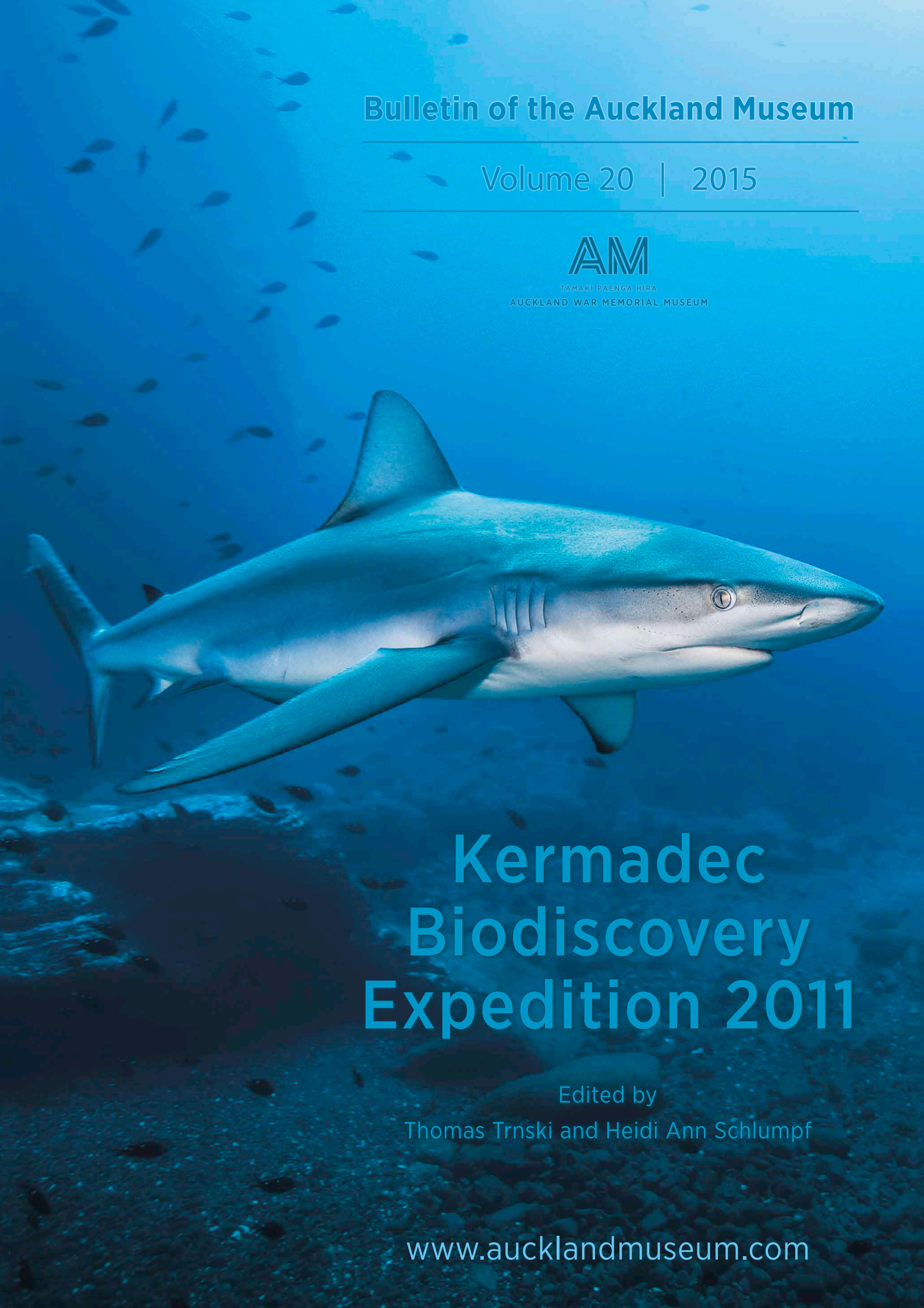




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Scleractinian corals and crown-of-thorns seastars of the Kermadec Islands

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Abstract

New material collected from the Kermadec Islands verifies the presence of at least 11 scleractinian coral species and a crown-of-thorns seastar survey suggests a high density of corallivores are present at North Meyer Island (i.e. > 0.008 individuals per m²). Despite not currently being classified as a coral reef, tropical reef-building coral species are present in the coral community and there has been a population of *Acanthaster planci* present for at least three decades. This marginal coral community represents a valuable opportunity to examine climate-driven coral and coral predator transitions into high latitude locations.

Keywords

Crown-of-thorns; marginal coral community; Scleractinia; transitions

INTRODUCTION

The Kermadec Islands (29–31.5°S and 178–179°W) are an isolated volcanic archipelago situated midway between tropical Tonga and temperate New Zealand. Despite their isolation (~800km from the nearest landmass) and subtropical position (just 1°N of the southern-most coral reefs of the world, Lord Howe Island), previous studies have shown a mix of reef-building (hermatypic) tropical, subtropical and temperate corals are present (Cairns, 1995; Kosmynin, 1994; Brook, 1999; Wicks *et al.*, 2010).

The first accounts of the Kermadec Islands coral fauna were published by Vaughan (1917) and these records were used by Wells (1954), and Stehli and Wells (1971) in their analysis of coral biogeographic patterns. The next significant coral diversity studies were conducted by Kosmynin (1994) who raised the number of scleractinian species known at the islands from 6 to 14 and Cairns (1995) who documented the azooxanthellate (i.e. lacking algal symbionts) species. In 1999, Brook revised this number to 24 species (17 zooxanthellate species from 15 genera and 7 azooxanthellate species from 6 genera).

While coral reefs typical of tropical locations in the Pacific Ocean are not formed at the Kermadec Islands, surveys conducted in 2011 and 2012 have substantiated that considerable populations of not only hard corals, but a corallivore are present. Here we report new observations of the coral assemblage and a recent estimate of the abundance of the crown-of thorns seastar (*Acanthaster planci*; Linnaeus, 1758).

MATERIALS AND METHODS

During the 2011 Kermadec Biodiscovery Expedition hard corals were opportunistically collected on SCUBA from the 0–20 m depth zone (see Trnski and Lange, 2015 for sampling stations). The samples were preserved in 100% ethanol. Identifications were carried out by Dr Zoe Richards with comparison to known specimens in the Australian Museum. Corals were identified according to the revised classification schemes of Benzoni *et al.* (2012) for Coscinaraeidae and Huang *et al.* (2014) for Merulinidae. Acroporidae, Pocilloporidae and Dendrophyllidae were identified according to Veron (2000) and azooxanthellate corals were identified according to Cairns (1995).

During the 2011 Kermadec Biodiscovery Expedition and 2012 Inaugural Young Blake Expedition crown-of-thorns seastars were opportunistically observed around Raoul Island and surrounding islets. On August 16, 2012 the local abundance of crown-of-thorns seastars was surveyed within a 100 m x 32 m belt transect on the shallow reef (3–10 m) west of North Meyer Island (29.24°S and 177.88°W), an islet north of Raoul Island. This site was selected for its proximity to previously surveyed reefs areas (as detailed in Gardner *et al.*, 2006) and for its discrete topography, recognisable upon return. Every seastar within the designated area was counted and simultaneously sampled for genetic analysis by clipping the tip of an arm.

RESULTS

Twenty hard coral specimens were collected and have been deposited in the Australian Museum, Sydney, Australia. From this collection 11 hard coral species from 10 genera were identified (8 zooxanthellate, 3 axooxanthellate) (Table 1). Crown-of-thorns seastars were observed around Dayrell Island (2011), Meyer Islands (2011 and 2012), Egeria Rock and Boat Cove (2012). In 2012, 26 crown-of-thorns seastars were counted within the designated area west of North Meyer Island, providing a local density estimate of 0.008 individuals per m².

DISCUSSION

From the material collected in 2011, 11 hard coral species were identified. Three species are newly recorded from the Kermadec Islands (*Hydnophora exesa*; *Pocillopora damicornis*; *Goniastrea favulus*). These records provide southerly extensions of the known ranges of these tropical species and their occurrence at the Kermadec Islands suggests that tropical waters reach the Kermadec region, possibly from the northeast as suggested by Ridgeway and Heath (1975). A fourth species tentatively identified here as *Balanophyllia* cf. *chnous* is endemic to the Southwest Pacific Ocean (Cairns, 1995) and has not previously been recorded in shallow water. *B. chnous* is previously known from the 140–549 m depth range (Cairns, 1995). The finding of this species in shallow water is atypical but could relate to the availability of reef slope habitat and cold-water temperatures enabling this species to enter the euphotic zone. However it is recommended further verification of this identification should be sought from an azooxanthellate coral taxonomic expert.

Another of the azooxanthellate specimens identified in 2011 (*Culicia rubeola*) was recorded at the Kermadec Islands by Brook (1999); however that record was considered dubious {denoted with a (?)}. *Culicia rubeola*

is a putative endemic to the New Zealand region, recorded within the 0–82 m depth zone (Cairns, 1995) hence the new record we provide here from the Kermadec Islands is regionally significant. However, a revision of the genus is needed and no attempt has been made here to rigorously compare this *C. rubeola* sample to the other 12–14 species known from the genus worldwide.

Taxonomic uncertainty also surrounds two of the putative zooxanthellate species collected. The first relates to the *Hydnophora* spp. The 2011 samples of *Hydnophora* sp. show close affinity to *Hydnophora exesa* (which was recorded by Kosmynin, 1994 at the Kermadec Islands); however Kosmynin's identification was revised by Brook (1999) as *Hydnophora pilosa*. Further examination of the type material of these samples in relation to the 2011 material is advisable.

Three *Montipora* samples identified from the present collection resemble samples identified by Kosmynin (1994) as *Montipora caliculata*; however Brook (1999) revised Kosmynin's identification to *M. capricornis*. The 2011 *Montipora* samples show affinity to *Montipora capricornis*. Again, further examination of the Kosmynin and Brook skeletal material {deposited at the National Museum of New Zealand, National Museum of Natural History (Smithsonian Institution) and the Auckland War Memorial Museum}, in relation to the 2011 material (deposited in the Australian Museum, Sydney) is advisable.

Despite not currently being classified as a coral reef, tropical hermatypic coral species are present and the benthic cover of hard corals has been documented to reach 40% at Raoul Island (Brook, 1999). The level of coral cover was highly variable however with < 1% coral cover recorded at the southern islands in that study. A more recent study found around the island group as a whole, the mean scleractinian coral cover was around 14% (Wicks *et al.*, 2010). New coral cover estimates were not obtained in this study however we recommend these estimates be updated on future expeditions.

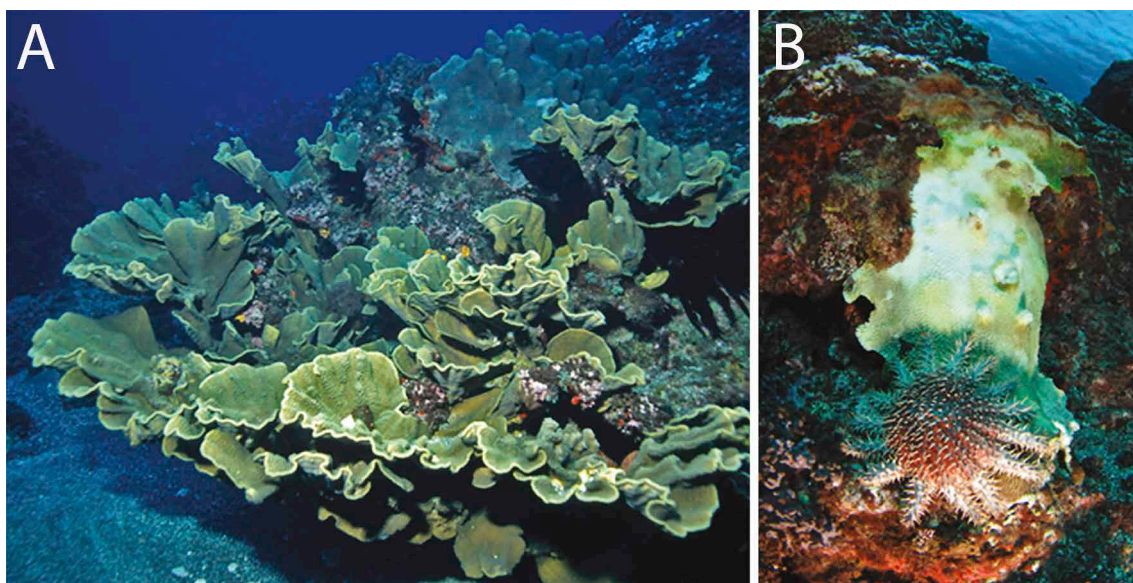


Figure 1. A. Mature colony of *Turbinaria mesenterina* at Raoul Island. Photo © Malcolm Francis. B. *Acanthaster planci* devouring a colony of *Hydnophora exesa*. Photo © Pete Mesley, www.petemesley.com

Table 1. Scleractinian corals collected from the Kermadec Islands, May 2011.

Species	Family	Authority	Number of Samples	Previously recorded at Kermadec Islands?	Relevant literature	Range denoted in Veron, 2000
<i>Coscinaraea columna</i>	Coscinaraeidae	(Dana, 1846)	3	Yes	Brook (1999)	Yes
<i>Pocillopora damicornis</i>	Pocilloporidae	(Linnaeus, 1758)	2 juveniles	Yes	Schiel <i>et al.</i> (1986); Kosmynin (1994); Brook (1999); Wicks <i>et al.</i> (2010)	No
<i>Goniastrea favulus</i>	Merulinidae	(Dana, 1846)	2	Yes	Schiel <i>et al.</i> (1986); Wicks <i>et al.</i> (2010)	No
<i>Astrea curta</i>	Merulinidae	(Dana, 1946)	1	Yes (as <i>Montastrea curta</i>)	Schiel <i>et al.</i> (1986); Kosmynin (1994); Brook (1999); Wicks <i>et al.</i> (2010a, b)	Yes
<i>Turbinaria frondens</i>	Dendrophylliidae	(Dana, 1846)	1 juvenile	Yes	Schiel <i>et al.</i> (1986); Brook (1999); Wicks <i>et al.</i> (2010a, b)	Yes
<i>Hydnophora exesa</i>	Merulinidae	(Pallas, 1766)	2	Yes	Kosmynin (1994)	No
<i>Montipora spongodes</i>	Acroporidae	Bernard, 1897	3	Yes	Brook (1999); Wicks <i>et al.</i> (2010)	Yes
<i>Montipora capricornis</i>	Acroporidae	Veron, 1985	3	Yes	Brook (1999); Wicks <i>et al.</i> (2010)	Yes
<i>Tubastrea diaphana</i>	Dendrophylliidae	(Dana, 1846)	1	Yes	Brook (1999); Wicks <i>et al.</i> (2010)	NA
<i>Balanophyllia cf. chnous</i>	Dendrophylliidae	Squires, 1962	1	No	Cairns, 1995	NA
<i>Culicia rubeola</i>	Rhizangiidae	(Quoy and Gaimard, 1833)	1	Yes (listed with a ?)	Brook (1999)	NA

Despite variable benthic cover of corals and a low diversity of scleractinian corals relative to tropical coral reefs, the Kermadec Islands coral community has supported a population of the corallivore *Acanthaster planci* for more than three decades. Crown-of-thorns seastars were first reported at the Kermadec islands in 1978 (McKnight, 1978) and have been subsequently reported several times (Schiel *et al.*, 1986; Francis *et al.*, 1987; Cole *et al.*, 1992; Brook, 1999; Gardner, 2006). Observations from the 2011 and 2012 expeditions (although not exhaustive in extent) confirm crown-of-thorns seastars continue to be present around Raoul Island and many surrounding islets. Results of the current survey suggest there is a high density of crown-of-thorns seastars on the reef west of North Meyer Island (i.e. > 0.008 individuals per m²) which has been maintained for at least a decade. In this same location, up to 0.008 individuals per m² were observed in 1995 (Brook, 1999), and in 2002 Gardner *et al.* (2006) observed 0.25 individuals per m² (6–9 m depth). Furthermore, genetic analysis of crown-of-thorns seastars suggest the population surrounding Raoul Island is self-recruiting (based on haplotype identity and frequency; Vogler *et al.*, 2013; Liggins *et al.*, 2014). Thus, the transitional coral-algal benthic community of the Kermadec Islands is sustaining a resident population of this corallivore.

Further systematic study is required to resolve the identity of the *Balanophyllia*, *Culicia*, *Hydnophora* and *Montipora* species of the Kermadec Islands and additional quantitative data is needed to monitor the abundance and extent of coral and coral predators around the Kermadec Islands. Overall, this marginal community represents a valuable opportunity to examine climate-driven coral and coral predator transitions into high latitude locations.

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