopluma biserialis</i> (Ridley & Dendy, 1886)                                                                                 | Lévi (1964)                             | Kermadec Trench                         |                 |         |           |       |   |
| <i>Asbestopluma hadalis</i> Lévi, 1964                                                                                                | Lévi (1964)                             | Kermadec Trench                         |                 |         |           | x     |   |
| <i>Asbestopluma wolffi</i> Lévi, 1964                                                                                                 | Lévi (1964)                             | Kermadec Trench                         |                 |         |           | x     |   |
| <i>Chondrocladia</i> sp. <sup>2</sup>                                                                                                 |                                         | Volcano H, Kermadec Ridge               |                 |         | x         |       |   |
| <i>Chondrocladia</i> ( <i>Chondrocladia</i> ) <i>asigmata</i> Lévi, 1964                                                              | Lévi (1964)                             | Kermadec Trench                         |                 |         |           | x     |   |
| <b>Family COELOSPHAERIDAE</b>                                                                                                         |                                         |                                         |                 |         |           |       |   |
| <i>Lissodendoryx</i> ( <i>Echyodoryx</i> ) <i>frondosa</i> (Ridley & Dendy, 1886) as <i>Myxilla frondosa</i> in Ridley & Dendy (1886) | Ridley & Dendy (1886)                   | off Kermadec Islands                    |                 | x       |           |       |   |
| <b>Family MICROCIONIDAE</b>                                                                                                           |                                         |                                         |                 |         |           |       |   |
| <i>Clathria</i> ( <i>Clathria</i> ) <i>intermedia</i> Kirk, 1911                                                                      | Kirk (1911); Bergquist & Fromont (1988) | Denham Bay, Smith's Bluff, Raoul Island | x               |         |           |       |   |
| <i>Echinochalina</i> ( <i>Protophlitaspongia</i> ) sp. <sup>3</sup>                                                                   |                                         | Denham Bay, Raoul Island                | x               |         |           |       |   |
| <b>Family MYCALIDAE</b>                                                                                                               |                                         |                                         |                 |         |           |       |   |
| <i>Mycale</i> ( <i>Mycale</i> ) sp. <sup>3</sup>                                                                                      |                                         | Southern Kermadec Ridge                 |                 |         | x         |       | x |
| <b>Order AXINELLIDA</b>                                                                                                               |                                         |                                         |                 |         |           |       |   |
| <b>Family RASPAILIIDAE</b>                                                                                                            |                                         |                                         |                 |         |           |       |   |
| <i>Raspailia</i> ( <i>Clathriodendron</i> ) <i>rubrum</i> (Kirk, 1911)                                                                | Kirk (1911); Bergquist (1970)           | Denham Bay, Raoul Island                | x               |         |           |       |   |

| Taxon                                                      | Citation               | Locality                                 | Depth range (m) |        |          |           |       |
|------------------------------------------------------------|------------------------|------------------------------------------|-----------------|--------|----------|-----------|-------|
|                                                            |                        |                                          | 0–50            | 50–200 | 200–1000 | 1000–2000 | 2000+ |
| Order VERONGIIDA                                           |                        |                                          |                 |        |          |           |       |
| Family APLYSINELLIDAE                                      |                        |                                          |                 |        |          |           |       |
| <i>Suberea meandrina</i> Kelly sp. nov. (this work)        |                        | L' Esperance Rock, Kermadec Islands      | x               |        |          |           |       |
| Class HOMOSCLEROMORPHA                                     |                        |                                          |                 |        |          |           |       |
| Order HOMOSCLEROPHORIDA                                    |                        |                                          |                 |        |          |           |       |
| Family PLAKINIDAE                                          |                        |                                          |                 |        |          |           |       |
| <i>Corticium bargibanti</i> Lévi & Lévi, 1983 <sup>3</sup> |                        | Volcano F, Kermadec Ridge                |                 | x      |          |           |       |
| Class HEXACTINELLIDA                                       |                        |                                          |                 |        |          |           |       |
| Order HEXACTINOSIDA                                        |                        |                                          |                 |        |          |           |       |
| Family EURETIDAE                                           |                        |                                          |                 |        |          |           |       |
| <i>Chonelasma hamatum</i> Schulze, 1886                    | Reiswig & Kelly (2011) | off Raoul Island, Kermadec Islands       |                 |        |          | x         |       |
| <i>Chonelasma lamella</i> Schulze, 1886                    | Reiswig & Kelly (2011) | Southern Kermadec Ridge                  |                 |        |          | x         |       |
| <i>Conorete gordonii</i> Reiswig & Kelly, 2011             | Reiswig & Kelly (2011) | Volcano A, Kermadec Ridge                |                 |        |          | x         |       |
| <i>Gymnorete pacificum</i> Reiswig & Kelly, 2011           | Reiswig & Kelly (2011) | NNE of Herald Islets, Raoul Island       |                 |        |          | x         |       |
| Family FARREIDAE                                           |                        |                                          |                 |        |          |           |       |
| <i>Farrea anachorata</i> Reiswig & Kelly, 2011             | Reiswig & Kelly (2011) | Feature K (Cupcake), Kermadec Ridge      |                 |        | x        | x         |       |
| <i>Farrea anoxyhexastra</i> Reiswig & Kelly, 2011          | Reiswig & Kelly (2011) | Kermadec Islands                         |                 |        | x        |           |       |
| <i>Farrea medusiforma</i> Reiswig & Kelly, 2011            | Reiswig & Kelly (2011) | Southern Kermadec Ridge                  |                 |        |          | x         | x     |
| <i>Farrea occa occa</i> Bowerbank, 1862                    | Reiswig & Kelly (2011) | Gill Seamount, Volcano H, Kermadec Ridge |                 |        |          | x         |       |
| <i>Farrea similaris</i> Reiswig & Kelly, 2011              | Reiswig & Kelly (2011) | Kermadec Ridge                           |                 |        | x        |           |       |
| <i>Farrea raoulensis</i> Reiswig & Kelly, 2011             | Reiswig & Kelly (2011) | NNE of Herald Islets, Raoul Island       |                 |        |          | x         |       |
| Family AULOPLACIDAE                                        |                        |                                          |                 |        |          |           |       |
| <i>Auloplax breviscopulata</i> Reiswig & Kelly, 2011       | Reiswig & Kelly (2011) | Kermadec Islands, near Kermadec Islands  |                 |        | x        | x         |       |
| <i>Auloplax sonnae</i> Reiswig & Kelly, 2011               | Reiswig & Kelly (2011) | Monowai caldera and cone                 |                 |        | x        |           |       |
| Family TRETODICTYIDAE                                      |                        |                                          |                 |        |          |           |       |
| <i>Hexactinella acanthacea</i> Reiswig & Kelly, 2011       | Reiswig & Kelly (2011) | Kermadec Ridge                           |                 |        |          | x         |       |

| Taxon                                                                    | Citation               | Locality                                                                       | Depth range (m) |           |
|--------------------------------------------------------------------------|------------------------|--------------------------------------------------------------------------------|-----------------|-----------|
|                                                                          |                        |                                                                                | 0–50            | 50–200    |
|                                                                          |                        |                                                                                | 200–1000        | 1000–2000 |
|                                                                          |                        |                                                                                |                 | 2000+     |
| Order AULOCALYCOIDA                                                      |                        |                                                                                |                 |           |
| Family AULOCALYCIDAE                                                     |                        |                                                                                |                 |           |
| <i>Eurylegma auriculare</i> Schulze, 1886                                | Reiswig & Kelly (2011) | Feature K (Cupcake), Kermadec Ridge                                            |                 | x         |
| Order AMPHIDISCOSIDA                                                     |                        |                                                                                |                 |           |
| Family HYALONEMATIDAE                                                    |                        |                                                                                |                 |           |
| <i>Hyalonema (Oonema) bipinnulum</i> (Lévi, 1964) <sup>1</sup>           |                        | Feature K (Cupcake), Kermadec Ridge                                            | x               | x         |
| Family PHERONEMATIDAE                                                    |                        |                                                                                |                 |           |
| <i>Pheronema conicum</i> Lévi & Lévi, 1982 <sup>1</sup>                  |                        | Macauley Caldera, Kermadec Ridge                                               |                 | x         |
| Order LYSSACINOSIDA                                                      |                        |                                                                                |                 |           |
| Family EUPECTELLIDAE                                                     |                        |                                                                                |                 |           |
| <i>Regadrella</i> sp. <sup>1</sup>                                       |                        | Feature K (Cupcake), Kermadec Ridge                                            | x               |           |
| <i>Saccocalyx pedunculatus</i> Schulze, 1895 <sup>1</sup>                |                        | Macauley Caldera, Kermadec Ridge                                               |                 | x         |
| <i>Walteria leuckarti leuckarti</i> Ijima, 1896 <sup>1</sup>             |                        | ridge west of Volcano L, Kermadec Ridge; North of Raoul Island, Kermadec Ridge | x               | x         |
| Family ROSSELLIDAE                                                       |                        |                                                                                |                 |           |
| <i>Crateromorpha (Aulochone) cylindrica</i> (Schulze, 1886) <sup>1</sup> |                        | Feature K (Cupcake) & Volcano D (Sonne), Kermadec Ridge                        |                 | x         |
| <i>Caulophacus (Caulophacus) hadalis</i> Lévi, 1964                      |                        | Kermadec Trench                                                                |                 | x         |

**Table 2.** Sponge species from international and New Zealand EEZ waters surrounding the Kermadec Islands, Ridge, and Volcanic Arc region, first described from the seamounts of the Norfolk Ridge south of New Caledonia, or other South Pacific locations.

| Taxon                                                                  | Type Locality | Other distribution                                         |
|------------------------------------------------------------------------|---------------|------------------------------------------------------------|
| <b>Class DEMOSPONGIAE</b>                                              |               |                                                            |
| <b>Order TETRACTINELLIDA</b>                                           |               |                                                            |
| <b>Family CORALLISTIDAE</b>                                            |               |                                                            |
| <i>Herengeria vasiformis</i> Schlacher-Hoenlinger <i>et al.</i> , 2005 | Norfolk Ridge | New Caledonian EEZ, South Norfolk Basin, New Zealand EEZ   |
| <i>Neoschrammeniella fulvodesmus</i> (Lévi & Lévi, 1983)               | Norfolk Ridge | New Caledonian EEZ, Norfolk Is., New Zealand EEZ           |
| <i>Corallistes australis</i> Schlacher-Hoenlinger <i>et al.</i> , 2005 | Norfolk Ridge | New Caledonian EEZ, Kermadec Islands region of New Zealand |
| <b>Family PHYMATELLIDAE</b>                                            |               |                                                            |
| <i>Neosiphonia superstes</i> Sollas, 1888                              | Fiji Islands  | New Caledonian EEZ, New Zealand EEZ                        |
| <i>Reidispongia coerulea</i> Lévi & Lévi, 1988                         | Norfolk Ridge | New Caledonian EEZ, New Zealand EEZ                        |
| <b>Family THEONELLIDAE</b>                                             |               |                                                            |
| <i>Discodermia proliferans</i> Lévi & Lévi, 1983                       | Norfolk Ridge | New Caledonian EEZ, New Zealand EEZ                        |
| <b>Family PLEROMIDAE</b>                                               |               |                                                            |
| <i>Pleroma menoui</i> Lévi & Lévi, 1983                                | Norfolk Ridge | Lord Howe Is., Norfolk Is., New Caledonia, New Zealand     |
| <i>Pleroma turbinatum</i> Sollas, 1888                                 | Fiji Islands  | Lord Howe Is., Norfolk Is., New Caledonia, New Zealand     |
| <b>Family NEOPELTIDAE</b>                                              |               |                                                            |
| <i>Callipelta punctata</i> Lévi & Lévi, 1983                           | Norfolk Ridge | New Caledonian EEZ, New Zealand EEZ                        |
| <b>Family ISORAPHINIIDAE</b>                                           |               |                                                            |
| <i>Costifer wilsoni</i> Lévi, 1993                                     | Norfolk Ridge | New Caledonian EEZ, New Zealand EEZ                        |
| <b>Family ANCORINIDAE</b>                                              |               |                                                            |
| <i>Stelletta phialimorpha</i> Lévi, 1993                               | Norfolk Ridge | New Caledonian EEZ, New Zealand EEZ                        |
| <i>Stelletta centroriata</i> Lévi & Lévi, 1983                         | Norfolk Ridge | New Caledonian EEZ, New Zealand EEZ                        |
| <i>Penares palmatocladia</i> Lévi 1993                                 | Norfolk Ridge | New Caledonian EEZ, New Zealand EEZ                        |
| <b>Order SUBERITIDA</b>                                                |               |                                                            |
| <b>Family SUBERITIDAE</b>                                              |               |                                                            |
| <i>Suberites pisiformis</i> Lévi, 1993                                 | Norfolk Ridge | New Caledonian EEZ, New Zealand EEZ                        |
| <b>Family HALICHONDRIIDAE</b>                                          |               |                                                            |
| <i>Topsentia bubaroides</i> (Lévi & Lévi, 1983)                        | Norfolk Ridge | New Caledonian EEZ, New Zealand EEZ                        |
| <b>Order TETHYIDA</b>                                                  |               |                                                            |
| <b>Family TETHYIDAE</b>                                                |               |                                                            |
| <i>Halicometes cf hooperi</i> Lévi, 1993                               | Norfolk Ridge | New Caledonian EEZ, New Zealand EEZ                        |
| <b>Family HEMIASTERELLIDAE</b>                                         |               |                                                            |
| <i>Hemiassterella topsenti</i> (Lévi & Lévi, 1983)                     | Norfolk Ridge | New Caledonian EEZ, New Zealand EEZ                        |
| <b>Order HAPLOSCLERIDA</b>                                             |               |                                                            |
| <b>Family PETROSIIDAE</b>                                              |               |                                                            |
| <i>Petrosia (Petrosia) pluricristata</i> Lévi & Lévi, 1983             | Norfolk Ridge | New Caledonian EEZ, New Zealand EEZ                        |

| Taxon                                                                  | Type Locality     | Other distribution                                  |
|------------------------------------------------------------------------|-------------------|-----------------------------------------------------|
| Order POECILOSCLERIDA                                                  |                   |                                                     |
| Family GUITARRIDAE                                                     |                   |                                                     |
| <i>Coelodischela massa</i> Lévi & Lévi, 1983                           | Norfolk Ridge     | New Caledonian EEZ, New Zealand EEZ                 |
| Family ACARNIDAE                                                       |                   |                                                     |
| <i>Cornulum virguliferum</i> (Lévi & Lévi, 1983)                       | Norfolk Ridge     | New Caledonian EEZ, New Zealand EEZ                 |
| Family CRELLIDAE                                                       |                   |                                                     |
| <i>Crella</i> ( <i>Yvesia</i> ) <i>acanthosclera</i> Lévi & Lévi, 1983 | Norfolk Ridge     | New Caledonian EEZ, New Zealand EEZ                 |
| Family MYCALIDAE                                                       |                   |                                                     |
| <i>Mycale incurvata</i> Lévi, 1993                                     | Norfolk Ridge     | New Caledonian EEZ, New Zealand EEZ                 |
| Family PHELLODERMIIDAE                                                 |                   |                                                     |
| <i>Echinostylinos stylophora</i> Lévi & Lévi, 1983                     | Norfolk Ridge     | New Caledonian EEZ, New Zealand EEZ                 |
| Class HOMOSCLEROMORPHA                                                 |                   |                                                     |
| Order HOMOSCLEROPHORIDA                                                |                   |                                                     |
| Family PLAKINIDAE                                                      |                   |                                                     |
| <i>Corticium bargibanti</i> Lévi & Lévi, 1983                          | Norfolk Ridge     | New Caledonian EEZ, New Zealand EEZ                 |
| Class HEXACTINELLIDA                                                   |                   |                                                     |
| Order HEXACTINOSIDA                                                    |                   |                                                     |
| Family TRETODICTYIDAE                                                  |                   |                                                     |
| <i>Psilocalyx wilsoni</i> Ijima, 1927                                  | Indonesian waters | Lord Howe Is., Norfolk Is. regions, New Zealand EEZ |
| Order AMPHIDISCOSIDA                                                   |                   |                                                     |
| Family PHERONEMATIDAE                                                  |                   |                                                     |
| <i>Pheronema conicum</i> Lévi & Lévi, 1982                             | Norfolk Ridge     | New Caledonian EEZ, New Zealand EEZ                 |

reinforces the assertion that the marine environment surrounding the Kermadec Islands provides a unique and critical link between the temperate waters of mainland New Zealand and tropical waters further north.

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