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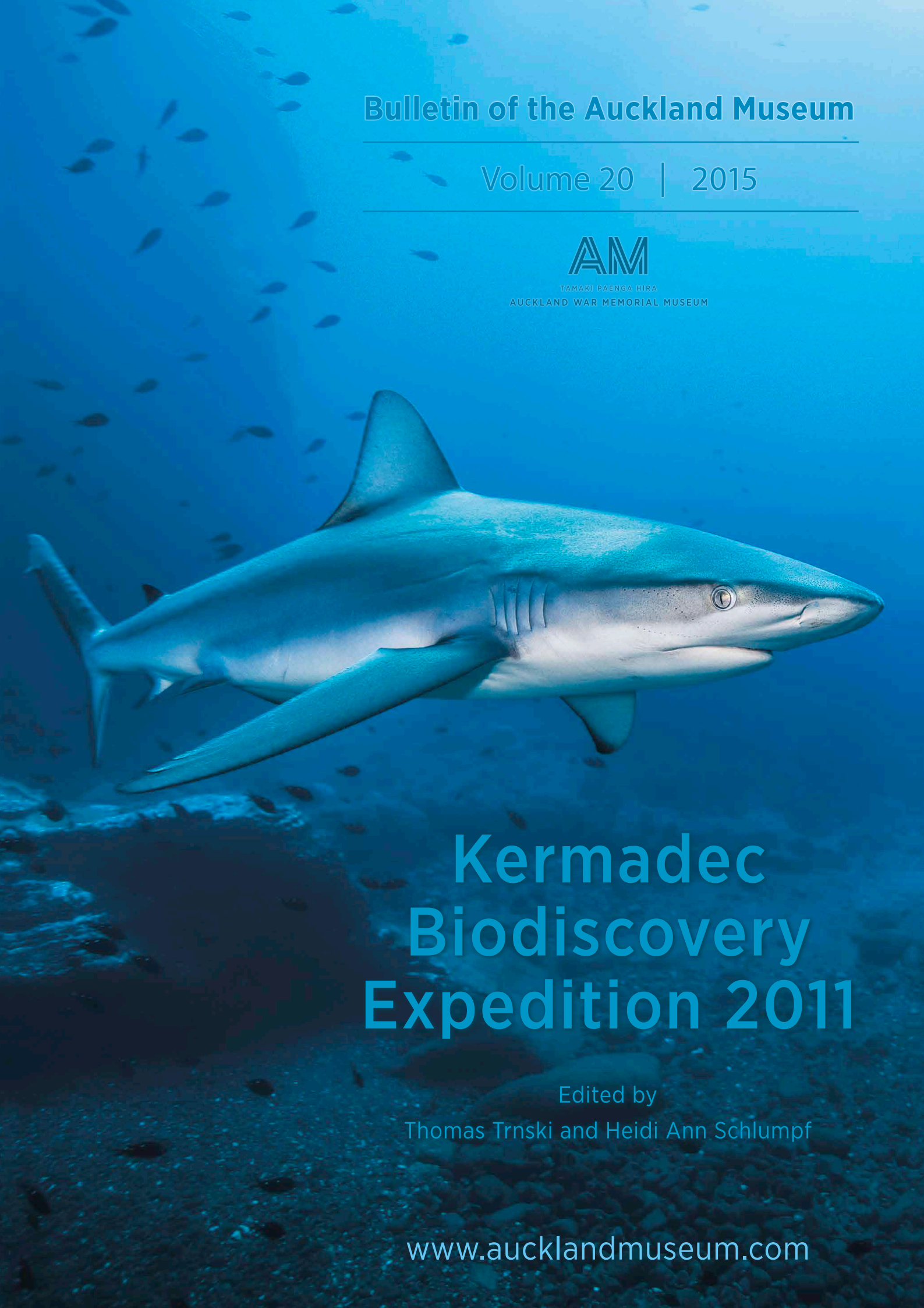

Kermadec Biodiscovery Expedition 2011

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Recent collections of fishes at the Kermadec Islands and new records for the region

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Abstract

Five visits to the Kermadec Islands between 2004 and 2013 have increased the number of confirmed fish species from the region. The most intensive survey of shore fishes from all island groups of the Kermadec Islands was undertaken in May 2011. Additional fishes were recorded during surveys undertaken in 2004, 2012 and 2013. The main method used was rotenone, targeting cryptic fishes, supplemented by fishes collected by night lighting, hook and line fishing, gill netting, trapping, spearing and hand-collecting. A total of 114 species of coastal fishes and an additional 12 species from deeper water were collected. Four species of coastal fishes, based on voucher material, reported here are new records for the Kermadec Islands, with an additional nine species records to be reported in a forthcoming publication. Of these 13 new records for the Kermadec Islands, all but one species were also new records for the New Zealand Exclusive Economic Zone. In addition, 12 species of deeper shelf and upper slope fishes were collected in depths to 300 m, confirming their presence at the islands.

Keywords
Fish diversity; distributions; southwestern Pacific; new records

INTRODUCTION

The Kermadec Islands have been emergent above sea level for about 0.5 million years (Latter *et al*., 1992). The existence of uplifted limestone reefs on some the islands provides evidence that mid-late Pleistocene (0.5 million to 12,000 years before present) subtropical communities existed near the ocean surface (Brook, 1998, 1999).

Subtidal habitat has been available for considerably longer with the development of the Kermadec Ridge, with early Miocene (about 23 million years before present (mybp)) fossils dredged from the top of the ridge (Brook, 1999). The presence of *Patella Scutellastra kermadecensis* at the Kermadec Islands argues for shallow water habitats along the ridge by at least the late Pliocene (about 2.6 mybp) when this species died out across the rest of its range (Fleming, 1973).

The present morphology of Raoul Island was largely produced by erosion and explosive volcanism beginning from about 4,000 ybp (Lloyd & Nathan 1981). Macauley Island is a small, emergent fragment of the rim of the Macauley Caldera (13 km x 11 km x 1000 m deep) that was formed in the last few thousand years by a magnitude 11 eruption (Latter *et al*. 1992; Lloyd *et al*. 1996). The rate of recent uplift has been rapid; for example, Curtis and Cheeseman islands have been uplifted by about 18 m in the last 200 years (Doyle *et al*., 1979).

Considering the recent emergence of these islands, and their relative isolation – a distance of 650 km or more from the nearest reef or landmass (Trnski & de Lange, 2015) – all coastal species that occur at the Kermadec Islands must have derived from adjacent populations through dispersal (Trnski *et al*., 2010).

The Kermadec Islands have been exposed to a very low level of fishing effort, as there rarely has been a human population resident at the islands, and commercial fishing effort is relatively low and is focused on pelagic fishes (Zylich *et al*., 2012). This is due to the remoteness and inhospitability of the islands for human habitation due to the lack of permanent potable water and coastal

shelter on any of the islands, and the frequent tropical storms and volcanic activity. These same conditions have limited opportunities to undertake surveys of marine life of these islands (Trnski & de Lange, 2015). In addition to these factors, the marine environment within 12 nautical miles of the islands has been fully protected from exploitation within the Kermadec Islands Marine Reserve since 1990.

The first collections of fishes from the Kermadec Islands were made during the Challenger Expedition in 1873-1876 and reported by Günther (1887, 1889) and Murray (1895). Only two of the 12 species collected were shore fish species: *Carcharhinus galapagensis* (as *Carcharias lamia*) and *Naucrates ductor*; the other species were all mesopelagic or deepwater species. Since that time, each expedition to collect fishes at the Kermadec Islands has generated an increase in the known number of coastal fish species (excluding deep water and epipelagic species) (Francis & Cole, 2010; Trnski & de Lange, 2015). In summary, 12 species were reported from the Challenger Expedition, 32 species were recorded by Waite (1910, 1912), a summary of holdings at the Museum of New Zealand Te Papa Tongarewa recorded 72 species (excluding cartilaginous fishes; Paulin & Stewart, 1985), and from a number of voyages between 1984 and 1992, the total species of coastal fishes rose to 145 species (Francis, 1993); see Francis and Cole (2010) and Trnski & de Lange (2015) for further details on these surveys. The deepwater fish fauna was described by Beaumont *et al*. (2012), and McMillan *et al*. (2011 a,b,c) recorded 56 pelagic and coastal fishes from the north Kermadec and Colville ridges. The increasing rate of newly recorded coastal species at the Kermadec Islands is a consequence of the intensification of sampling effort and technological changes through time.

The main objective of the Kermadec Biodiscovery Expedition 2011 was to complement earlier collections of fishes by intensively collecting at all island groups and at as many locations as weather and sea conditions would allow. Here we report the results of these collections and also on four other recent visits to the region for which the information on fishes collected has either not been published or is not available publicly (for example, Duffy (2005)).

METHODS

The collections reported here derived from five recent visits to the Kermadec Islands. The Kermadec Islands Expedition in November 2004 utilised the RV *Southern Salvor* and made collections at Raoul Island and adjacent islands. The party also stopped at Macauley Island, and Curtis and Cheeseman Islands, but made no fish collections at these islands due to adverse sea conditions (Duffy, 2005). A total of nine rotenone stations, one station of line fishing, one station with a dropline, one spear fishing station, and an overnight landing of a flying fish on the vessel were achieved. Specimens resulting from this survey are held at the Museum of New Zealand Te Papa Tongarewa (NMNZ).

The 2011 Kermadec Biodiscovery Expedition aboard RV *Braveheart* collected at all island groups except Havre Rock. Rotenone was the main method used. Each rotenone station was marked by a buoy and diver pairs entered the water at 10–20 minute intervals after rotenone was laid, so that all fishes affected were collected over a period of 45 to 90 minutes, depending on the depth. Fishes were also collected by line fishing, dropline, spear fishing, night lighting, hand net, gill net, trap, and an overnight landing on the deck of the RV *Braveheart* (for details on collection methods, see Trnski & de Lange, 2015). These collections are held at the Auckland Museum (AIM), Australian Museum (AMS) and NMNZ.

In August 2012, the Sir Peter Blake Trust organized a visit to Raoul Island as a youth leadership programme on board the HMNZS *Canterbury* (http://www.sirpeterblaketrust.org/young-blake-expeditions/kermadecs-expedition-2013/). A few fishes were collected, under Clinton Duffy's supervision. All fishes were collected by line fishing and are housed at AIM.

About 100 km SSW of L'Esperance Rock is the Star of Bengal Bank (32°30'S, 180°00'E), rising to within 150 m of the sea surface. During a brief visit to the bank on board the RV *Braveheart* from 26-27 April 2013 line fishing was undertaken at depths of 150 to 250 m. Most fishes were released or retained for consumption; a small subset of the fishes collected are housed at AIM.

An opportunistic five-day visit to Raoul Island, L'Esperance Rock and Havre Rock in November to December 2013 on board the RV *Braveheart* provided an opportunity to complement earlier collections. Only a single scientist was on board (T. Trnski), and the focus of collecting was algae and invertebrates, though a few fish collections were made and visual observations recorded. Fishes were collected from Raoul Island, in Boat Cove and on the west side of North Meyer Island. Methods included spear fishing, hook and line fishing, hand collecting, night lighting and dipnet, and clove oil. These collections are held at AIM. Havre Rock was also visited, but no fishes were collected.

A brief stopover at Raoul Island in January 2015 on board the RV *Braveheart* provided the opportunity for two dives on the west side of the Meyer Islands. No fishes were collected, though photographs by Richard Robinson documented five new species records, which are reported by Francis and Duffy (2015).

A number of fish species reported here were recorded from the Kermadec region for the first time. Most of these new species records are documented by Roberts *et al*. (2015), and a reference to the individual chapters in that book is provided in Table 1. New species records not reported by Roberts *et al*. (2015) are presented here with a photograph and specimen data to confirm the identification. Additional new species records on all five voyages were based on visual records only and, in most cases, these were supported by photos or video footage (Francis & Duffy, 2015). Where no photographic evidence was available for visual records, these species are recorded in this paper.

Shore fishes are defined as species that occur in depths between 0 and 50 m, and are also referred to as "coastal

fishes". Several species that were collected and that occur at greater depths are also reported here. Institutional acronyms are consistent with Leviton *et al*. (1985).

Methodology and diagnostic characters for new species records follow Böhlke (1989) and Smith (2012) for Muraenidae; Smith and McCosker (1999) and Randall (2005) for Ophichthidae; Bellwood and Randall (2000) and Randall and Randall (1981) for Labridae; and Matsuura (1980) for Balistidae.

RESULTS

A total of 5,288 fishes, representing 114 shorefish species in 58 families plus 12 deeper water species in nine additional families, were collected from the Kermadec Islands and Star of Bengal Bank (Table 1, 2) in the five surveys between 2004 and 2013. Of these, 912 (17%) were collected in 2004 and 4,302 (81%) were collected during the Kermadec Biodiscovery Expedition in 2011. Ninety-six percent of specimens were collected from 50 rotenone stations; nine rotenone stations were conducted in November 2004, and 41 during May 2011. Bad weather during the 2004 expedition meant that seven of the nine stations were made in shallow rocky reef habitats located between the beach at Denham Bay Flat and Smith Bluff; two stations were conducted in Boat Harbour, Meyer Islands (Duffy, 2005). In 2011, 26 stations were conducted in a variety of habitats around Raoul Island, including intertidal rock pools, shallow subtidal rocky reef and subtidal sand flats; five stations were conducted on subtidal rocky reef around Macauley Island; eight around Curtis and Cheeseman Islands; and two at L'Esperance Rock (Trnski and de Lange, 2015). The size range of fishes collected using rotenone was 7–806 mm SL, although most individuals were 15–400 mm SL (Table 1).

The total numbers of fish species collected using rotenone were 47 in 2004 and was 85 in 2011. The number of species recorded per station ranged from 10 to 26 (average 18.9, S.E. 3.7) in 2004, and 1 to 33 (average 15.4, S.E. 1.1) in 2011. Species discovery curves for the rotenone stations are shown in Fig 1. In 2011, species discovery was almost monotonic until the 33rd station (82 species, 96.6% of total species), at which point it plateaued until the capture of three additional species at the last station (Fig. 1). These additional species were *Priacanthus* sp., *Acanthurus* sp. and *Anampses caeruleopunctatus*. *Priacanthus* sp. and *Acanthurus* sp. are new records for New Zealand waters (Trnski, 2015d; Struthers, 2015), whereas *A. caeruleopunctatus* is widely distributed and relatively common throughout the Kermadec archipelago (Table 1; Francis *et al*., 1987; Eddy 2011). Two families were recorded for the first time in New Zealand: Isonidae, surf silversides (Trnski, 2015b), and Priacanthidae, bigeyes (Trnski, 2015d).

Tropical species contribute most to the diversity recorded but, numerically, subtropical species dominate the Kermadec Islands environment (Francis & Duffy, 2015). The most abundant species (≥ 5% of total numbers) in the 2004 rotenone collections were *Pseudolabrus luculentus* (20.3%), *Eviota kermadecensis* (12.1%), *Enneapterygius kermadecensis* (8.6%), *Limnichthys fasciatus* (7.4%), *Chrysiptera rapanui* (6.9%), *Bathystethus cultratus* (6.2%), and *Lotella phycis* (5.3%). *Optivus elongatus*, *Scorpaena cardinalis*, *Scorpaenodes evides*, *Trachypoma macracanthus*, *Suezichthys arquatus*, *Cirripectes alboapicalis*, *Pempheris analis*, *Notolabrus inscriptus*, *Priolepis psygmophilia*, *Girella fimbriata*, *Anampses elegans* and *Entomacrodus niuafoouensis* were secondarily abundant, each contributing between 1% and 5% of total numbers. In 2011 rotenone stations, the most abundant species in collections were *C. rapanui* (12.2%), *P. luculentus* (9.8%), *Enneapterygius kermadecensis* (7.7%), *Engyprosopon raoulensis* (7.5%) and *Scorpaenodes evides* (5.5%). Secondary species in 2011 were *L. phycis*, *S. cardinalis*, *T. macracanthus*, *Upeneus francisi*, *Chromis dispila*, *L. fasciatus*, *C. alboapicalis*, *Entomacrodus cymatobiotus*, *Entomacrodus niuafoouensis*, *Parablennius laticlavius*, *Plagiotremus tapeinosoma*, *Eviota kermadecensis*, *P. psygmophilia*, and *Torquigener altipinnis*.

Engyprosopon raoulensis was collected only at two stations, both over soft sediments at Raoul Island, and 77% of the specimens of this species came from a single station (K2011-48) on coarse, rippled sand at 20–23 m depth off Fishing Rock. Also collected at this station were large numbers of *T. altipinnis*, *Maxillicosta raoulensis* and *Upeneus francisi*, as well as several eels (*Gnathophis* sp.). No fish were observed prior to laying the rotenone at this station and all of the fish collected emerged from within the sand or strayed into the rotenone cloud (for example *Upeneus francisi*).

Three blennies, *Cirripectes alboapicalis*, *Entomacrodus cymatobiotus* and *Parablennius laticlavius*, and the endemic triplefin *Enneapterygius kermadecensis* dominated rotenone collections at Curtis and Cheeseman Islands in 2011, constituting 10.6%, 6.1%, 7.2% and 23.8% of specimens collected, respectively. *Enneapterygius kermadecensis* also represented 15.7% of specimens collected from Macauley Island. Almost all of the specimens of these species collected from Curtis and Cheeseman Islands came from a single station (K2011-76) located on the west side of Cheeseman Island. The habitat at the site consisted of a very steep, almost featureless rock wall with sparse algal and invertebrate cover (Trnski & de Lange, 2015).

Rotenone collections in 2011 included a large number of infrequently collected species, with 36 (42%) recorded from only one or two stations (Fig. 2). The most frequently occurring species was *Pseudolabrus luculentus* (83% of stations), followed by *Scorpaena cardinalis* (78%), *Chrysiptera rapanui* (75.6%), *Scorpaenodes evides* (73.2%), *Eviota kermadecensis* (68.3%), *Trachypoma macracanthus* (63.4%), *Chromis dispila* (58.5%) and *Anarchias seychellensis* and *Plagiotremus tapeinosoma* (both 51.2%). Three of these species were proportionally less abundant in collections from the southern islands (Curtis and Cheeseman Islands, L'Esperance Rock). They were *Chrysiptera rapanui* (14 and 16% at Raoul and Macauley Islands respectively cf. 5 and 6% at the southern islands), *Eviota kermadecensis* (7 and 4% cf. 1%) and *Plagiotremus*

Table 1. Shorefish species recorded during five visits to the Kermadec Islands and Star of Bengal Bank in 2004, 2011, 2012 and 2013. Collection method abbreviations: **GN** gill net, **H** hand collecting, **H&L** hook and line, **NL** night light, **Ro** rotenone, **Sp** spear, **Tr** trap. Records based on specimens held in museum collections or, for most *C. galapagensis* and all *E. daemelii* specimens, collected and released following positive identification and fin clip sample retained. Total number of specimens: size range in mm SL except for elasmobranchs, eels and Star of Bengal Bank specimens measured in mm TL; **+** specimen number and size collected not known; **V** species recorded from visual records without an image as evidence. For all new records, catalogue numbers and/or citations are listed in Notes column (institutional acronyms consistent with Leviton *et al.*, 1985).

Family	Species	Collection methods	2004 Raoul Is	2011 Raoul Is	2011 Macauley Is	2011 Cheeseman–Curtis Is	2011 L'Esperance Rock	2012 Raoul Is	2013 Star of Bengal Bank	2013 Raoul Is	Notes
Triakidae	*Mustelus* sp.	H&L						7: 600–885			Endemic to the Kermadec Islands. Description being prepared by C. Duffy.
Carcharhinidae	*Carcharhinus galapagensis*	H&L, GN		18:845–1490	V	V	V	17:830–1510	1:1800		
Lamnidae	*Isurus oxyrinchus*								V: 2200–2800		
Dasyatidae	*Dasyatis brevicaudata*			V							
Muraenidae	*Anarchias seychellensis*	Ro	3:153–176	25:87–215	8:103–180	5:57–170	2:107–125				
Muraenidae	*Enchelycore ramosa*	Ro	5:135–710	8:171–745							
Muraenidae	*Gymnothorax eurostus*	Ro	1:342	4:64–375		2:95–98					
Muraenidae	*Gymnothorax nubilus*	Ro, Tr		16:163–625	1:640		4:58–140				
Muraenidae	*Gymnothorax porphyreus*	Ro	11:57–577	14:182–528		4:425–806	1:761				
Muraenidae	*Gymnothorax thyrsoideus*	Ro	V	1:505							Recorded from a photo by Duffy (2005: 6). New voucher record for Kermadec Is and NZ. EEZ.
Ophichthidae	*Apterichtus australis*	Ro		2:372–499							
Ophichthidae	*Leiuranus semicinctus*	Ro		1:330							New record for Kermadec Is and NZ EEZ.
Ophichthidae	*Scolecenchelys australis*	Ro		7:73–506	1:327	2:169–315					
Congridae	*Ariosoma* sp.	Ro		2:155–405							New genus record for NZ. Previously recorded as *Poeciloconger* sp (Francis, 1993). Species treated by Smith & Stewart (2015).
Congridae	*Conger wilsoni*	Ro		8:72–570	16:66–132	12:70–135	4:76–122				
Congridae	*Gnathophis* sp.	Ro		6:82–178							May be an undescribed species; species treated by Smith & Stewart (2015).
Gonorynchidae	*Gonorynchus* sp.	NL	6:42–75								Too small to identify to species.
Synodontidae	*Synodus doaki*	Ro		1:182							

Family	Species	Collection methods	2004 Raoul Is	2011 Raoul Is	2011 Macauley Is	2011 Cheeseman–Curtis Is	2011 L'Esperance Rock	2012 Raoul Is	2013 Star of Bengal Bank	2013 Raoul Is	Notes
Synodontidae	*Synodus similis*	H&L		1:154							Species record being treated by Russell (2015).
Synodontidae	*Synodus variegatus*	Ro		3:113–293							
Gobiesocidae	*Aspasmogaster* sp.	Ro	1:23	11:17–29							Endemic to the Kermadec Islands. Description being prepared by K. Conway.
Bythitidae	*Microbrotula punicea*	Ro	9:38.5–57.6		1:33	1:49					Endemic to the Kermadec Islands
Moridae	*Lotella phycis*	Ro	47:40–200	24:66–190	24:104–206	14:73–194	2:52–131				
Moridae	*Lotella rhacina*	Ro			6:104–310	9:191–346					
Isonidae	*Iso* sp.	Ro		V	2:21–21	6:16–26					New family and genus record for Kermadec Is and NZ. Species treated by Trnski (2015a).
Belonidae	*Ablennes hians*			V							
Exocoetidae	*Cheilopogon pinnatibarbatus*	H	2:380–385								
Exocoetidae	*Cheilopogon furcatus*									+	
Exocoetidae	*Hirundichthys rufipinnis*	H		1:107							
Trachichthyidae	*Optivus elongatus*	Ro	34:17–24	3:65–101							*H. rondeletii* is a synonym (Stewart & Struthers, 2015).
Berycidae	*Centroberyx affinis*	H&L, Ro		2:19–21		3:285–366					
Holocentridae	*Pristilepis oligolepis*	Ro		1:280							
Syngnathidae	*Cosmocampus* sp.	Ro	1:88	4:105–112							New genus record for Kermadec Is and NZ. Recorded by Duffy (2005). Species treated by Stewart (2015).
Aulostomidae	*Aulostomus chinensis*	Ro		2:188–242							
Fistulariidae	*Fistularia commersonii*			V						V	
Neosebastidae	*Maxillicosta raoulensis*	Ro		28:52–105							
Scorpaenidae	*Dendrochirus* sp.	Ro		2:118–140							Species treated by Motomura & Struthers (2015).
Scorpaenidae	*Pterois antennata*	Ro		5:40–128	1:31	2:20–58					
Scorpaenidae	*Pterois volitans*	Ro	2:109–150	17:37–235	6:145–224		4:50–153			+	

Family	Species	Collection methods	2004 Raoul Is	2011 Raoul Is	2011 Macauley Is	2011 Cheeseman–Curtis Is	2011 L'Esperance Rock	2012 Raoul Is	2013 Star of Bengal Bank	2013 Raoul Is	Notes
Scorpaenidae	*Scorpaena cardinalis*	Ro	17:40–355	90:18–250	39:78–290	18:53–409	19:124–412	4			*Scorpaena cookii* is a junior synonym (Motomura *et al*., 2011).
Scorpaenidae	*Scorpaenodes evides*	Ro	20:20–60	141:7–128	24:13–51	55:12–56	9:19–52				Formerly reported as *Sebastella littoralis and Scorpaenodes scaber* (Francis, 1993; Motomura *et al*., 2010).
Serranidae	*Acanthistius cinctus*	Ro, NL	8:14–370	10:14–280	8:13–225	3:33–346	3:195–388				
Serranidae	*Aulacocephalus temminckii*	Ro		11:32–180	6:116–194	3:21–226					
Serranidae	*Epinephelus daemelii*	H&L	V	1:1100	V	V	V	V		V	
Serranidae	*Hypoplectrodes* sp. B	Ro	8:20–72	19:36–90	11:45–84	3: 57–70	3:70–113				Distribution includes Lord Howe and Norfolk islands, and northern North Island of New Zealand. Description being prepared by C. Roberts.
Serranidae	*Trachypoma macracanthus*	Ro	14:23–183	49:125–190	14:76–197	13:90–205	4:82–193	2			
Apogonidae	*Ostorhinchus* sp.	Ro		14:85–114	4:97–119	15:28–49					Previously recorded as *Apogon doederleini*. Species treated by Trnski (2015c).
Kuhliidae	*Kuhlia mugil*	Ro	7:40–113	31:20–156		2:28–43					
Priacanthidae	*Priacanthus* sp.	Ro					5:138–171				New family and genus record for Kermadec Is and NZ EEZ. Species treated by Trnski (2015d).
Carangidae	*Pseudocaranx georgianus*	H&L, Ro		5:355–425	V	2:140–289	V				Previously reported as *P. dentex*.
Carangidae	*Seriola lalandi*	H&L, Sp		1:1085	V	V	V	4: 895–1060	10:770–1400		
Carangidae	*Seriola rivoliana*									V	
Arripidae	*Arripis xylabion*	H&L, Ro		7:270–350	V			3		+	
Mullidae	*Mulloidichthys vanicolensis*			V							
Mullidae	*Parupeneus spilurus*	Ro	1:230	V	1:216	1:98	7:41–48				
Mullidae	*Upeneichthys porosus*	Ro		V	2:177–200	V					
Mullidae	*Upeneus francisi*	Ro		103:31–70							
Pempheridae	*Pempheris analis*	Ro	9:120–148	13:85–166	12:151–167		14:38–59				
Microcanthidae	*Atypichthys latus*	Ro, Sp	2:81–129	3:145–170	11:105–195	1:119					
Girellidae	*Girella cyanea*	Ro		6:85–190	V	V					
Girellidae	*Girella fimbriata*	Ro, H	23:17–120	12:76–220	V	V					Endemic to the Kermadec Islands

Family	Species	Collection methods	2004 Raoul Is	2011 Raoul Is	2011 Macauley Is	2011 Cheeseman–Curtis Is	2011 L'Esperance Rock	2012 Raoul Is	2013 Star of Bengal Bank	2013 Raoul Is	Notes
Kyphosidae	*Kyphosus bigibbus*	Sp		V							*K. sydneyanus* is a synonym (Knudsen & Clements, 2014)
Kyphosidae	*Kyphosus sectatrix*	Sp		11:245–475	V	V	V			+	*K. pacificus* is a synonym (Knudsen & Clements, 2014)
Scorpididae	*Bathystethus cultratus*	Ro	56:57–91	V	9:112–178	12:20–100	V			+	
Scorpididae	*Labracoglossa nitida*	Ro	1:79	2:24–170	V	V	V				
Scorpididae	*Scorpis violacea*	Ro		1:290	1:156	4:98–166	V				
Chaetodontidae	*Amphichaetodon howensis*	Ro		1:134	4:129–142	4:102–140	3:127–144				
Chaetodontidae	*Forcipiger flavissimus*			V							
Pentacerotidae	*Evistias acutirostris*			V						V	
Pomacentridae	*Abudefduf* sp.	Ro		2:47–77							New genus record for Kermadec Is. Species treated by Stewart *et al*. (2015).
Pomacentridae	*Chromis dispila*	Ro	6:22–61	64:20–164	23:38–153	23:23–66	14:33–102				
Pomacentridae	*Chrysiptera rapanui*	Ro	63:32–55	350:16–65	116:21–57	34:26–52	12:23–41				
Pomacentridae	*Parma alboscapularis*	Ro	2:19–25	1:210	4:46–110	V	1:196			+	
Pomacentridae	*Parma kermadecensis*	Ro		2:200–215	V	6:190–210	1:208				Endemic to the Kermadec Islands
Pomacentridae	*Stegastes fasciolatus*	Ro	9:37–155	6:17–152	1:145	1:71	2:31–31				
Cirrhitidae	*Notocirrhitus splendens*	Ro	3:53–133	17:24–182	2:29–163	3:57–70	3:158–183				Formerly *Cirrhitus splendens*.
Chironemidae	*Chironemus microlepis*	Ro	3:30–195	3:180–215		4:120–140	V				
Aplodactylidae	*Aplodactylus etheridgii*	Ro	5:32–255	1:148	9:243–386	10:85–264	V				
Cheilodactylidae	*Cheilodactylus ephippium*	Ro		2:250–295	V	V	V				
Cheilodactylidae	*Cheilodactylus francisi*			V							
Mugilidae	*Chelon* sp.										New species record recorded from a specimen in the NMNZ collection. Species being treated by Trnski (2015a).
Sphyraenidae	*Sphyraena* sp.	NL	4:213–257					4			Previously recorded as *S. acutipinnis.* Species treated by Trnski (2015e).
Labridae	*Anampses caeruleopunctatus*	Ro	4:180–235	V	V	V	1:33				
Labridae	*Anampses elegans*	Ro	9:37–62	V	V						
Labridae	*Bodianus unimaculatus*	Ro		1:19		V					
Labridae	*Coris picta*			V							

Family	Species	Collection methods	2004 Raoul Is	2011 Raoul Is	2011 Macauley Is	2011 Cheeseman–Curtis Is	2011 L'Esperance Rock	2012 Raoul Is	2013 Star of Bengal Bank	2013 Raoul Is	Notes
Labridae	*Coris sandeyeri*	Ro		8:202–335	8:49–315	6:34–318	4:99–404				
Labridae	*Notolabrus inscriptus*	Ro, Sp	14:21–330	1:248	2:178–280	V					
Labridae	*Pseudojuloides elongatus*	Ro		1:31							Recorded by Duffy (2005: 6) based on a photograph. New species record for the Kermadec Islands.
Labridae	*Pseudolabrus luculentus*	Ro	128:16–165	261:15–155	48:44–178	39:51–154	61:49–126				
Labridae	*Suezichthys arquatus*	Ro	4:41–63	85:16–115	45:21–122	24:32–118	9:74–100				
Labridae	*Thalassoma purpureum*	Ro, Sp		25:14–295							
Labridae	*Thalassoma trilobatum*	Ro	1:33								
Creediidae	*Limnichthys fasciatus*	Ro	62:15–37	25:17–42	46:20–38						
Blennidae	*Cirripectes alboapicalis*	Ro	19:37–69	48:31–88	12:34–46	76:29–80					
Blennidae	*Entomacrodus cymatobiotus*	Ro	4:41–57	59:19–48		44:15–52					
Blennidae	*Entomacrodus niuafoouensis*	Ro, H	19:70–109	93:11–112		3:36–51					Springer (1967: 70) suggested that this species is the same as E. *epalzeocheilos* (Bleeker, 1859). Randall (2005: 492) tentatively placed *E. niuafoouensis* in synonymy with that species.
Blennidae	*Parablennius laticlavius*	Ro	4:36–47	1:40	3:23–46	52:20–53	1:22			+	
Blenniidae	*Plagiotremus tapeinosoma*	Ro	9:49–55	61:34–64	33:32–55	8:43–82	2:45–46				
Tripterygiidae	*Enneapterygius kermadecensis*	Ro	76:15–28	38:12–35	114:10–29	171:18–34					Endemic to the Kermadec Islands.
Gobiidae	*Eviota kermadecensis*	Ro	109:13–22	170:8–22	28:12–20	7:11–20	2:14–15				Endemic to the Kermadec Islands.
Gobiidae	*Priolepis psygmophilia*	Ro	10:17–38	52:10–40	6:12–39	4:9–32					
Acanthuridae	*Acanthurus* sp.	Ro					1:52				Species treated by Struthers (2015).
Zanclidae	*Zanclus cornutus*			V						V	
Bothidae	*Asterorhombus* sp.	Ro		3:20–65							New genus record for the Kermadec Islands and NZ EEZ. Species treated by Munroe (2015).
Bothidae	*Engyprosopon raoulensis*	Ro		313:17–100							
Soleidae	*Aseraggodes bahamondei*	Ro	4: ??	2:14–150	7:18–169	3:24–33					

Family	Species	Collection methods	2004 Raoul Is	2011 Raoul Is	2011 Macauley Is	2011 Cheeseman–Curtis Is	2011 L'Esperance Rock	2012 Raoul Is	2013 Star of Bengal Bank	2013 Raoul Is	Notes
Balistidae	*Canthidermis maculata*	H				1:54					New genus and species record for Kermadec Is and NZ EEZ.
Monacanthidae	*Meuschenia scaber*	Ro			V	1:224					
Monacanthidae	*Thamnaconus analis*	Ro		9:162–194	6:146–206	2:207–210					
Ostraciidae	*Ostracion cubicus*			V	1:15					V	
Tetraodontidae	*Canthigaster callisterna*			V	1:109						
Tetraodontidae	*Torquigener altipinnis*	Ro, H&L	4:125–150	134:34–166							
Diodontidae	*Diodon hystrix*	Ro		1:330							

Table 2. Recent collections of deeper shelf (>50 m depth) and upper slope (>200 m depth) fishes from the Kermadec Islands and Star of Bengal Bank (number of specimens: size range mm TL for elasmobranchs, SL for teleosts). All specimens collected using hook and line except the nomeid *Cubiceps* sp. collected by night light.

Family	Species	2004 Raoul Is	2011 Raoul Is	2011 Macauley Is	2011 Cheeseman–Curtis Is	2011 L'Esperance Rock	2012 Raoul Is	2013 Star of Bengal Bank	Notes
Squalidae	*Squalus griffini*		1: 1065		3: 930-1021			3: 940-1500	
Squalidae	*Squalus raoulensis*	2: 651–681			5: 700-839				Endemic to the Kermadec Islands
Aulopidae	*Hime pyrhistion*				1: 178				
Paraulopidae	*Paraulopus okamurai*				2: 289–303				
Sebastidae	*Helicolenus percoides*	1: 365			7: 187–268				
Polyprionidae	*Polyprion americanus*				1: 850			15: 630–1200	
Polyprionidae	*Polyprion oxygeneios*				1: 810			3: 740–1780	
Emmelichthyidae	*Plagiogeneion rubiginosus*							1: 390	
Lutjanidae	*Etelis coruscans*		1: 400						
Cheilodactylidae	*Nemadactylus* sp. "king tarakihi"				1: 470			20: 430–780	Description being prepared by C. Roberts.
Centrolophidae	*Seriolella labyrinthica*							1: 550	
Nomeidae	*Cubiceps* sp.			2: 37–39	3: 30–32				

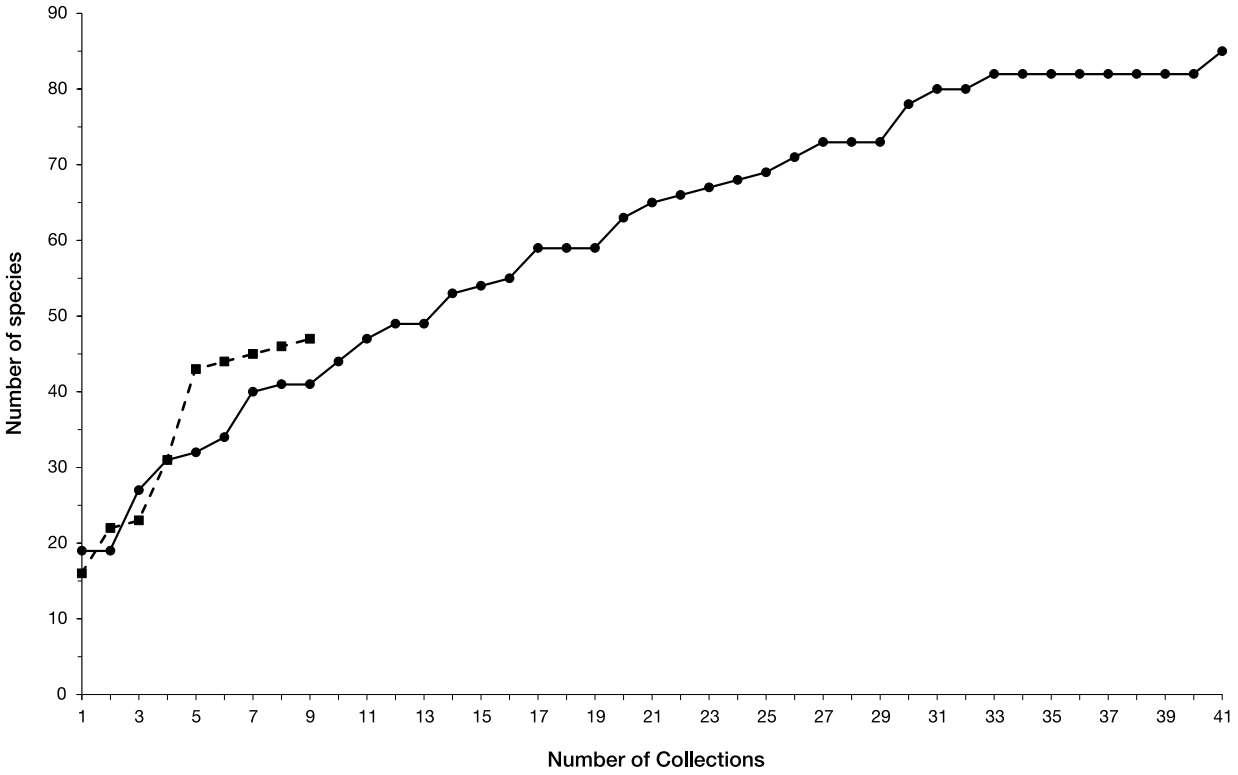

Figure 1. Species discovery curves for rotenone stations conducted at the Kermadec Islands in November 2004 (squares) and 2011 (circles). All stations were located at Raoul Island in 2004. In 2011 collections 1–26 were made around Raoul Island, 27–31 at Macauley Island, 32–39 at Curtis and Cheeseman Islands, and 40–41 at L'Esperance Rock.

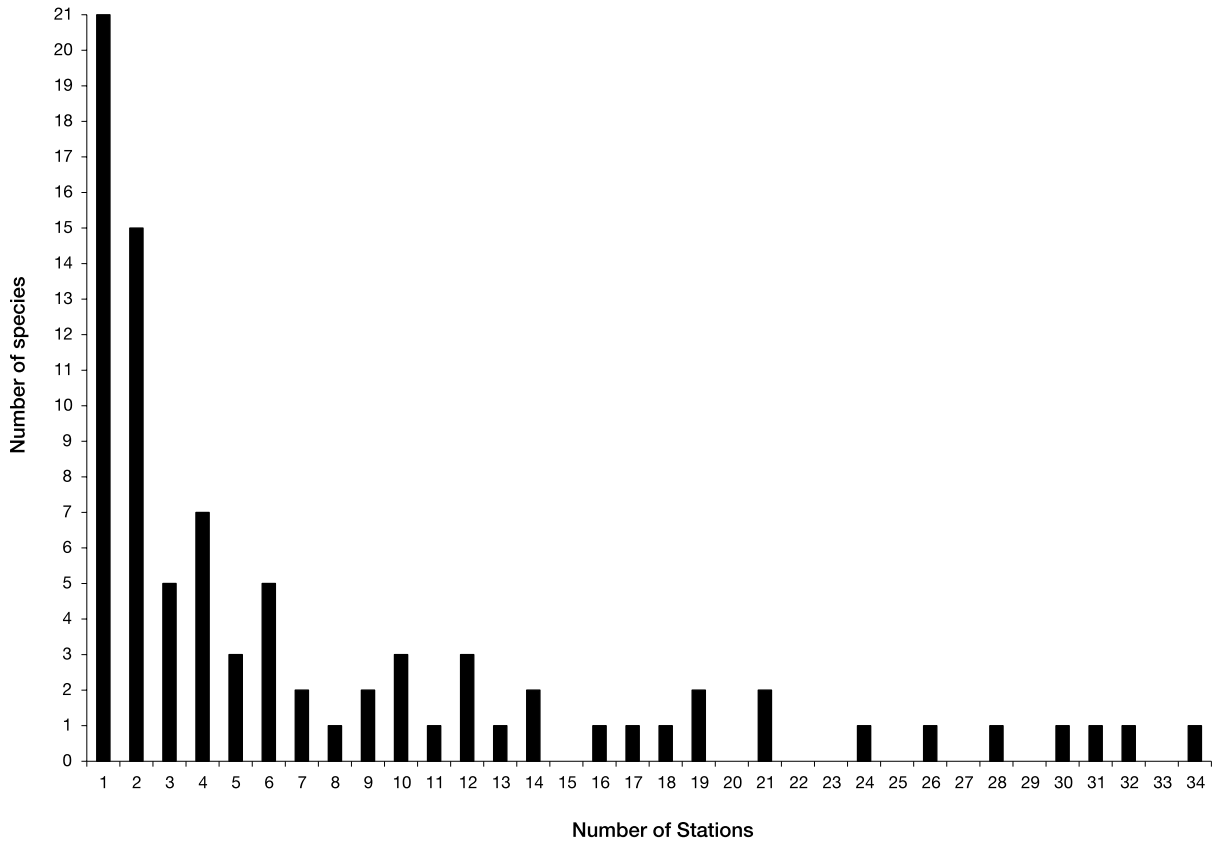

Figure 2. Frequency of species diversity in rotenone stations at the Kermadec Islands in May 2011. Total number of rotenone stations was 41.

tapeinosoma (2.4 and 4.5% cf. 1%). *Chromis dispila* was most abundant in collections from L'Esperance Rock (7% cf. 2.5–3% at other islands). *Pseudolabrus luculentus* was most abundant in collections at Raoul Island (10%) and L'Esperance Rock (31%) compared to Macauley (7%) and Curtis and Cheeseman islands (5%). The remaining species showed no obvious pattern in abundance among islands. Of those species collected only from Raoul Island in 2011, only *Enchelycore ramosa* and *Engyprosopon raoulensis* occurred at four or more stations. *Enchelycore ramosa* is a widespread subtropical species that also occurs in northern New Zealand. Its absence from rotenone collections made around the southern Kermadec Islands could be due to chance or differences in habitat types sampled. Francis *et al*. (1987) recorded it from Curtis Island and L'Esperance Rock. *Engyprosopon raoulensis* is known only from sandy substrata between 15–36 m depth off Raoul Island and 59 m depth off Norfolk Island (Amaoka & Mihara 1995). It is probably widespread on soft sediments at suitable depths around the Kermadec Islands.

Other methods used to complement the rotenone collections yielded a limited number of specimens (Tables 1 and 2). This was in part due to the majority of effort directed towards collecting and processing the rotenone stations. However, in May 2011 few pelagic organisms of any sort were observed around the expedition vessel at night meaning few collections were able to be made using landing nets and jigs. This contrasted with the November 2004 expedition when numerous flying fishes and small squids were attracted to the vessel's lights at night in Denham Bay, Raoul Island. In 2011, fishing with rod and line from the drifting expedition vessel proved more effective than droplining for sampling upper slope fishes. Invertebrate traps set in shallow water predominantly caught moray eels and scorpaenids. The single *Epinephelus daemelii*, all but one of the *Seriola lalandi* and all but two of the *Carcharhinus galapagensis* and *Mustelus* sp. were released alive after a small tissue sample (fin clip) was taken for DNA analysis.

Four species are reported here as new records for the Kermadec Islands, three of which are new records for the New Zealand Exclusive Economic Zone (Table 1, Figures 3-6); one species (*Pseudojuloides elongatus*) has been recorded previously from mainland New Zealand (Ayling & Russell, 1977; Francis, 2012). Nine additional new records are reported from voucher specimens collected at the Kermadec Islands (Roberts *et al*., 2015), and additional species are recorded from photographs or visual records (Francis & Duffy, 2015). Four species were undescribed at the time of the Kermadec Biodiscovery Expedition 2011: *Hime pyrhistion* Gomon *et al*., 2013 (occurs in Australia and New Zealand); *Aspasmogaster* sp. (endemic to the Kermadec Islands); *Hypoplectrodes* sp. B (the "half-banded perch" in Francis (2012) is also known from Lord Howe and Norfolk islands, and northern New Zealand); and *Eviota kermadecensis* Hoese & Stewart, 2012 (endemic to the Kermadec Islands). The addition of *Chelon* sp. to the list was based on a specimen collected in 1908 that is held in the NMNZ collection (Trnski, 2015a).

NEW SPECIES RECORDS NOT TREATED IN ROBERTS *ET AL.* (2015)

Family MURAENIDAE

***Gymnothorax thyrsoideus* (Richardson, 1845)**
New species record for the Kermadec Islands and New Zealand EEZ.
Voucher – NMNZ P.050106 (1: 505 mm total length (TL)) (Figure 3)
Collected at NW corner of North Meyer Island, Kermadec Islands (29°14.48'S, 177°52.72'W); rotenone and hand nets, 16–18 m depth; rocky bottom interspersed with sand and gravel, corals and seaweeds. Collectors: C. Bedford, M. McGrouther, C. Struthers, T. Trnski, S. Ullrich, G. Wiren, V. Zintzen; 19 May 2011 (Station K2011-57).

Diagnosis. Dorsal-fin origin about half-way between rictus of mouth and the gill opening. Teeth: conical, two rows in upper and lower jaws, two conical teeth in median row of intermaxillary, vomerine teeth in two rows, diverging anteriorly in large adults. Body depth 17–22 in TL; pre-anal length *ca*. 2.5 in TL. Vertebrae: predorsal fin 3–6, preanal fin 48–55, total 125–137.

Colour. Head and body brown, head darker (sometimes with paler snout), densely mottled with darker brown speckling and random blotches. The gill opening often sits in a dark brown to dusky spot. Iris brilliant white. Some specimens purplish grey to greyish white with a yellowish tinge.

Specimen meristics and morphometrics.
Vertebrae: predorsal fin 4, preanal fin 50, total 133.
Proportions in total length (TL): head length 8.8; body depth 18.4; predorsal-fin length 14.1; preanal fin length 2.5.
Proportions in head length (HL): snout length 7.7; eye diameter 12.8, mouth gape 3.7.

Morphology. Premaxillary teeth 6, maxillary teeth in a single row, and about half size of premaxillary teeth; teeth broad based, curved, pointed. Intermaxillary teeth 9, as a single row, and longer than maxillary teeth. Dentary teeth in two groups and two rows, the inner larger than the outer. Vomer with two large conical teeth anteriorly and two rows of molariform teeth (becoming a single row posteriorly).

Colour. Brown, head darker, snout pale, body with darker brown speckling and random darker blotches; gill opening in a dark brown spot; iris brilliant silvery-white.

Notes. This species can be distinguished from similar species by gill opening sitting in a dark brown blotch; iris brilliant white, head darker than body, and densely mottled with dark brown speckles and randomly-arranged blotches. The teeth have been widely reported as conical, but examination of this specimen has found the dentary and maxillary teeth are short, broad-based, slightly curved and

Figure 3. A new record for the Kermadec Islands and New Zealand: Muraenidae *Gymnothorax thyrsoideus* NMNZ P.050106, 505 mm TL. *Photo: C. Struthers, NMNZ*

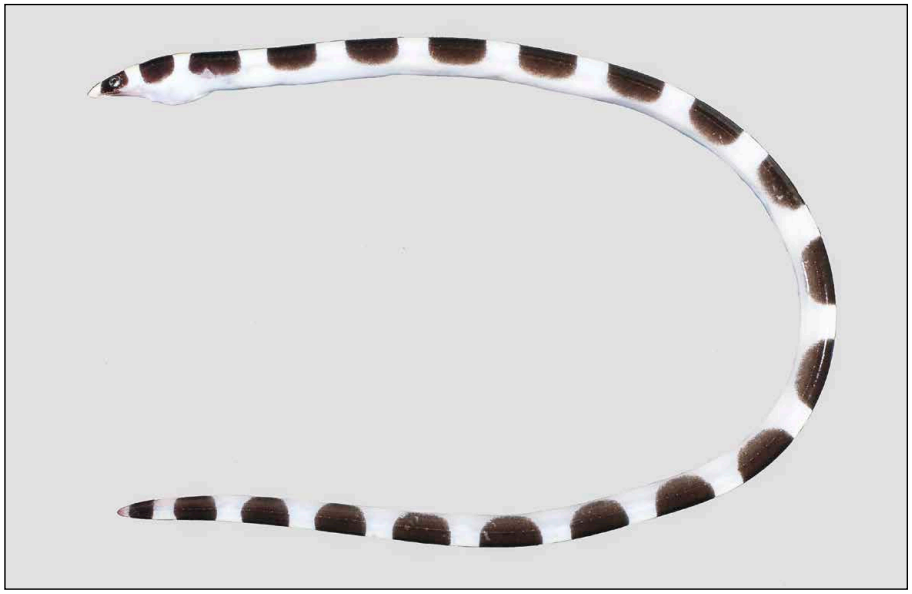

Figure 4. A new record for the Kermadec Islands and New Zealand: Ophichthidae *Leiuranus semicinctus* AIM MA655341, 330 mm TL. *Photo: C. Struthers, NMNZ*

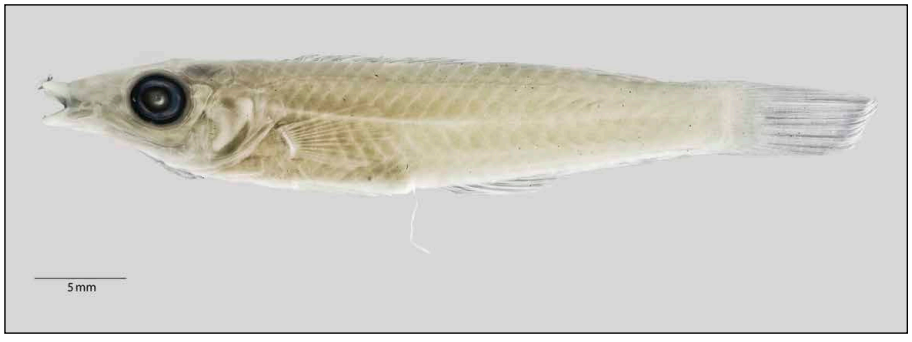

Figure 5. A new record for the Kermadec Islands: Labridae *Pseudojuloides elongatus* AIM MA655350, 30.0 mm SL. Note that small artefacts of tissue appear on the tip of the snout and from the anus. *Photo: P. Quin, AIM*

pointed. Has been recorded in the genus *Siderea* (Randall *et al*., 1990; Kuiter, 1994) and *G. prosopeion* (Bleeker) is a synonym (Randall, 2005). Contrary to the keys in Böhlke *et al*. (1999) and Böhlke and McCosker (2001), the gill sits in a dark blotch or spot, as seen in the specimen collected (Fig. 3) and that published by Randall (2005: 48). This species was first recorded from the Kermadec Islands by Duffy (2005) based on a sight record.

Family OPHICHTHIDAE

***Leiuranus semicinctus* (Lay & Bennett 1839)**
New genus and species record for the Kermadec Islands and New Zealand EEZ.
Voucher – AIM MA655341 (1: 330 mm TL) (Figure 4) Collected at Herald Islands, west side of North Chanter Island, Kermadec Islands (29°15.156'S, 177°51.316'W); sand with occasional rock outcrops, fringed with emergent rocks; rotenone and handnets, 24–26 m. Collectors: C. Bedford, M. McGrouther, C. Struthers, T. Trnski, S. Ullrich, G. Wiren, V. Zintzen; 16 May 2011 (Station K2011-41).

Diagnosis. Mouth inferior; anterior nostrils without conspicuous, leaf-like appendages; upper lip not fringed with cirri; vomerine teeth absent or up to three teeth; pectoral fins reduced, about the size of the gill opening; dorsal-fin origin is above or slightly posterior to gill opening; tip of tail finless. *Colour:* white to pale yellow with 22–30 broad, black, saddle-like bars, only those on posterior of tail extending to ventral midline; saddles wider than or about equal in width to pale interspaces.

Specimen meristics and morphometrics.
Vertebrae: preanal 69, postanal 102, total 171.
Proportions in total length (TL): head length 13.2; body depth 59.6; snout to anus length 2.3; snout to dorsal fin length 13.9.

Specimen description. This specimen varies from the diagnosis in having expanded membranes medially on the anterior nostrils and 21 dark saddles on the head and body, with the last four saddles reaching the ventral midline of the tail. It has three. small teeth on the vomer and the median groove of the snout contains four small, recumbent canine teeth

Notes. This species can be distinguished from similar species by the combination of evenly-spaced dark saddles along the body, inferior mouth, pectoral fin about the size of the gill opening, dorsal-fin origin above the gill opening, and no to 3 vomerine teeth in a medial row.

Family LABRIDAE

Pseudojuloides elongatus Ayling & Russell, 1977
New species record for the Kermadec Islands.
Voucher – AIM MA655350 (1: 30.0 mm SL) (Figure 5) Collected on the west side of North Chanter Island, Herald Islands off Raoul Island, Kermadec Islands (29°15.156'S, 177°51.316'W); sand with occasional rock outcrops, fringed with emergent rocks; 24–26 m; rotenone and handnets. Collectors: C. Bedford, M. McGrouther, S. Ullrich, C. Struthers, T. Trnski, G. Wiren, V. Zintzen; 16 May 2011 (Station K2011-41).

Diagnosis. 6 branchiostegal rays; scales cycloid and large on body, smaller on thorax and on nape; no scales below cheek; lateral line continuous, steeply descending beneath posterior of soft dorsal fin.

Specimen meristics and morphometrics.
Dorsal fin IX,12; anal fin III,12; pectoral fin 12 (including upper rudiment); pelvic fin I,5; lateral line scales 27; gill rakers 13.
Proportions in standard length (SL): head length 2.8; body depth 5.6.
Proportions in head length (HL): snout length 2.9; pelvic fin length 1.9; caudal fin length 1.5.

Specimen description. anterior teeth in upper and lower jaw caniniform and larger than teeth posteriorly, no canine tooth at corner of mouth; orbit 1.4 in snout length; suborbital pores 6; dorsal-fin spine 9 longest; pelvic fin reaches almost to anus; no median predorsal scales; scale rows between origin of dorsal fin and lateral line3; lateral line continuous, dips sharply between dorsal soft rays 7–9; scale rows between lateral line and origin of anal fin7; caudal peduncle depth 1.3 times length; caudal fin rounded. *Colour in alcohol:* uniformly pale.

Notes. Four species of *Pseudojuloides* have been recorded in the region. *P. atavai* has been recorded from Niue (Randall, 2005) but does not match the specimen as the species has 11 soft rays in the dorsal fin, 13 rays in the pectoral fin, and there are 4–5 scale rows between the origin of the dorsal fin and the lateral line. *P. cerasina* has been recorded from Lord Howe Island, New Caledonia, Fiji, Samoa, and the Cook Islands (Randall & Randall, 1981); this species has about 8–11 median predorsal scales, 11 (to 12 according to Kuiter, 1993) soft rays in the dorsal fin, 4 scale rows between the origin of the dorsal fin and the lateral line, and caudal fin is 1.6–1.9 in HL. The other two species have 3 (3–4 in *P. severnsi*) scale rows between the origin of the dorsal fin and the lateral line, consistent with the specimen. *P. severnsi* has been recorded in New Caledonia; this species has 11 dorsal-fin rays,13 pectoral-fin rays, 15–17 gill rakers, 7–8 suborbital pores, about 7–9 small median predorsal scales, scale rows from lateral line to origin of anal fin 8–8.5, a caudal peduncle usually slightly longer than depth. The specimen is confirmed as *P. elongatus*, usually found in shallow water (3–15 m) and confirmed in the region from Norfolk Island and northern New Zealand (Francis, 2012). The specimen is consistent with this species except it has only 13 gill rakers (17–19 for the species), has no spots of pigment, and many morphometric proportions are outside of the published range; these mismatched characters change with growth and can be explained by its juvenile stage.

Family BALISTIDAE
***Canthidermis maculata* (Bloch, 1786)**

New genus and species record for the Kermadec Islands and the New Zealand EEZ.
Voucher – NMNZ P.050469 (1: 54 mm SL) (Figure 6) Collected at Stella Passage between Curtis and Cheeseman islands, Kermadec Islands (30°32.286'S, 178°33.723'W), hand net at surface associated with a floating plastic bottle (with attached gooseneck barnacles and polychaetes); Collectors: C. Struthers, W. Chinn, A. Mangnall; 25 May 2011 (Station K2011-93).

Diagnosis. No enlarged osseous scales behind the gill opening; mouth terminal; teeth white, uneven, each one notched; a deep groove behind the eye, below nostrils; no grooves on cheek; third dorsal spine developed, extending above dorsal edge of body, second dorsal rays 23–25, anal rays 20–22, and pectoral rays 14–15 (usually 14); depth of body 2.27–2.91 in SL.

Specimen meristics and morphometrics.:
Dorsal-fin rays III,25; anal-fin rays 22; pectoral-fin rays 15; vertebrae 7+11=18.
Proportions in standard length (SL): body depth 2.08.

Colour. Body and head dark, lighter below, with many elongated white spots; these spots less prominent or missing from large adult specimens; all fins dark.

Notes. NMNZ P.050469 generally agrees to the description given by Matsuura (1980), with one exception, body depth. The SL of the collected specimen (54 mm SL) is outside the range of those examined by Matsuura (95.4–289.5 mm SL) and therefore these differences may be due to allometric growth. This species can be distinguished from the only other member of the family known from NZ waters, *Rhinecanthus rectangulus* by the absence of the black, wedge-shaped markings on the caudal peduncle.

DISCUSSION

A total of 126 species of fishes were recorded from the collections made in 2004, 2011, 2012 and 2013. Of these species, 114 were shorefishes. Recent expeditions to the Kermadec Islands have added another 13 species of shorefishes to those previously known from the Kermadec Islands. Of these, four new distribution records for the Kermadec Islands, of which three are new records for the New Zealand Exclusive Economic Zone (EEZ), are reported in this paper, and nine additional distribution records will be reported in Roberts *et al*. (2015). Francis and Duffy (2015) report additional species visually documented during these expeditions, and in subsequent visits. From these three publications, the coastal fish fauna of the Kermadec Islands has increased to 175 species (present study, Francis & Duffy (2015), Roberts *et al.*, (2015)). A complete list of the coastal fish fauna, including new records, recorded since 2004 can be found in Appendix 1 of Francis and Duffy (2005). It is clear that we are still in the discovery phase of recording fish diversity at the Kermadec Islands (Francis & Duffy, 2015), as additional species are likely to be recorded in future surveys, especially if alternative capture methods are deployed.

Eight species of fishes in Tables 1 and 2 are endemic to the islands: *Squalus raoulensis*, *Mustelus* sp., *Aspasmogaster* sp., *Microbrotula punicea*, *Girella fimbriata*, *Parma kermadecensis*, *Enneapterygius*

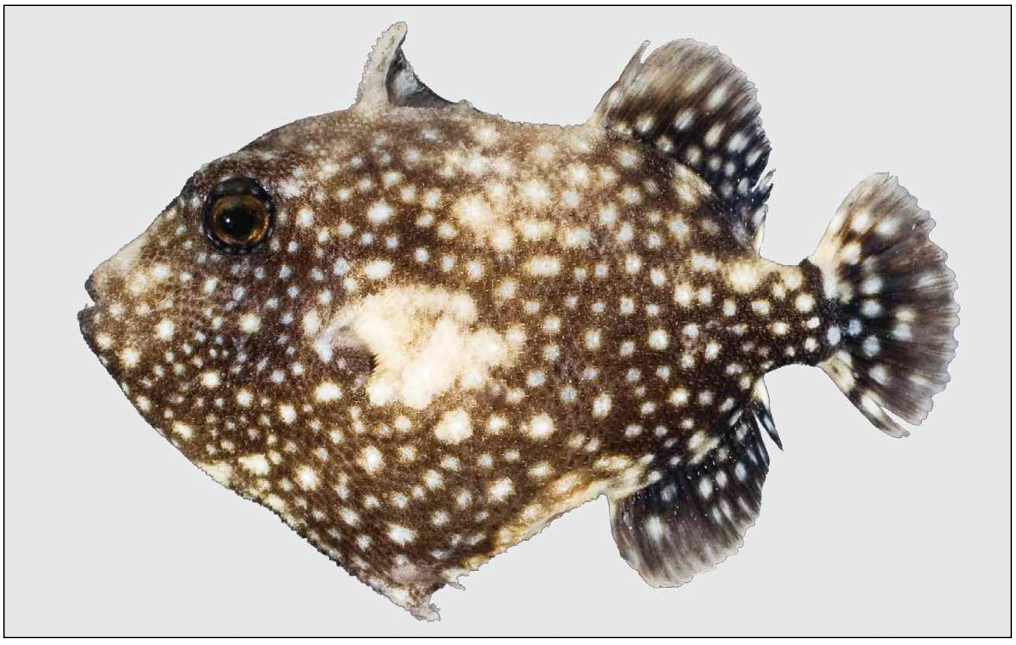

Figure 6. A new record for the Kermadec Islands and New Zealand: Balistidae *Canthidermis maculatus* NMNZ P.050469, 54 mm SL. *Photo: C. Struthers, NMNZ*

kermadecensis and *Eviota kermadecensis*. However, two of these species (*G. fimbriata* and *P. kermadecensis*) have been recorded as occasional vagrants in the northern North Island of New Zealand (Francis, 2012; Francis & Duffy 2015). In addition to these confirmed endemics, the Kermadec Islands population of *Chrysiptera rapanui* is probably an undescribed species, given its colour differences to the population at Rapanui (Easter Island) (Allen, 1991), and individuals of this species have also been reported from the northern North Island (Francis & Duffy, 2015). The proportion of endemic shorefishes (4.6%) is relatively low, which is not surprising considering the short period since emergence of these islands and the opportunity for dispersal from adjacent islands, and thus the opportunity for genetic transfer among these neighbouring populations. Seven of the eight endemic species are either live bearers or have demersal eggs (the exception is *G. fimbriata*), which likely limits the opportunity for dispersal (Francis & Cole, 2010; Francis & Duffy, 2015), and suggests the isolation of the islands selects species that are more likely to self-recruit. Even so, one of these species with demersal eggs (*P. kermadecensis*) occasionally reaches mainland New Zealand (Francis, 2012), a dispersal distance of over 700 km (Trnski & de Lange, 2015).

Among the apex predators, the Galapagos sharks (*Carcharhinus galapagensis*) observed and caught near the islands appear to be juveniles as they measured up to 1.5 m, whereas the size at which they reach sexual maturity and the maximum size for the species are 2.1–2.4 m and 3.0 m, respectively (Last & Stevens, 2009). The protected spotted black grouper, *Epinephelus daemelii* was observed at many of the dive locations. Both of these observations are consistent with the oceanic islands of Elizabeth and Middleton Reefs (Oxley *et al*., 2004), also considered to be a remote area with low levels of fish exploitation by humans. The biology, ecology, distribution and abundance of *E. daemelii* throughout its geographic range is provided by Francis *et al*. (2015).

The presence of several species warrants mention. *Iso* sp. is known from the western Pacific from Japan to Australia, including Lord Howe Island, and is likely to be distributed as far east as Tonga (Randall *et al*., 2003) and Samoa (Wass 1984), but is yet to be confirmed from New Caledonia (Fricke *et al*., 2011) or Norfolk Island (Francis, 1993). Given its occurrence at the Kermadec Islands, this species is likely to occur at these intermediate locations (Trnski, 2015b). This is the first record of *Canthidermis maculata* from New Zealand waters. This species has a prolonged pelagic phase and the single specimen was collected under a plastic bottle floating at the surface, a reminder that floating objects provide potential vectors for long-distance dispersal for some species of fishes.

The fish fauna is a mix of species that occur to the north and south of the islands, and in the regional southwest Pacific (Francis & Duffy, 2015). This is consistent with oceanographic currents that provide opportunities for dispersal from the west, north and south (Sutton *et al*., 2012; Trnski & de Lange, 2015). The most consistent surface current influencing the Kermadec Islands is the eastward-flowing Tasman Front, branching off the East Australia Current (Trnski & de Lange, 2015), potentially acting as a mechanism for eastward dispersal of shorefishes. However, there is strong attenuation of coastal fish taxa as the Tasman Front extends into the Tasman Sea (Mullaney *et al*., 2011; Francis & Duffy, 2015) and the dispersal of marine species to the Kermadec Islands may be also from islands to the north (Liggins *et al*., 2013).

The maintenance of fish species at the Kermadec Islands is likely dependent on a combination of self-recruitment and arrival of new recruits from nearby islands (Trnski *et al*., 2010). The relative contribution of each of these mechanisms is unknown and is likely to be a fruitful area of further study. Pelagic larval duration is one measure of potential dispersal from nearby islands. Modeling of regional currents indicates that exchange between the Kermadec Islands and mainland New Zealand would take 30-50 days (Sutton *et al*., 2012), which is longer than the larval duration of most fishes. However, that model assumed passive drift of larvae; incorporating larval behaviour could reduce these transit times. The model is also based on average current conditions; occasional extreme events such as cyclones could also alter the speed and direction of dispersal.

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