A literature review on the Poor Knights Islands Marine Reserve

2009

Department of Conservation
Te Papa Atawhai

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2009

Report prepared by the National Institute of Water & Atmospheric Research Ltd for:

Department of Conservation
Northland Conservancy
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Cover photo: Schooling pink maomao at Northern Arch

Photo: Kent Ericksen

Sim-Smith, Carina

A literature review on the Poor Knights Islands Marine Reserve /

Carina Sim-Smith, Michelle Kelly. Whangarei, N.Z: Dept. of

Conservation, Northland Conservancy, 2009.

112 p. : col. ill., col. maps ; 30 cm.

Print ISBN: 978-0-478-14686-8

Web ISBN: 978-0-478-14687-5

Report prepared by the National Institue of Water & Atmospheric

Research Ltd for: Department of Conservation, Northland Conservancy.

Includes bibliographical references (p. 67 -74).

1. Marine parks and reserves -- New Zealand -- Poor Knights Islands.

2. Poor Knights Islands Marine Reserve (N.Z.) -- Bibliography.

I. Kelly, Michelle. II. National Institute of Water and Atmospheric Research (N.Z.)

III. New Zealand. Dept. of Conservation. Northland Conservancy. IV. Title.

CONTENTS

Executive Summary

The Poor Knights Islands Marine Reserve is renowned for its unique assemblage of marine flora and fauna, its rich diversity of marine life, and unusual subtidal habitats, and consequently has been the focus of a number of scientific research studies. The last comprehensive literature review of the Poor Knights Islands Marine Reserve was by Kelly (1983). Over the last 25 years significant new information has been generated on the habitats of the Poor Knights Islands and the marine flora and fauna that inhabit them. The aim of this project is to collate and review scientific information that has been generated on the Poor Knights Islands Marine Reserve since 1983 to increase our overall understanding of the Poor Knights Islands ecosystem.

The Poor Knights Islands (Tawhiti Rahi Island and Aorangi Island) are extremely steep, with rocky cliffs extending over 100 m below sea level. Seven subtidal habitat types have been defined at the Poor Knights Islands; vertical reef walls and caves, macroalgal reef habitats, coralline flats/*Evechinus chloroticus*-dominated reefs, broken rock, sand, encrusting corallines, and Centro *(Centrostephenus rodgersii)* barrens. The vertical reef wall and macroalgal reef habitats have been well described in the literature, but there is currently a paucity of available information on the other habitat types. The National Institute of Water and Atmospheric Research is currently conducting a subtidal habitat mapping study of the Poor Knights Islands, to be published in 2009, that will provide us with detailed information on the other subtidal habitats within the reserve.

The Poor Knights Islands lie slightly west of the East Auckland Current, and thus are influenced by waters of higher temperature, salinity, and clarity than the waters around the mainland or at other islands on the northeastern coastline. Larvae of numerous subtropical and tropical species are transported to the Poor Knights Islands from northern regions, and consequently there is a rich diversity of subtropical flora and fauna within the reserve. A number of these subtropical species are transient visitors that settle at the Poor Knights Islands in mid summer but are unable to survive over winter. Other subtropical species fail to establish successful breeding populations in New Zealand, relying on the continual transport of larvae from outside New Zealand to sustain populations at the Poor Knights Islands. Thus, the population size of these non-breeding species at the Poor Knights Islands varies greatly over time.

An updated species inventory shows a large increase in the number of protozoans (110 new species records), molluscs (153 new species records) and fish (70 new species records) recorded from the Poor Knights Islands Marine Reserve. Macroalgae, cnidarians, and arthropods showed a moderate increase (10–25 new species records), while poriferans, bryozoans, ascidians, annelids, echinoderms, brachiopods, seabirds, reptiles, and marine mammals increased by less than 10 species per phylum. The species diversity of marine invertebrate taxa, at the Poor Knights Islands is most likely to be underestimated, given that there has been no significant research collection of marine invertebrates undertaken at the Poor Knights Islands in the last 20 years.

One hundred and eighty seven species of fish have been recorded from the Poor Knights Islands, of which, approximately 38% are subtropical species. Fish monitoring studies at the Poor Knights Islands show that fish abundances vary greatly at both temporal and spatial scales, with temporal patterns, in some cases, spanning several years. Following the establishment of full marine reserve status at the Poor Knights Islands in 1998 the abundance of fish species targeted by fishers such as snapper (*Pagrus auratus*) and pink maomao (*Caprodon longimanus*), increased by more than 100% in four years, whilst the abundance of most non-targeted species did not increase. However, by 2007 snapper was the only monitored species at the Poor Knights Islands to show a significant increase in abundance over 1998 levels.

Molluscan species diversity at the Poor Knights Islands (353 spp.) is similar to species diversity at Cape Rodney to Okakari Point Marine Reserve and Parengarenga Harbour, but much lower than species diversity at the Bay of Islands (551 spp.). The Poor Knights Islands are a 'hotspot' for opisthobranch diversity and 66 species have been recorded from the marine reserve. The intertidal molluscan fauna of the Poor Knights Islands has a number of unusual species distribution patterns compared to communities that inhabit exposed rocky shores on the mainland. Factors that influence the intertidal species assemblage at the Poor Knights Islands are currently poorly understood.

One hundred and twenty one species of macroalgae have been recorded from the Poor Knights Islands. This is likely to be a conservative estimate of the actual species diversity, as the macroalgal flora of the Poor Knights Islands has not been throughly studied. The marine flora of the Poor Knights Islands is an unusual mixture of species common to northeastern New Zealand, subtropical species, and southern New Zealand species. This unlikely mixture of species is probably a result of the location of the islands, the influence of the East Auckland Current, and the high degree of wave exposure at certain locations around the islands.

Twenty seven species of seabirds utilise the Poor Knights Islands, of which, 14 species are known to breed on the islands (including the Sugarloaf and High Peak Rocks). Ten of the species that breed on the Poor Knights Islands are classified as 'at risk' under the New Zealand Threat Classification System, and one species, the red-billed gull *Larus novaehollandiae scopulinus*, is classifed as 'threatened – nationally vulnerable'. The Poor Knights Islands are the only place in the world where the Buller's shearwater is known to nest.

In summary, this updated literature review of the Poor Knights Islands Marine Reserve has reviewed and interpreted over 130 new references relevant to the marine biota of the Poor Knights Islands since Kelly's 1983 bibliography, and compiled a checklist of 1259 marine species. Significant new research has been conducted on fish abundance, subtidal macroalgal communities, and vertical reef wall communities.

Introduction

The Poor Knights Islands Marine Reserve located 24 km off the northeastern coastline of New Zealand (Fig. 1) covers an area of approximately 1890 ha, encompassing the waters and seabed within 800 m of the Poor Knights Islands (Tawhiti Rahi Island and Aorangi Island) and associated islets. The reserve also includes the waters and seabed within 800 m of the High Peak Rocks (Pinnacles or Poor Knights Rocks) and Sugarloaf Rock that lie approximately 8 km to the south of the Poor Knights Islands (Figs. 2 & 3). The region was designated a marine reserve on 18 February 1981. At that time commercial fishing was prohibited within the reserve but restricted recreational fishing was permitted, pursuant to section 3(3) of the Marine Reserves Act, using drift-line, trolling, or spear guns, of certain species of fish[1] in most areas, with the exception of two 'no-take' areas around Nursery Cove Reef/Bartle's Bay/Maroro Bay and Frasers Bay/ South Harbour. In October 1998 the provisions that permitted restricted recreational fishing at the Poor Knights Islands Marine Reserve expired and the reserve became a fully protected marine reserve.

Figure 1. Location of the Poor Knights Islands Marine Reserve (red dot).

Map: Department of Conservation, Northland Conservancy

The Poor Knights Islands Marine Reserve has a unique assemblage of marine flora and fauna owing to a number of factors including:

1) the East Auckland current that originates in the Coral Sea (i.e., as the East Australian Current) and transports subtropical larvae to the reserve,
2) the steep, rocky, subtidal topography of the islands,
3) oceanic salinity levels, and
4) high water clarity.

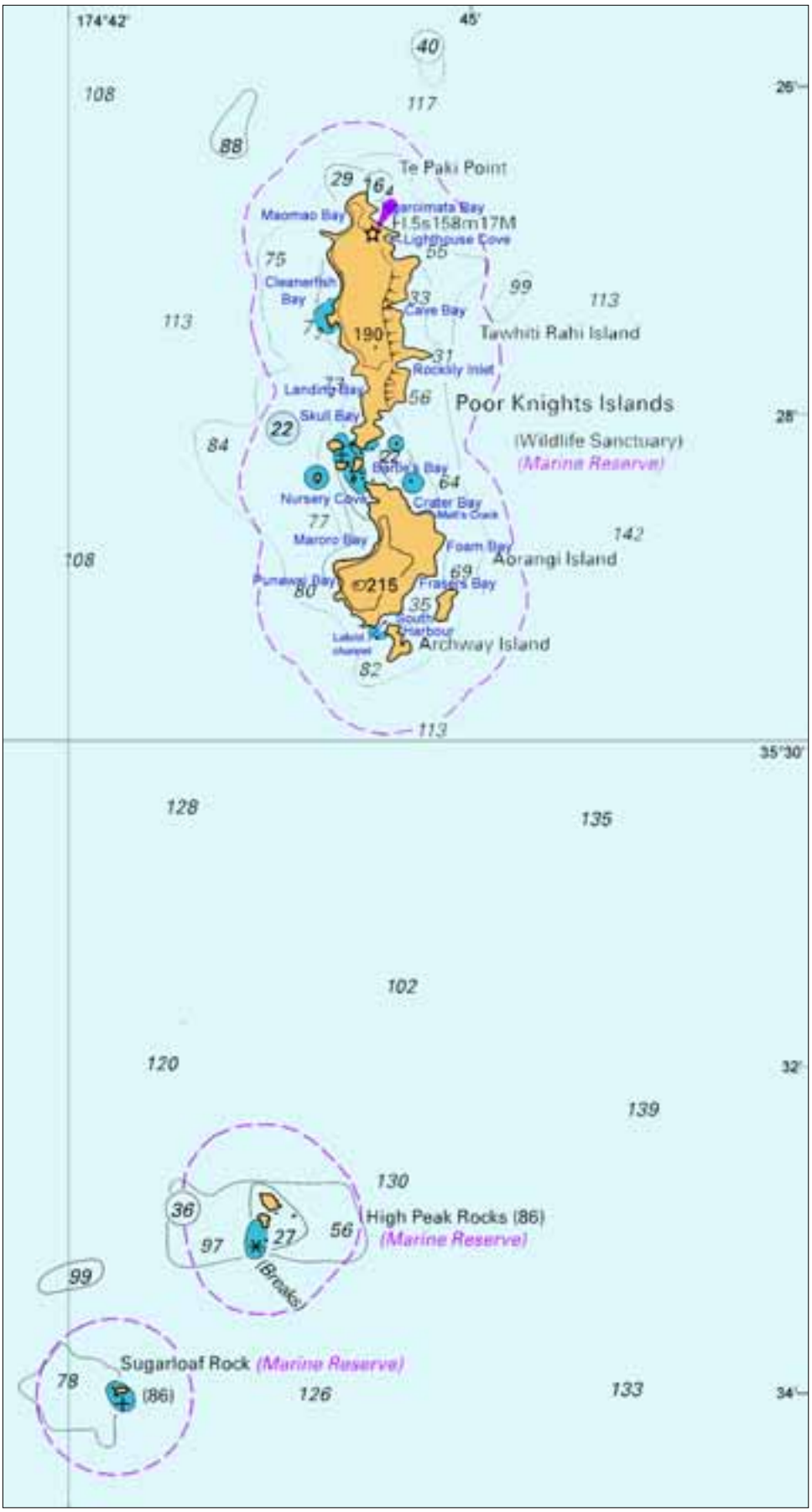
The combination of these environmental factors creates a unique environment that supports an unusual biological community at the Poor Knights Islands that has a strong subtropical component.

The Poor Knights Islands Marine Reserve has been the focus of a number of scientific research studies owing to the uniqueness of its flora and fauna and their protected status. However, the last comprehensive literature review of the Poor Knights Islands Marine Reserve was by Kelly (1983) entitled 'A Bibliography and Literature Review for the Poor Knights Islands Marine Reserve'. Over the last 25 years significant new information has been generated on the habitats of the Poor Knights Islands and the marine flora and fauna that inhabit them. While some of this information has been published much of the information resides in unpublished scientific reports and grey literature. The aim of this project is to collate and review scientific information that has been generated on the Poor Knights Islands Marine Reserve since 1983 to increase our overall understanding of the Poor Knights Islands ecosystem.

1 Recreational fishing of snapper, kingfish, trevally, mackerel, kahawai, shark, billfish, tuna, barracouta, and pink maomao was permitted prior to October 1998.

Figure 2. The Poor Knights Islands Marine Reserve. The purple dashed line shows the reserve boundaries.

Map adapted from Land Information NZ chart NZ521



2. The physical environment

2.1 SEABED GEOLOGY AND BATHYMETRY

The Poor Knights Islands are located on New Zealand's northeastern continental shelf at 35°28'S, 174°44'E. The volcanic origin of the Poor Knights Islands is obvious in the geology of the islands and the seabed. The islands are extremely steep, with cliffs reaching over 200 m above and extending over 100 m below sea level. The seabed drops sharply away from the coastline along much of the island, reaching depths of over 100 m within the 800 m radius of the marine reserve. A shallow region joins Tawhiti Rahi Island and Aorangi Island, with depths typically less than 30 m (Fig. 4). Shallow, gently sloping rocky reefs exist at South Harbour, Maroro Bay, Nursery Cove, Bartle's Bay, Cleanerfish Bay, and Lighthouse Cove (Fig. 2). Away from the steep gradient of the islands the continental shelf is predominantly regular and flat, with the occasional peak rising sharply from the sea floor. The continental shelf edge occurs approximately 10 km offshore of the islands at approximately 150–180 m depth (Eade, 1967; Stewart, 2001).

Figure 3. Tawhiti Rahi Island (foreground) and Aorangi Island. The High Peak Rocks (Pinnacles) and Sugarloaf Rock can be seen in the distance.
Photo: Keith Hawkins, DOC

Medium to coarse shelly sand is the predominant sediment type on the inner shelf around the Poor Knights Islands. Finer sand is present in areas of Maroro Bay and Skull Bay. The sediment is predominately bioclastic[2] with a small lithic[3] component and almost no mud. The bioclastic component of the sediment primarily consists of skeletal debris from bryozoans and molluscs, with smaller percentages of barnacle, brachiopod, echinoid, and scleractinian coral skeletons (Brook *et al.*, 2001). Further out towards the continential slope, the grain size of sediments differs

2 Skeletal carbonate sands
3 Rock/stone

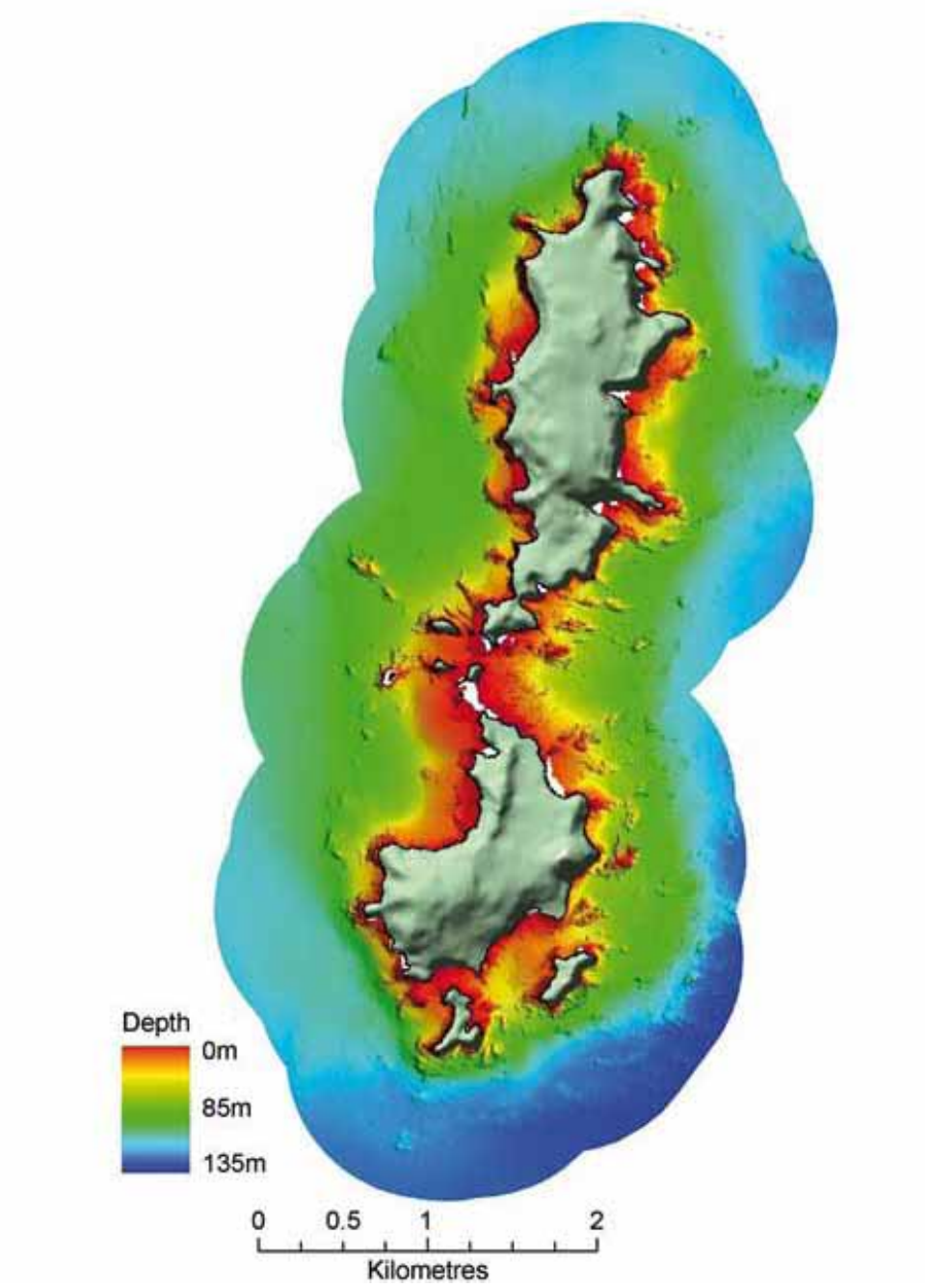


Figure 4. Bathymetry map of Poor Knights Islands produced by high resolution multi-beam sonar. The edge of the coloured area aligns with the reserve boundary. A bathymetry map that includes the High Peak Rocks and Sugarloaf Rock will be published by NIWA later in 2009.

Map reproduced with permission from Morrison *et al.*, 2007

significantly north and south of the Poor Knights Islands. North of the islands, coarse, shelly sands graduate into well-sorted fine sands on the shelf and upper slope down to about 500 m, which graduate into progressively finer deposits in deeper water. South of the islands, coarse shelly sands grade rapidly into sandy mud and mud deposits on the central shelf. On the outer shelf fine sands graduate into finer deposits in deeper water (Eade, 1967). Most of the sediment on the continental shelf of northeastern New Zealand has a carbonate content of less than 40%. However, carbonate concentrations close inshore around the Poor Knights Islands are higher than average owing to the high proportion of bioclastic sands. East of the Poor Knights Islands, a region beyond the shelf edge at 300–500 m depth has an usually low percentage (<20%) of carbonate in the sediment owing a high percentage of volcanic glass (Eade, 1967).

2.2 HYDROLOGY OF THE AREA

The East Australian Current forms the principle southward flowing current along the east coast of Australia. This very strong current, originating in the Coral Sea travels south to approximately Brisbane where a major branch turns eastward across the Tasman Sea towards New Zealand. The current, now called the East Auckland Current, passes north of New Zealand and flows down the northeastern coastline of New Zealand to East Cape following approximately the edge of the continental shelf (Fig. 5), at speeds of between 0.18–0.3 m/s (Harris, 1985). This current of warmer oceanic waters is usually held offshore by topographic trapping over the continental shelf (Sharples, 1997). Thus, a band of 'resident' hydrologically different coastal water usually exists between the mainland and the East Auckland Current. On occasions during periods of intense stratification in spring–summer, strong southeasterly winds may drive the clear, warm oceanic waters of the East Auckland Current closer towards the mainland resulting in a rapid increase in water temperature (~2°C) and salinity (Sharples, 1997). This summer event, known by local communities as "the blue water coming in", transports oceanic plankton and planktonic life-stages of subtropical species closer towards the northeastern coastline of New Zealand (Zeldis *et al.*, 1995; Sharples, 1997).

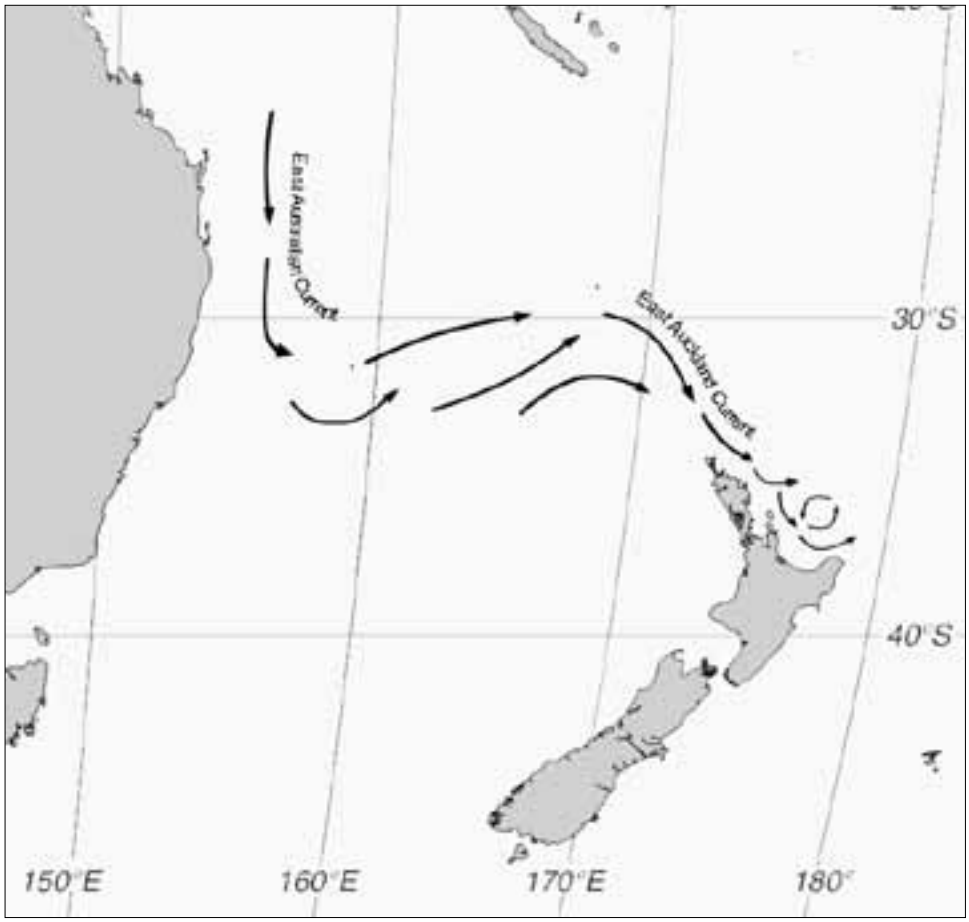


Figure 5. Generalised path of the East Australian and East Auckland currents.

The Poor Knights Islands are situated 5–10 km west of the shelf-break sea surface temperature front that separates the cooler coastal waters from the East Auckland Current (Stewart, 2001), and thus, the islands

are more frequently influenced by waters of higher salinity, clarity, and temperature than the waters around the mainland or at other islands on the northeastern coastline[4]. Water salinity around the Poor Knights Islands is on average 0.2% higher than around the mainland, and water clarity can exceed 30 m (Ritchie *et al.*, 1979; Grace, 1983). On certain days sea surface temperature (SST) at the Poor Knights Islands can be 2°C higher than on the adjacent coastline (Grace, 1983), but long-term SST data collected by satellite mounted Advanced Very High Resolution Radiometer shows much smaller differences in average SST between the Poor Knights Islands and the adjacent coastline. Comparison of the average monthly SST for the Poor Knights Islands and the Tutukaka coastline between 1993 and 2007 show that the SST around the Poor Knights Islands is, on average, only 0.2°C higher than the SST of the Tutukaka coastline (NIWA Satellite Data Services[5], unpublished data). The largest temperature differences between the two regions appears to be during the winter months (July–September), when average SST at the Poor Knights Islands is 0.5–0.8°C higher than the SST along the Tutukaka coastline (Fig. 6). Maximum SSTs of around 22°C occur in February at the Poor Knights Islands and minimum SSTs of around 13°C occur in September (NIWA Satellite Data Services, unpublished data). The water is thermally stratified with surface temperatures typically 5°C higher than temperatures at 100 m depth. The depth of the surface mixed layer varies but typically ranges between 30–50 m (Stewart, 2001).

The East Auckland Current is the main non-tidal current that affects the Poor Knights Islands, flowing predominantly southeast with a mean speed

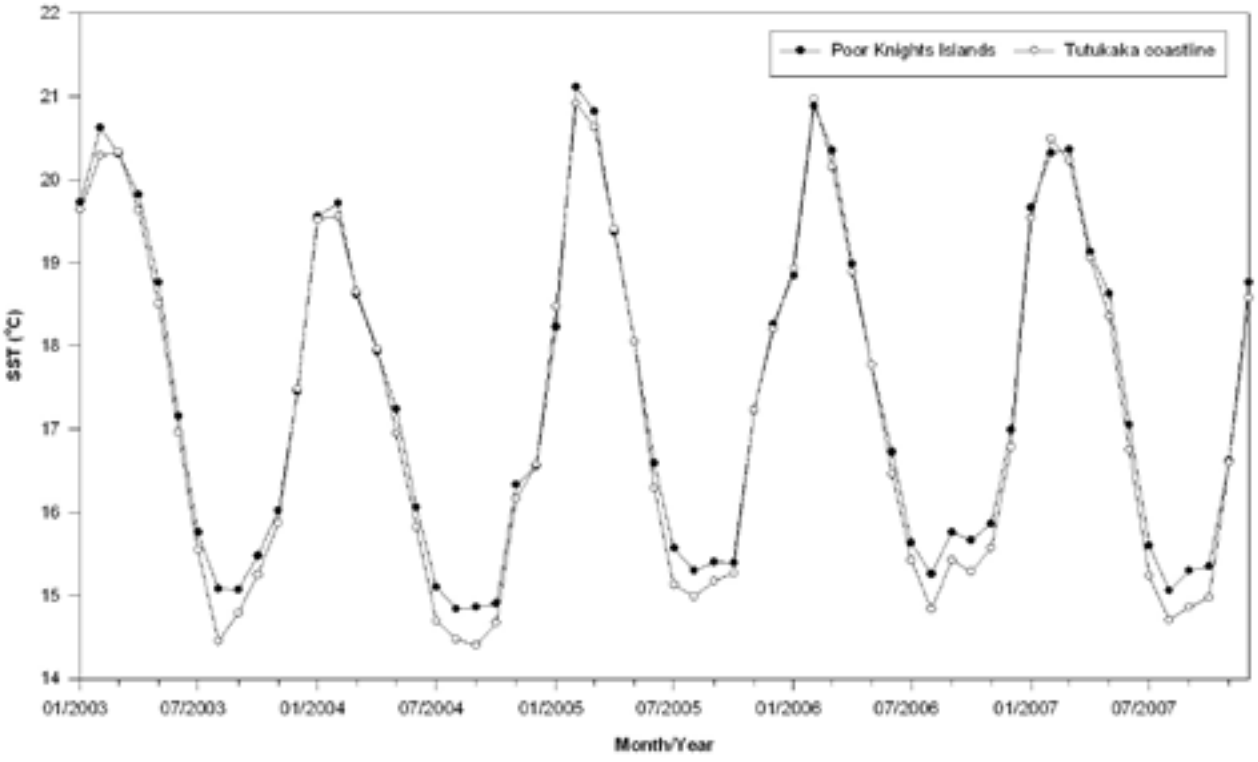


Figure 6. Average monthly Sea Surface Temperature (SST) for the Poor Knights Islands and the Tutukaka coastline between 2003 and 2007.

Data from NIWA Satellite Services

4 It should be noted that pronounced cold water upwellings at North Cape and the Three Kings Islands override the strong subtropical influence of the East Auckland Current that one might expect in these more northern regions (Grace, 1972 in Kelly, 1983).

5 http://www.niwascience.co.nz/services/paid/sat

of 0.2 m/s (Sharples & Greig, 1998). Waters around the Poor Knights Islands are also affected by onshore internal waves and a strong north–south tidal current, which reverses direction depending on the state of the tide (Kingsford & MacDiarmid, 1988). Internal waves are generated by the interaction of tides, stratification, and bathymetry at the continental shelf edge. These waves facilitate vertical mixing of the water column drawing nutrients from deeper waters to the surface, and may provide a mechanism for the shoreward transport of larvae and plankton. The main tide-driven internal wave travels towards the Poor Knights Islands at a mean speed of 0.3 m/s and has a minimum travel time of 30 hours from the closest generation region (Stevens & Abraham, 2005).

Spring tides at the Poor Knights Islands have a maximum range of around 2 m and neap tides have a range of around 1 m (Stevens & Abraham, 2005).

Figure 7. Encrusting invertebrate community at Cream Gardens with three divers in the background illustrating the high water clarity of the waters around the Poor Knights Islands.

Photo: Kent Ericksen

3. The biological marine environment

3.1 INTERTIDAL ZONATION

The intertidal substratum at the Poor Knights Islands is primarily volcanic rhyolite breccia, with very limited areas of sand or shell. The majority of the intertidal region consists of steep rock walls. Gently sloping rocky platforms occur at Ramariki, Hope Point, and Bartle's Bay (Fig. 8). On rocky shorelines there is a general pattern of zonation down the shore. In the upper eulittoral zone[6] the dominant organisms are the drought resistant alga *Porphyra columbina*, and large brown surf barnacles (*Chamaesipho brunnea*), which form densely packed sheets on the rock surface. The limpet *Notacmaea pileopsis* and the periwinkle *Austrolittorina unifasciata* are scattered throughout this zone. In the damper crevices of the lower part of the upper eulittoral zone the anemone *Actinia tenebrosa* can be found. Slightly lower on the shore the predominant alga is a small endemic encrusting red alga, *Apophlaea sinclairii. Epopella plicata* replaces *C. brunnea* as the dominant barnacle and the gastropods *Nerita atramentosa, Lepsiella scobina,* and *Notoacmea scopulina* are abundant in this zone. In the mid and lower eulittoral zones the encrusting gastropod *Novastoa lamellosa* forms a dense band of interwoven tubes, 1–3 cm high, across the shore. A number of very small grazing chitons and gastropods are found in the gaps between the *N. lamellosa* tubes, including *Plaxiphora caelata, P. obtecta, Patelloida corticata, Risellopsis varia,* and *L. scobina.* Other invertebrates commonly found in this zone include isopods, amphipods, and the polychaete *Nereis* sp.. The brown alga, *Xiphophora chondrophylla* is the dominant alga of the lower eulittoral zone in areas of moderate exposure, but it is replaced by *Durvillea antarctica* in areas of high exposure. In the lowermost section of the eulittoral zone the barnacle *Balanus tintinnabulum*, the ascidians *Pyura trita* and *Asterocarpa coerulea*, and the polyzoan *Emma crystallina* can be found (Cranwell & Moore, 1938; Creese & Ballantine, 1986) (For more information see Sections 4.1 on intertidal macroalgae and 5.8.1 on intertidal molluscs).

6 Intertidal zone

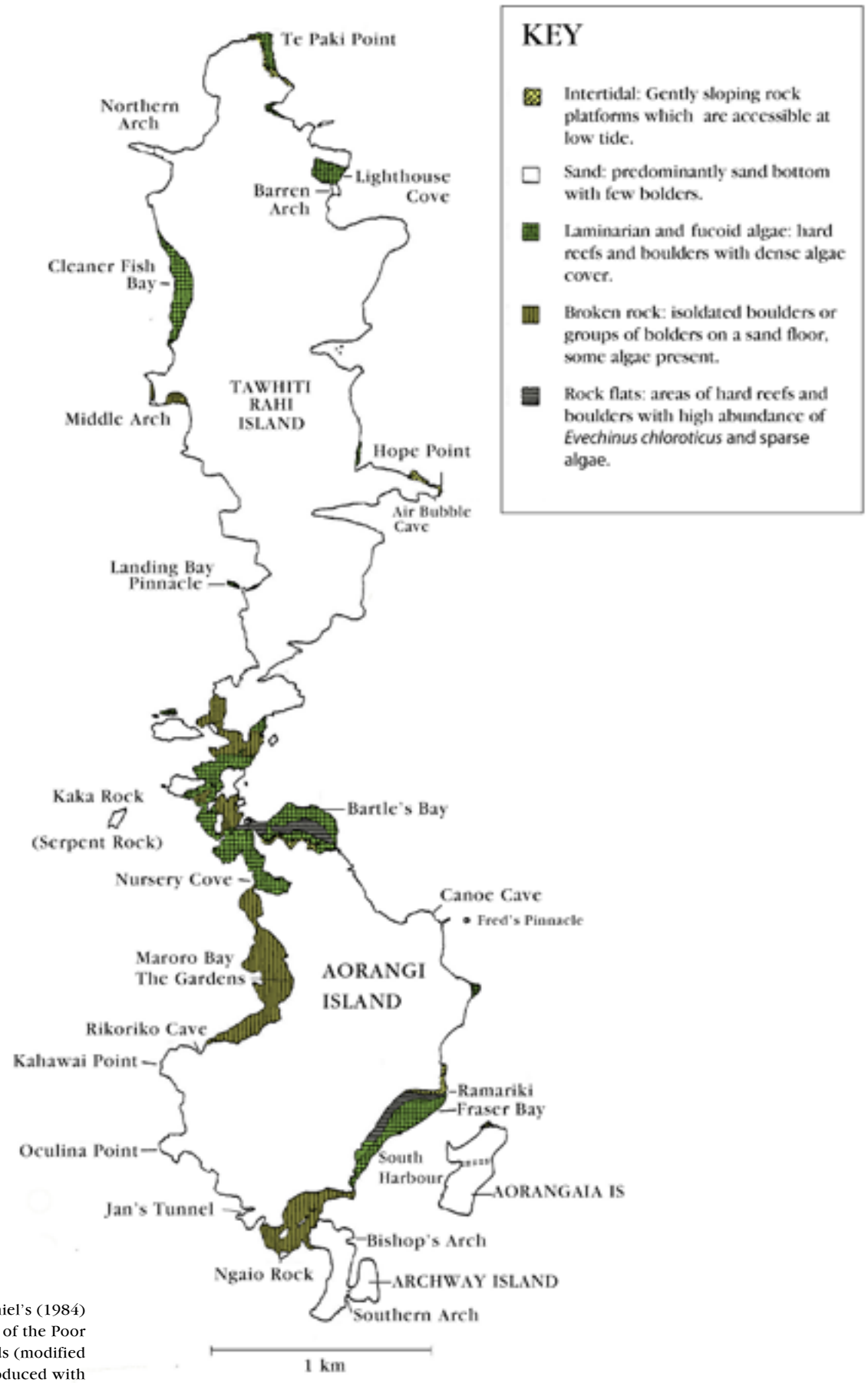


Figure 8. Schiel's (1984) habitat map of the Poor Knights Islands (modified and reproduced with permission).

3.2 SUBTIDAL ZONATION

3.2.1 Subtidal habitats

Schiel (1984) constructed the first habitat map of the Poor Knights Islands Marine Reserve (Fig. 8), which depicted five main subtidal habitat types at depths of less than 30 m:

1. vertical reef walls and caves,
2. macroalgal reef habitats,
3. coralline rock flats & echinoids,
4. broken rock, and
5. sand.

The majority of the subtidal region consists of steep rock walls, caves, and archways that are covered with an abundance of sessile invertebrates and macroalgae. These rock wall regions are not represented on Schiel's two-dimensional map. The second major habitat type is gently sloping rocky reefs covered in laminarian macroalgae. Large areas of macroalgae reefs that extend down to 50+ m in some places are present at Frasers Bay, Bartle's Bay, Nursery Cove, Cleanerfish Bay, Te Paki Point, Lighthouse Cove, and the channel between the two main islands. Coralline-encrusted rock flats associated with large numbers of echinoids are present at Bartle's and Frasers Bays. Large areas of broken rock are present on the west side of Aorangi Island (The Gardens), around Ngaio Rock, and at the southern point of Tawhiti Rahi Island (Fig. 8).

Over the years the majority of habitats around the Poor Knights Islands have been stable, but there have been some changes. For example, prior to 1980 Nursery Cove Reef was covered in large brown macroalgae but by 1984 it was devoid of large macroalgae and instead dominated by the sea urchin, *Evechinus chloroticus*. This change in habitat was associated with an increase in abundance of the black angelfish, *Parma alboscapularis,* which builds nests on prominent boulders that are devoid of large brown macroalgae (Schiel, 1984). Between 1999 and 2006 the habitat at Bartle's Bay changed from turfing red algae to coralline flats/ echinoid-dominated reefs. Areas of *Ecklonia radiata* forest at 10–12 m depth at Frasers Bay and Cleanerfish Bay were also replaced with coralline flats/echinoid-dominated reefs, but these areas were associated with the black sea urchin, *Centrostephanus rodgersii*, rather than *E. chloroticus* (Shears, 2007).

The first two habitat types have been well studied and more detailed descriptions of these habitats are given below. Very little information is available about the other habitat types.

Vertical reef walls and caves

The Poor Knights Islands Marine Reserve is most renowned for its vertical reef walls and caves that are covered with an amazing diversity of flora and fauna including sponges, bryozoans, ascidians, anemones, and encrusting algae. Light and wave action are the major factors that determine the community composition on the rock surfaces, and a general pattern of

change can be seen in the community composition with increasing depth. Near the sea surface the rock wall is covered by macroalgae, predominantly *Carpophyllum* sp. and red foliose algae, which are succeeded by *E. radiata* at depths between 5–30 m. Under the canopy of *E. radiata* the rock surface is covered by numerous sponges (e.g. species of *Tethya, Polymastia, Cliona, Tedania, Callyspongia*), bryozoans (*Bugula dentata, Emma triangula, Margaretta barbata*), anemones (*Corynactis australis, Corynactus haddoni*), hydroids (*Symplectosycphus* sp., *Thecocarpus* sp., *Aglaophenia* sp.), and encrusting algae. As depth increases beyond 30 m the community composition becomes dominated by large sponges (*Iophon minor, Callyspongia latituba, Calyx imperialis*), hydroids, bryozoans, and gorgonians (e.g. *Primnoeides* sp.), that thrive in the low light and calm water conditions. Notable components of deep reef communities include the rare black coral (*Lillipathes lillei*), giant tube sponges (*C. imperialis*), and organ pipe sponges (*Iophon laevistylus*). This pattern of change in community composition is also evident in caves but along a horizontal plane towards the back of the cave. Near the cave entrance the community is similar to that near surface overhangs, but growth is less profuse as water movement in the caves is limited. Further into the cave large finger sponges (*Callyspongia ramosa*) are absent and gorgonian fans are stunted. This community is dominated by encrusting sponges, compound ascidians, hydroids, and polyzoans. In the near dark depths of the cave the flora and fauna are sparse, predominantly simple ascidians and the solitary cup corals such as *Monomyces rubrum* and *Tethocyathus cylindraceus* (Doak, 1971; Ayling, 1974a, 1974b; Battershill, 1986; Ayling & Schiel, 2003).

Figure 9. Community of encrusting invertebrates on an underwater vertical rock wall at the Poor Knights Islands.

Photo: Vince Kerr

Although the community composition of the rock walls varies greatly with location and depth Battershill (1986) observed some general trends:

1. The most abundant groups of organisms in terms of percentage cover were thin encrusting sponges, thin encrusting algae, turfing hydroids, and turfing bryozoans.
2. Sites on the more exposed eastern side of the island had a higher percentage of ascidians (mainly *Cystodites* sp., *Leptoclinides* sp., and *Aplidium* sp.) and massive sponges (mainly *Stelletta* spp. and *Ancorina* spp.).
3. In shallow, turbulent areas thin encrusting sponges, ascidians, and algal species dominated, while in sheltered shallow waters bryozoans and turfing branching hydroids dominated.
4. Reef fish and urchins were found in low numbers on vertical walls.
5. The composition and distribution of the vertical reef community is stable over time.

Macroalgal reef habitats

A variety of macroalgal habitats are present in shallow waters (<5 m) including *Carpophyllum*, mixed algal, red foliose algal, and turfing algal habitat depending on location and wave exposure. Between 5 and 30 m *Ecklonia radiata* is the dominant algal species accounting for more than half of the total algal biomass (Shears, 2007) (See Section 4.2 for more detail). Sponges, bryozoans, hydroids, and ascidians are important substrate covers beneath the *E. radiata* canopy. The common sea urchin, *Evechinus chloroticus*, is the most common mobile macroinvertebrate on the reefs, accounting for approximately 90% of the total counts of all mobile macroinvertebrates. Densities of herbivorous gastropods at the Poor Knights Islands are much lower than on similar coastal reefs, possibly because of recruitment limitation or the high abundance of predators (Shears & Babcock, 2004). The macroalgal habitats support a large numbers of small fish, primarily labrids (Choat & Ayling, 1987).

Shears and Babcock (2004) and Shears (2007) conducted surveys of nine reef sites[7] at the Poor Knights Islands in 1999, just after all fishing was prohibited, and again in 2006. The results showed that subtidal reef communities at the Poor Knights Islands were relatively stable over the eight year period, although there was a significant increase in the total macroalgal biomass. This increase was primarily because of a doubling in *E. radiata* biomass. There were no major changes in the species composition or extent of the reef areas between the two surveys. However, there was a reduction in turfing algal habitat, and an increase in the coralline flats/echinoid-dominated reefs between 1999 and 2006, particularly at Bartle's Bay. Surprisingly, the abundance of *E. chloroticus* was similar between the two sampling periods despite a significant increase in snapper numbers between 1998 and 2001 (Denny *et al.*, 2004). Generally, sea urchin numbers are negatively correlated to the numbers of large predators.

7 Lighthouse Bay, Rocklily Inlet, Nursery Cove, Cleanerfish Bay, Skull Bay, Bartle's Bay, Matt's Crack, Frasers Bay, and Labrid Channel (see Fig. 2 for locations).

Coralline flats/echinoid-dominated reefs

The coralline flats/echninoid-dominated reef habitat (sometimes referred to as 'urchin barrens') was first described by Ayling (1981). This habitat is characterised by coralline covered rocks that are generally devoid of any large macroalgae, but with a high abundance of sea urchins (*E. chloroticus*). This habitat typically occurs at depths between 5–10 m where *E. chloroticus* is most abundant (Choat & Schiel, 1982; Schiel, 1984). Coralline flats/echninoid-dominated reefs are uncommon at the Poor Knights Islands and large areas are only present at Bartle's Bay. Small patches of coralline flats/echninoid-dominated reefs are also present at Rocklily Inlet, Matt's Crack, Frasers Bay, Cleanerfish Bay, and Labrid Channel (Shears, 2007). Abundance of labrids around the coralline flats/ echninoid-dominated reefs is lower than within macroalgal reef habitats, but higher numbers of large benthic carnivores such as snapper are present (Choat & Ayling, 1987).

3.2.2 Subtidal habitat mapping (by Jarrod Walker)

The National Institute of Water and Atmospheric Research Ltd (NIWA) are currently (2005–2009) undertaking a research programme at the Poor Knights Islands Marine Reserve, entitled 'Marine Recreation' funded by the Foundation of Research, Science, and Technology (Contract no: C01X0506). This project sets out to determine whether the current levels of recreational diving has a detectable impact on the benthic flora and fauna associated with near-shore, shallow rocky reefs (0–50 m depth). NIWA are using a number of methods to determine what effect current diving intensities have at the Poor Knights Islands. The overall aim of this project is to move towards an ecosystem management framework that will allow managers, Iwi, and interested stakeholders to manage and sustainably progress the tourist industry while protecting the resources that are the foundation of the tourist industry at the Poor Knights Islands. One of the main outputs is to overlay, in Geographic Information System (GIS), biological and habitat information that has been collected onto a bathymetric map to produce habitat maps for public and managerial end users.

Methods

Bathymetric surveys of the Poor Knights Islands, using multi-beam sonar, were completed in 2006. Multi-beam technology is an advanced depth sounding and hydrographic mapping system which allows acoustic mapping of the topographic features of the seafloor. It provides detailed information about the rugosity (roughness) of the terrain and bathymetry (water depth), and can produce high resolution images and maps of the seafloor. It also collects information that can be used to predict the geology, and potential habitats available to marine life. This mapping exercise provided a detailed and accurate description of the major physical components of both the rocky reef and sandy areas of the sea floor in depths from approximately 2 to 100+ m (Fig. 4, Section 2.1).

In addition to this work, large scale biological surveys have been undertaken using both a dropped underwater video camera and diver

operated video cameras (detailed below). From the images captured by video, counts and estimates of the percentage coverage of various organisms found inhabiting the reef were collected. A range of habitats were also recorded from the video footage, along with the depth that they were found and GPS locations. The types of habitat classifications used in this study were those described by Ayling (1978) and more recently by Shears *et al*. (2004). This information, in particular the habitat data, will be compiled with the multi-beam maps to produce high resolution physical and biological maps of the Poor Knights Islands underwater seascape, due to be published in 2009.

Dropped underwater video surveys

To survey the subtidal rocky reef biota of the Poor Knights Islands a dropped underwater video system was employed. At 80 sites evenly distributed around the island chain (Fig. 10) cameras were lowered along a series of transects to capture the biological communities residing on

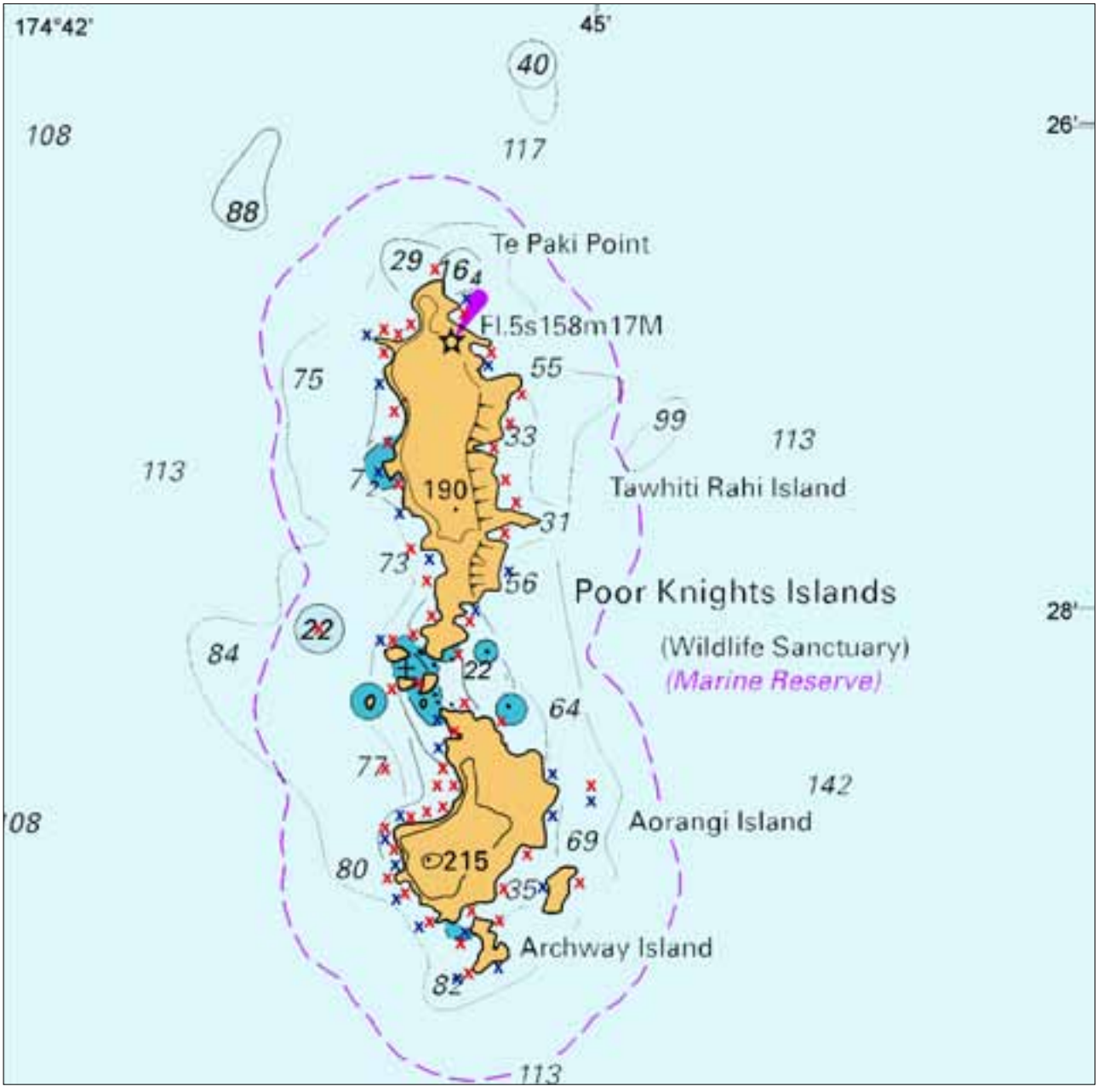


Figure 10. Map of the Poor Knights Islands displaying sites where the dropped camera system (red x) and diver operated camera systems (blue x) were used to survey benthic biological communities. Not shown on the map are two sites at the Sugarloaf Rock and four sites at the High Peak Rocks (Pinnacles),

Map adapted from Land Information NZ chart NZ521)

the reef. Transects were run from the shallow intertidal (~2 m depth) out to 50+ m, with the length of transects dictated by the slope of the reef (i.e. steep reefs = short transects, while gently sloping reefs = longer transects). A downward facing underwater camera was lowered to the rocky substrate 3–5 times in each of 9 depth strata (0–5, 5–10, 10–15, 15–20, 20–25, 25–30, 30–35, 40–50, and 50+ m), with each camera drop treated as a 0.5 m^2 sampling unit. From each quadrat, the benthic habitat was classified (e.g. kelp forest or mixed algae), and counts and estimates of the reef coverage of all major categories of invertebrates and macroalgae were recorded. Each camera drop was GPS, time, date, and depth stamped to enable the integration of these data with the multi-beam data.

Diver operated underwater video and still photography

In places where the drop camera could not access, e.g. caves, archways, and against vertical cliffs, a team of divers using video/still cameras sampled the biota using similar methodologies to the dropped underwater camera surveys. Transects ran from shallow intertidal to 30 m depth and were typically vertical. Video footage was taken of the entire transect to obtain information on habitat variations down a depth gradient. Along each transect six still photos were taken within each of 6 depth strata (0–5, 5–10, 10–15, 15–20, 20–25, 25–30 m) with each photograph treated as a 0.5 m^2 sampling unit (Fig. 11). From each quadrat, the benthic habitat was classified (e.g. kelp forest or mixed algae), and counts and estimates of the reef coverage of all major categories of invertebrates and macroalgae were recorded. Each photo contained time, date, and depth information while the transect start point was GPS-ed enabling these data to be combined with the dropped camera data and integrated with the multi-beam maps.

Figure 11. Still photo from the diver operated underwater camera showing an orange massive sponge (*Stelletta crater*), an encrusting yellow sponge (*Aaptos confertus*), and a rich assemblage of encrusting ascidians and bryozoans at 23.2 m depth.

Photo: NIWA

3.2.3 New habitat types

The first habitat maps constructed by Schiel (1984) were detailed and well-constructed and displayed a range of habitat configurations and the depths at which these habitats altered. The work currently being undertaken by NIWA at the Poor Knight Islands covers a larger spatial scale (80 sites spread across the entire island chain, including the Sugarloaf Rock and High Peak Rocks (Pinnacles), and greater depth range (>40 m), than previous research at the Poor Knights Islands (Ayling, 1974b, 1974a; Schiel, 1984; Battershill, 1986; Shears & Babcock, 2004; Shears, 2007), and has lead to the recognition of two new habitat types.

The first habitat is predominantly found at depths greater than 40 m where divers have very limited safe diving time. Accordingly, very little scientific work has been undertaken at these depths. This habitat mainly consists of encrusting coralline algae that form leaf-like plates that occupy the majority of the reef. This habitat is named "encrusting corallines" and has been recorded at a number of sites around the two main islands.

A second habitat, equivalent to the urchin barrens habitat described in Shears *et al.* (2004) was also observed. Called "Centro barrens", this habitat consists of moderate densities of the sea urchin *Centrostephenus rodgersii.* The Centro barrens habitat was found deeper (~20–25 m) than the previously described urchin barrens habitat (~4–10 m), which is formed by *Evechinus chloroticus* (Choat & Schiel, 1982; Schiel, 1984; Shears, 2007).

The NIWA survey has shed light on the ranges and breadth of subtidal habitats over a number of spatial scales (metres to kilometres) and at depths where few scientific divers are able to access. Accurate mapping of deep subtidal habitats will allow the identification of benthic communities that are vulnerable to damage, and allow management practices to be put in place to protect them.

Figure 12. Schooling pink and blue mamao.
Photo: Matthew Oldfield

4. Marine flora

There is a rich abundance and diversity of macroalgae at the Poor Knights Islands, with 121 species of algae recorded from the islands. However, a thorough taxonomic survey of the macroalgae of the Poor Knights Islands has not been conducted, and therefore this is likely to be a conservative estimate of the number of macroalgal species present. Some of the lushest kelp beds in New Zealand can be found at Nursery Cove and Cleanerfish Bay, where subtidal reefs are covered with the golden seawrack, *Carpophyllum angustifolium*, the strap kelp, *Lessonia variegata*, and the common kelp, *Ecklonia radiata* (Ayling & Schiel, 2003). The marine flora of the Poor Knights Islands is an unusual mixture of species common to northeastern New Zealand such as *C. angustifolium* and *Gigartina alveata*, subtropical species such as *Pedobesia clavaeformis, Microdictyon umbilicatum,* and *Palmophyllum umbracola*, and southern New Zealand species, such as *Durvillea antarctica* and *Caulerpa brownii.* Bull kelp *(D. antarctica)* is a common species in southern New Zealand, but is not found in the North Island between North Cape and East Cape with the exception of some exposed offshore islands including the Poor Knights Islands. It is possible that at high levels of wave exposure *D. antarctica* can withstand higher water temperatures (Creese & Ballantine, 1986).

Several rare species of macroalgae are found at the Poor Knights Islands. In 1994 the rare, endemic red alga, *Gelidium allanii*, was discovered with a sample of *Pterocladia capillacea* taken from the Poor Knights Islands in 1978. Prior to 1994 *G. allanii* had only been recorded from the type locality in the Bay of Islands. The alga is typically found growing in intertidal pools on calcium carbonate substrata (Nelson *et al.*, 1994), however, no limestone is present at the Poor Knights Island therefore it must grow on a different substrate at the Poor Knights Islands (F. Brook, pers. comm.). The green alga, *Palmophyllum umbracola*, was first found at the Poor Knights Islands in 1982 (Nelson & Ryan, 1986). This subtidal species is known from the Poor Knights Islands, the Kermadec Islands, and a few mainland New Zealand coastal sites down to 30 m depth in shaded areas such as caves and overhangs (W. Nelson, NIWA, pers. comm.). An unusual green alga, *Pedobesia clavaeformis*, was discovered at Nursery Cove in 1980. This species has also been recorded from the Kermadec Islands, the Three Kings Islands, the Bay of Islands, and Cape Rodney–Okakari Point Marine Reserve (Hawkes, 1983). An undescribed species of *Rhodymenia* that has previously been reported from the Three Kings Islands has also been collected at the Poor Knights Islands (W. Nelson, NIWA, pers. comm. in Shears & Babcock, 2004).

4.1 INTERTIDAL MACROALGAE

Sixty two species of intertidal macroalgae have been recorded from the Poor Knights Islands (Appendix 2, Table 1). Published information on the intertidal macroalgal community at the Poor Knights Islands is

mainly limited to the studies by Cranwell & Moore (1938) and Creese & Ballantine (1986). There is also some information on intertidal macroalgal species collected at the Poor Knights Islands in Battershill (1986) and Nelson & Adams (1987). Unpublished algal collections taken from the Poor Knights Islands are held at Museum of New Zealand Te Papa Tongarewa, Wellington, and the Auckland Museum Herbarium (W. Nelson, NIWA, pers. comm.).

Rocky shores at the Poor Knights Islands show a general pattern of algal zonation down the shore. Blue-green and filamentous algae grow high up on the shore in areas of freshwater runoff or where there is sustained sea spray. In the upper eulittoral zone the drought-resistant red alga, *Porphyra columbina,* is common. *Porphyra columbina* has a seasonal abundance, being most prolific in spring, and often absent from large areas in summer. Below the high tide mark the predominant alga is a small endemic encrusting red alga, *Apophlaea sinclairii*. This alga is extremely resistant to desiccation and wave exposure, and forms a dense, deep-red crust on the rocks. *Apophlaea sinclairii* appears to have a high light requirement, and does not grow much lower than mid-tide level. In the lower limits of the *A. sinclairii* zone, around mid-tide level, two other species of red algae, *Catenellopsis oligarthra* and *Catenellopsis* sp. are frequently present (Cranwell & Moore, 1938). The rocks on the lower shore are covered with thin, encrusting red algae (*Hildenbrandia* sp., *Melobesia* sp.), and various types of coralline algae. This base provides a substratum for the attachment of small gelatinous algae such as *Nemalion* sp., *Trematocarpus acicularis*, and dwarfed forms of *Gigartina alveata.* In shaded areas, tufts of *Ulva* sp., *Polysiphonia* sp., *Ceramium* sp., and *Callophyllis decumbens* occur. In areas of moderate exposure the brown alga, *Xiphophora chondrophylla*, dominates the lower intertidal zone. Interspersed between *X. chondrophylla* are several other algal species including *Pleurostichidium falkenbergii, Melanthalia abscissa, Pterocladia lucida, Rhodymenia leptophylla,* and *Champia* sp. In regions were wave exposure is extreme *Durvillea antarctica* replaces *X. chondrophylla* as the dominant alga. In the lower limit of the intertidal zone *Carpophyllum angustifolium* forms a dense band that extends into the subtidal zone. Other algal species commonly found in this zone include *Calophyllis decumbens, Champia* sp., *Rhodymenia leptophylla, Plocamium* sp., *Pterocladia lucida, P. capillacea, Rhodymenia* sp., *Griffithsia traversii*, and *Osmundaria colensoi* (Cranwell & Moore, 1938).

4.2 SUBTIDAL MACROALGAE

Seventy nine species of subtidal macroalgae have been recorded from the Poor Knights Islands (Appendix 2, Table 1). Distribution of subtidal macroalgae around the Poor Knights Islands is greatly influenced by wave exposure and light intensity. On the exposed eastern side of the islands the sublittoral fringe (<2 m) is dominated by *Carpophyllum angustifolium* and red turfing and foliose algae including *P. lucida, Rhodymenia* sp., *O. colensoi,* and *Pachymenia crassa. Lessonia variegata*, coralline turf, and red turfing algae dominate the 4–6 m region, and coralline turf and red turfing algae dominate the deeper waters (<18 m).

Sites of moderate exposure such as Cleanerfish Bay are dominated by *C. angustifolium* and red turfing algae in shallow waters (<2 m). Red turfing algae (e.g. *Gigartina macrocarpa*), red foliose algae (*O. colensoi, Placentophora colensoi, P. crassa, Nesophila hoggardii*), *Ulva lactuca*, and *E. radiata* dominate the 4–6 m region, while deeper regions are predominately covered by an *E. radiata* forest interspersed with patches of *Caulerpa flexilis*.

In the more sheltered locations such as Nursery Cove, Skull Bay, Landing Bay, and Labrid Channel, a mixture of species is present in the shallow region (<2 m) including; *Carpophyllum maschalocarpum, C. angustifolium, L. variegata, E. radiata*, coralline turf, red turfing algae, red foliose algae (*O. colensoi, P. lucida, Pterocladia capillacea, Rhodymenia* sp.), and *M. abscissa* (Shears & Babcock, 2004). *Carpophyllum angustifolium* reaches a mean density of up to 130 plants/m^2 in the shallows, but is quickly replaced by *L. variegata* and *E. radiata* at 4–6 m depths (Choat & Schiel, 1982). *Ecklonia radiata* dominates the deeper regions reaching densities of up to 70 plants/m^2 (Ayling & Schiel, 2003). Occasionally, dense stands of *Carpophyllum flexuosum* can be found at depths of 10–20 m (Choat & Schiel, 1982). Underneath the *E. radiata* canopy a diverse assemblage of other algal species is present, including *Distromium skottsbergii, Carpomitra costata, Phacelocarpus labillardieri, Delisea elegans, Plocamium* sp., and *Curdiea coriacea* (Shears & Babcock, 2004).

In deeper waters, light intensity is the major environmental factor determining the distribution of macroalgae. Light penetration in the clear waters of the Poor Knights Islands is at least three times deeper than at nearby inshore coastal regions, and as a result algae can survive at more than twice the depth they are normally limited to in inshore coastal waters (Ayling, 1968). For example, light intensity governs the lower limit of *E. radiata* and in areas where light intensity is reduced, such as on a vertical rock face, the lower limit of *E. radiata* is around 28 m. However, on more gently angled rock slopes *E. radiata* can be found at 48 m depth at the Poor Knights Islands, whereas, the lower limit of *E. radiata* in the Hauraki Gulf is around 12 m (Doak, 1971). Occasionally, in depths of 30 m and more, towering tangled 3 m high columns of *Sargassum sinclairii* can be found (Ayling, 1974c).

Shears and Babcock (2004) conducted a survey of nine shallow subtidal sites[8] (≤18 m depth) around the Poor Knights Islands (Fig. 1 in Shears & Babcock, 2004). Total average algal biomass was 475.6 g/m^2. The three most dominant species in terms of biomass were *E. radiata* (52.8 g/m^2), *C. angustifolium* (18.2 g/m^2), and *L. variegata* (5.7 g/m^2). The most abundant algae in terms of percentage occurrence were crustose coralline algae (mixed species) (99.4%), red turfing algae (mixed species) (90%), coralline turfing algae (mixed species) (79.4%), and *E. radiata* (66.7%) (Table 1).

8 Lighthouse Bay, Rocklily Inlet, Nursery Cove, Cleanerfish Bay, Skull Bay, Bartle's Bay, Matt's Crack, Frasers Bay, and Labrid Channel (see Fig. 2 for locations).

TABLE 1. PERCENTAGE OCCURRENCE OF SUBTIDAL MACROALGAL SPECIES RECORDED FROM THE WATERS OF THE POOR KNIGHTS ISLANDS ≤ 18 M DEEP (TABLE ADAPTED FROM SHEARS & BABCOCK, 2004)

SPECIES	% OCCURRENCE	SPECIES	% OCCURRENCE
Large brown algae		**Foliose red algae**	
Ecklonia radiata	66.7	*Nesophila hoggardii*	40.0
Xiphophora chondrophylla	23.9	*Osmundaria colensoi*	32.8
Carpophyllum angustifolium	20.0	*Pterocladia lucida*	26.1
Lessonia variegata	20.0	*Plocamium* sp.	25.0
Carpophyllum maschalocarpum	18.3	*Euptilota formosissima*	21.7
Sargassum sinclairii	16.7	*Curdiea coriacea*	21.1
Carpophyllum plumosum	8.9	*Pachymenia crassa*	16.1
Carpophyllum flexuosum	7.8	*Rhodymenia* undescr. sp.	13.3
Landsburgia quercifolia	5.6	*Placentophora colens*oi	10.6
		Rhodymenia sp.	8.3
Small brown algae		*Delisea compressa*	8.3
Zonaria turneriana	21.7	*Melanthalia abscissa*	6.7
Brown encrusting algae*	8.9	*Phacelocarpus labillardieri*	2.8
Distromium scottsbergii	7.8	*Callophyllis* sp.	2.2
Carpomitra costata	4.4	*Kallymenia berggrenii*	1.7
Halopteris sp.	3.9	*Taylorophycus filiformis*	1.7
Colpomenia sinuosa	1.7	*Plocamium costatum*	1.1
Brown turfing algae*	0.6		
		Red turfing algae (<5 cm)	
Green algae		Red turfing algae*	90.0
Ulva sp.	58.9	Coralline turfing algae*	79.4
Codium convolutum	42.8	*Gigartina macrocarpa*	10.0
Codium cranwelliae	8.9	*Champia novae-zelandiae*	3.3
Caulerpa flexilis	7.2		
Caulerpa geminata	7.2	**Encrusting red algae**	
Pedobesia clavaeformis	1.1	Crustose coralline algae*	99.4
Green turfing algae	0.6	Red encrusting algae*	46.7
		Curdiea codioides	7.2

* Mixed species.

5. The Invertebrates

5.1 PROTOZOA

One hundred and fourteen species of protozoans have been recorded from the Poor Knights Islands, all of which are benthic foraminiferans (Appendix 2, Table 2). The vast majority of the foraminiferan species recorded at the Poor Knights Islands were collected in four dredge samples taken from 20–120 m depth (Hayward *et al.*, 1999; B. Hayward, Geomarine Research, pers. comm.). Undoubtedly numerous other protozoans, including benthic and pelagic species, occur at the Poor Knights Islands, but no other surveys have been undertaken.

5.2 ZOOPLANKTON

Major categories of zooplankton recorded from the waters around the Poor Knights Islands include calanoid copepods (e.g. species of *Acartia*, *Calanus, Clausocalanus*, *Ctenocalanus*, *Eucalanus*, *Nannocalanus*, *Paracalanus*, and *Temora*), other copepods (e.g. species of *Corycaeus*, *Oithona*, *Oncaea*, *Euterpina*, *Caligus*, and *Sapphirina*), appendicularians, gelatinous zooplankton (e.g. doliolids, ctenophores, siphonophores, medusae), chaetognaths, macrocrustaceans (e.g. *Nyctiphanes australis, Squila* sp., mysids, isopods, amphipods), and meroplankton (e.g. eggs and larvae of many invertebrates and fish)[9] (Kingsford & MacDiarmid, 1980; Kingsford & MacDiarmid, 1988). In February 1980 total zooplankton concentrations in the waters around the Poor Knights Islands varied between ~250–650 ind./ m^3, of which, approximately 85% were copepods. Zooplankton densities were higher at sites 800 m north and south of the islands in comparison to sites nearer the islands. Kingsford & MacDiarmid (1988) hypothesised that the lower zooplankton densities near the Poor Knights Islands was a direct result of feeding pressure by planktivorous fish.

Giant salps (*Pyrostremma spinosum*) are a spectacular member of the zooplankton community of the Poor Knights Islands during spring. These colonial thaliaceans resemble a giant sock, up to 20 m long and with an opening up to 1 m wide (Baker, 1970; Ayling & Schiel, 2003).

5.3 PORIFERA

The total number of sponge species recorded from the Poor Knights Islands (140 species) has not changed since Battershill's (1986) study. However, a number of the species names listed by Battershill were either invalid, or have been synonymized with other species, and 51 species were undescribed at the time. A revised species list is presented in Appendix 2, Table 3, containing 20 additional species, many of which

9 See appropriate phylum section in Appendix 2 for taxonomic information

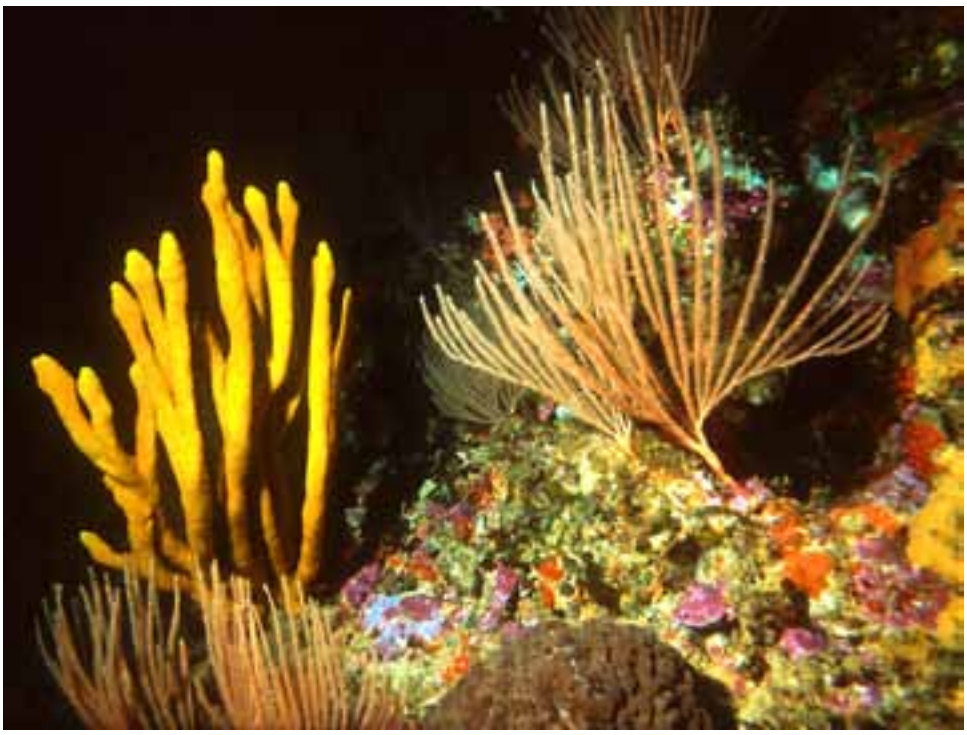


Figure 13. Finger sponge *Iophon minor* (centre left) and *Primnoeides sp.* gorgonian (centre right and bottton left) taken on a deep reef at the Poor Knights IslandS.

Photo: Roger Grace

have been first described from specimens collected from the Poor Knights Islands. The sponge fauna of the Poor Knights Islands is not considered to be unique (Bergquist, 1972), with the exception of *Ircinia fistulosa,* which has only been recorded from the Poor Knights Islands (Cook & Bergquist, 1999). However, species diversity and abundance of sponges at the Poor Knights Islands is unusually high (Kelly, 1983).

Sponges (e.g., *Tethya* spp., *Polymastia* spp., *Tedania* spp., *Callyspongia* spp., and *Cliona celata*) are found growing in unusually shallow waters (≥5 m) at the Poor Knights Islands. The presence of these sponges on the steep-sided rock walls may be explained by the reduced light levels underneath the macroalgae canopy, equivalent to those normally occurring at 15–20 m depth in open water (Battershill, 1986). As depth increases beyond 30 m, sponges (e.g. *Iophon minor, Iophon laevistylus, Callyspongia latituba,* and *Calyx imperialis*) that thrive in the low light and calm water conditions become the dominant fauna of deep reef communities at the Poor Knights Islands (Ayling & Schiel, 2003).

The boring sponge *Cliona celata* is one of the most common sponges at the Poor Knights Islands. In a subtidal survey of the Poor Knights Islands, *C. celata* was found to be present in 57–67% of sampled quadrats, and accounted for up to 2.3% of the total percentage cover in depths ≤12 m (Shears, 2007).

5.4 CNIDARIA

Sixty eight species of cnidarians have been recorded at the Poor Knights Islands, comprising 37 hydroids, 29 anthozoans (sea anemones, gorgonians, and corals), one scyphozoan, and one staurozoan (Appendix 2, Table 4). Well-known species present at the Poor Knights Islands include the jewel anemones (*Corynactis australis* and *Corynactus*

haddoni), hydroids (*Symplectoscyphus* spp., and *Aglaophenia* spp.), pink gorgonians (*Primnoiedes* sp.), black coral (*Lillipathes lillei),* and cup corals (*Monomyces rubrum,* and *Tethocyathus cylindraceus)* (Doak, 1971; Ayling, 1974a, 1974b; Battershill, 1986; Ayling & Schiel, 2003). *Tethocyathus cylindraceus* has an unusual distribution at the Poor Knights Islands. This solitary coral is normally a deep water species occurring at water depths of 200–1500 m, but in the Poor Knights Islands it is found in caves in depths as shallow as 10 m (Kelly, 1983; Ayling & Schiel, 2003).

Figure 14. Black coral (*Lillipathes lillei*) (centre front and upper left) at the Poor Knights Islands. Photo: Ian Skipworth

The rare black coral *Lillipathes lillei* occurs at the Poor Knights Islands in water depths of 50–80 m (Fig. 14). Black coral trees are around 1.5–1.8 m in height on average, though specimens up to 6.1 m tall were recorded at the Poor Knights Islands and High Peak Rocks in the 1970s (Doak, 1970, 2001b). These specimens were some of the largest black coral trees recorded in the world, but most of these have since disappeared, presumably taken by divers or destroyed by anchors and lobster pot lines (Doak, 1971; Ayling & Schiel, 2003). Black coral trees are often heavily encrusted with invertebrates including sponges, bryozoans, anemones, and goose-necked barnacles (*Oxynaspis indica*), and provide a habitat for the black coral tree star (*Astrobrachion constrictum)* and several crustacean species (Kelly, 1983; Ayling & Schiel, 2003).

Other notable cnidarians found at the Poor Knights Islands include the branching ivory coral (*Oculina virgosa*) (Cairns, 1995), two species of stony corals that are free-living on sediment substrata (*Kionotrochus suteri* and *Sphenotrochus ralphae*) (Brook *et al.*, 2001), and the pink gorgonian *Primnoeides* sp. (Kelly, 1983).

5.5 ECTOPROCTA (BRYOZOA)

The Poor Knights Islands is regarded as a key area for bryozoan species diversity and abundance (Gordon & Smith, 2007b; Ministry of Fisheries, 2007), however, there has been very little research conducted on the bryozoan communities of the Poor Knights Islands. To date, only 42 species of bryozoans have been recorded from the Poor Knights Islands (Appendix 2, Table 5). In comparison, approximately 114 species have been recorded from the Cape Rodney to Okakari Point Marine Reserve (Gordon & Ballantine, 1976), and over 300 species have been recorded from the Spirits Bay region (Cryer *et al.*, 2000).

Figure 15. Three bryozoan species; the orange pencil bryozoan (*Steginoporella neozelanica*), the green-blue *Bugula dentata* (behind *S. neozelanica*), and the white twiggy *Cellaria tenuirostris* (epizoic upon *S. neozelanica*); sit amongst feathery gorgonians (lower right), blue bell tunicates (*Clavelina* sp.) (centre top), and jewel anemones (*Corynactis australis*) (upper left) at the entrance of Matavana Cave, Poor Knights Islands.

Photo: Vince Kerr

Three species of bryozoans, *Bugula dentata, Emma triangula,* and *Margaretta barbata*[10] are particularly common in shallow waters (<23 m) around the Poor Knights Islands (Kelly, 1983; Ayling & Schiel, 2003). In a subtidal survey conducted at the Poor Knights Islands, *Bugula dentata* was found to be present in 26–52% of sampled quadrats, and accounted for up to 2.3% of the total percentage cover in depths ≤12 m (Shears, 2007).

5.6 BRACHIOPODA

Four species of brachiopods have been recorded from the Poor Knights Islands (Appendix 2, Table 6). *Calloria variegata*, which is endemic to northeastern New Zealand, is present locally in subtidal rock crevices, and on the walls and ceilings of subtidal caves around the Poor Knights Islands. Specimens of *C. variegata* from the Poor Knights Islands are typically smaller and paler than specimens from other localities around north-eastern New Zealand (Cooper & Doherty, 1993). The inarticulate brachiopod *Neocrania huttoni* is locally abundant on rock walls in the dark recesses of subtidal caves at the Poor Knights Islands (F. Brook pers. comm.).

10 This species is incorrectly referred to as *Marginella hirsute* in Ayling and Schiel (2003). The initial proposed name was *Margaretta hirsuta* but this name had already been assigned to another species so it was named *Margaretta barbata* instead (D. Gordon, NIWA, pers. comm.).

5.7 ANNELIDA

Very little published information exists on the annelids present at the Poor Knights Islands. Only 21 species of polychaetes have been recorded from the islands, of which, 19 species are serpulid worms (Appendix 2, Table 7) (Vine, 1977). Four species, *Protolaeospira gracei*, *P. tegwyni, Romanchella solea,* and *Simplicaria ovata*, are endemic to New Zealand (Read, 2004).

5.8. MOLLUSCA

Three hundred and fifty three species of molluscs have been recorded at the Poor Knights Islands, comprising 12 chitons, 292 gastropods (including 66 opistobranchs), 42 bivalves, and 7 cephalopods (Appendix 2, Table 8). Known species diversity at the Poor Knights Islands is much lower than at the Bay of Islands (551 species) (Morley & Hayward, 1999), but comparable to other Northland mainland regions such as Parengarenga Harbour (267 species) (Hayward *et al.*, 2001) and Cape Rodney to Okakari Point Marine Reserve (299 species) (Gordon & Ballantine, 1976). However, it should be noted that many habitat/substrate types represented at these other Northland mainland regions, e.g. intertidal mudflats and seagrass meadows, are absent from the Poor Knights Islands, and consequently the species that inhabit these habitats are also absent.

Figure 16. Spindle cowries (*Phenacovolva wakayamaensis*) on the gorgonian *Primnoeides* sp.
Photo: Roger Grace

Notable species found at the Poor Knights Islands include the gastropods *Prototyphis paupereques* and *Thoristella davegibbsi*, which are endemic to northeastern New Zealand (Marshall, 1998; Brook, 2001), and the spindle cowrie *Phenacovolva wakayamaensis*, which lives on the gorgonian *Primnoeides* sp. (Fig. 16) (Ayling & Schiel, 2003). A number of subtropical molluscan species have also been recorded from the Poor Knights Islands including the gastropods; *Antisabia* cf. *foliacea, Bursa (Tutufa) bubo, Bursa (Tutufa) bufo, Bursa verrucosa, Conus lischkeanus, Cumia adjuncta, Cymatium exaratum, Cypraea (Erosaria) cernica*, *Cypraea (Lyncina) vitellus*, *Fusinus genticus, Heliacus implexus, Hipponix* sp., *Babelomurex (Echinolatiaxis) wormaldi, Morula chaidea, Morula palmeri, Neothais smithi*, *Polinices simiae, Polinices tawhitirahia, Psilaxis radiatus, Sassia palmeri, Sassia parkinsonia, Semicassis royana, Tanea lemniscata, Terebra circumcincta, Trapania brunnea, Williamia radiata nutata;* and the bivalves; *Pteria levitata*, and *Septifer bilocularis* (Powell, 1976; Morley & Hayward, 1999; Brook, 2001).

5.8.1 Intertidal molluscs

The intertidal molluscan fauna of the Poor Knights Islands mainly consists of rocky shore species that can withstand high wave exposure. In terms of biomass, *Nerita atramentosa* is the most dominant intertidal mollusc at the Poor Knights Islands (Creese & Ballantine, 1986). Other common intertidal species include *Notoacmea scopulina, Siphonaria zelandica, Sypharochiton aorangi,* and the vermetid gastropod *Novastoa lamellosa*, the latter two species being restricted to New Zealand's offshore islands. *Novastoa lamellosa* has been recorded from islands off northeastern New Zealand, and the Chatham Islands (Morton & Miller, 1968; Morley & Hayward, 1999, B. Hayward, pers. comm.), whereas *S. aorangi* is known only from offshore islands north of East Cape (Creese & O'Neill, 1987).

The Poor Knights Islands intertidal molluscan fauna has a number of unusual species distribution patterns compared to communities that inhabit similar exposed rocky shores on the mainland (Creese & Ballantine, 1986; Brook & Carlin, 2000):

1 Several species that are common on similar exposed shores on the mainland are rare or absent at the Poor Knights Islands, including the common ornate limpet *Cellana ornata*, the snakeskin chiton *Sypharochiton pelliserpentis*, and the mussels, *Xenostrobus pulex*[11] and *Perna canaliculus*.

2. Other species that are common on exposed mainland shores including, *Notoacmea pileopsis,* the radiate limpet *Cellana radians,* and the periwinkle *Austrolittorina unifasciata,* occur at much lower densities at the Poor Knights Islands.

3. Several mollusc species (*C. radians, Turbo smaragdus, Melagraphia aethiops, N. atramentosa*) attained a greater maximum size at the Poor Knights Islands than on the northeastern mainland coast. For example, *C. radians* collected from the Poor Knights Islands ranged from 43 to 58 mm in length, whereas this species seldom exceeds 40 mm on the mainland.

4. Five small species of molluscs, *S. aorangi*, *Siphonaria zelandica*, *Radiacmaea inconspicua*, *Patelloida corticata*, and *Nerita atramentosa* were unusually abundant. Mean densities of *S. aorangi* and *S. zelandica* in the mid-eulittoral zone were 176 ind./m^2 and 368 ind./m^2, respectively.

5. Two gastropods, *Nerita atramentosa* and *Zeacumantis subcarinatus* that are usually found in sheltered locations were abundant in Bartle's Bay, which is very exposed to the east. *Zecumantis subcarinatus* was restricted to large shallow pools on the upper shore where it occurred at densities of up to 300 ind./m^2.

The factors that influence the intertidal species assemblage at the Poor Knights Islands are poorly understood at present.

11 Previously known as *Modoilus neozelanicus*

5.8.2 Subtidal molluscs

The most common gastropods inhabiting the subtidal rocky reefs of the Poor Knights Islands are *Cookia sulcata, Eudoxochiton nobilis, Dicathais orbita, Calliostoma punctulatum*, and *Buccinulum linea*. Abundance of rocky reef subtidal gastropods at the Poor Knights Islands, with the exception of opistobranchs, is much lower than at other mainland Northland locations such as Cape Reinga, Cape KariKari, Cape Rodney to Okakari Point Marine Reserve, and Tawharanui. For example, Shears & Babcock (2004) found that *C. sulcata* was present in less than 3% of the sampled quadrats taken at the Poor Knights Islands from depths of 0–12 m, whereas it was present in 48–81% of sampled quadrats from the mainland Northland regions mentioned above. Many common subtidal gastropods are rare, e.g. *Turbo smaragdus* and *Trochus viridis*, or absent e.g. *Cominella virgata*, from the Poor Knights Islands.

Similarly, the abundance of sediment-dwelling molluscs at the Poor Knights Islands is low, and the majority of species have a sparse and/or patchy distribution. The one exception is the turritellid gastropod, *Zeacolpus pagoda*, which is relatively common in water depths of 20–30 m. In Maroro Bay, *Z. pagoda* was found at densities of up to 100 ind./m^2 (Brook *et al.*, 2001).

Figure 17. The fiery orange nudibranch, *Janolus ignis*, next to the pink ascideans, *Hypsistozoa fasmeriana*.
Photo: Kent Ericksen

The Poor Knights Islands are a 'hotspot' for opisthobranchs (nudibranchs and sea slugs), with 66 species recorded from the marine reserve. Conspicuous nudibranchs include *Jason mirabilis, Tritonia incerta,* and *Ceratosoma amoena*. Some species are highly specialised feeders that only consume one type of prey. For example, *Tambja verconis* and *Janolus eximius* only feed upon the bryozoans *Bugula dentata* and *Orthoscuticella* aff. *margaritacea*, respectively, and *T. incerta* only feeds upon the soft coral *Alcyonium* sp. (Willan, 1986, 2003).

5.9 ARTHROPODA

Fifty seven species of crustaceans have been recorded at the Poor Knights Islands comprising 27 malacostracans, 28 maxillopods, and two branchiopods (Appendix 2, Table 9). The most common crustaceans in the intertidal zone are the purple rock crab *Leptograpsus variegatus,* and the barnacles *Chamaesipho brunnea,* and to a much lesser extent, *Epopella plicata* (Cranwell & Moore, 1938). Unusually, the common acorn barnacle *Chamaesipho columna*, is almost completely absent from the Poor Knights Islands (Brook & Carlin, 2000).

Notable crustacean species found at the Poor Knights Islands include; the subtropical red-banded coral shrimp, *Stenopus hispidus*, which was first found in New Zealand at the Poor Knights Islands (Yaldwyn, 1968); the rare endemic barnacle *Tetraclita aoranga*, which is restricted to the Poor Knights Islands and a few locations around Northland (Foster, 1978); and two species of tropical barnacles, *Oxynaspis indica* and *Balanus (Solidobalanus) auricoma*, that are found growing on black coral in depths of 60 m or more (Foster, 1978).

MacDiarmid & Breen (1992) conducted a survey of the spiny lobster (*Jasus edwardsii* and *Sagimariasus verreauxi*) populations at the Poor Knights Islands in March/April 1985. The density of red rock lobsters (*J. edwardsii*) was very low (0.2 ± 0.06 ind./100m^2), though the few individuals that were caught were relatively large (120–150 mm carapace length). Surprisingly, the density of *J. edwardsii* at the Poor Knights Islands was lower than at nearby mainland locations, despite the fact that the Poor Knights Islands had been a marine reserve for four years. The authors hypothesized this was because of a lack of shallow water boulder habitats that are preferred by juvenile lobsters. Packhorse lobsters (*S. verreauxi*) were rarely sighted, and comprised only 1% of the 1642 lobsters counted in the survey. In contrast, anecdotal reports state that packhorse lobsters were more common than red rock lobsters during the 1960s, when they were a popular target for commercial and recreational fishers (K. Hawkins, DOC, pers. comm; Ritchie *et al.*, 1979). No more recent studies have been conducted on spiny lobster populations at the Poor Knights Islands.

5.10 ECHINODERMATA

Fifty two species of echinderms have been recorded from around the Poor Knights Islands, comprising 18 echioids (sea urchins), 15 asteroids (starfish), 11 ophiuroids (brittle stars), five crinoids (feather stars), and three holothuriods (sea cucumbers) (Appendix 2, Table 10). *Evechinus chloroticus* is by far the most common mobile macroinvertebrate in the shallow subtidal region (<10 m) of the Poor Knights Islands, with average densities of between 2–4 ind./m^2. In slightly deeper waters (7–12 m) the black sea urchin *Centrostephanus rodgersii* becomes increasingly common, but its abundance is generally less than 1 ind./m^2 (Shears & Babcock, 2000; Shears & Babcock, 2004). A number of tropical and subtropical urchin species have been recorded from the Poor Knights

Islands including *Brissus agassizii, Brissus gigas*, *Centrostephanus rogersii*, *Clypeaster australasiae, Diadema palmeri*, *Diadema savignyi, Heliocidaris tuberculatus*, *Prionocidaris australis*, *Pseudoboletia indiana*, and *Tripneustes gratilla* (Baker, 1968a; McKnight, 1984; Francis & Evans, 1993; Brook, 2001). Other notable species include the yellow starfish *Knightaster bakeri* (Clark, 1972), the black coral tree star *Astrobrachion constrictum* (Baker, 1980), and the Poor Knights feather star *Cenolia novaezelandiae*, which is abundant around the Northern Arch but rare elsewhere in New Zealand (Ayling, 1968).

5.11 CHORDATA: ASCIDIACEA & THALIACEA

Fifty nine species of ascidians and two thaliaceans have been recorded at the Poor Knights Islands (Appendix 2, Table 11). In 1986 Battershill recorded 57 ascidian species at the Poor Knights Islands. At the time, 23 of these species were new to the region and several species (*Riterella* sp. and certain *Aplidium* spp.) had not been found elsewhere in New Zealand (Battershill, 1986).

One of the most common ascidians at the Poor Knights Islands is *Pseudodistoma* sp[12]. In a survey of the subtidal benthic community *Pseudodistoma* sp. occurred in 44–54% of the sampled quadrats and accounted for 1% of the total percentage cover in depths ≤12 m (Shears, 2007).

Figure 18. Pink, apricot, and cream colour variations of *Hypsistozoa fasmeriana* on a vertical rock wall at the Poor Knights Islands.

Photo: James Williams

12 This ascidian was only identified to genus level in Shears (2007)

6. The Vertebrates

6.1 FISH

The Poor Knights Islands has a rich fish fauna, with 187 species recorded from within the marine reserve (Appendix 2, Table 12), compared with 156 species recorded from the Bay of Islands (Brook & Carlin, 1992), 98 species from Cape Rodney to Okakari Point Marine Reserve (Gordon & Ballantine, 1976), and 74 species from the Cavalli Islands (Nicholson, 1979). Many of these species are widespread around northern New Zealand including snapper (*Pagrus auratus*), tarakihi (*Nemadactylus macropterus*), goatfish (*Upeneichthys lineatus*), red gurnard (*Chelidonichthys kumu*), red moki (*Cheilodactylus spectabilis*), leatherjacket (*Meuschenia scaber*), kingfish (*Seriola lalandi*), koheru (*Decapterus koheru*), and trevally (*Pseudocaranx dentex*). Conversely, a number of common coastal fishes, such as spotties (*Notolabrus celidotus*), parore (*Girella tricuspidata*), and triplefins (*Forsterygion lapillum, F. malcomi, F. varium*), are infrequent around the Poor Knights Islands. Brook (2002) suggested that the low abundance of these common coastal fish was because of the isolated offshore location and the lack of shallow, sheltered habitats at the Poor Knights Islands.

The fish fauna at the Poor Knights Islands contains a distinctive subtropical and tropical component. This includes many colourful reef fishes such as the toadstool grouper (*Trachypoma macracanthus*), blue knifefish, (*Labracoglossa nitida*), gold ribbon grouper (*Aulacocephalus temmincki*), and the striped boarfish (*Evistias acutirostris*), which also occur around Lord Howe Island, Norfolk Island, and eastern Australia. These subtropical and tropical fishes comprise around 38% of the total number of reef fish species recorded from the Poor Knights Islands (Brook, 2002). In recent years a number of excellent photograph references of the fish fauna of Poor Knights Islands have been published (Doak, 1991; Edney, 2001; Anthoni, 2007).

The tropical and subtropical element of the Poor Knights Islands fish fauna is continually changing. While some tropical species are able to breed and recruit around the Poor Knights Islands, other species, such as the moon wrasse (*Thalassoma lunare*), the sunset wrasse (*T. lutescens*), the long-nosed butterfly fish *(Forcipiger flavissimus)*, and the lionfish *(Pterois volitans)* appear to be transient visitors. These species are probably transported to the Poor Knights Islands as larvae via the East Auckland Current, and settle at the Poor Knights Islands during mid-summer, but are unable to survive over winter (Francis & Evans, 1993). Other species apparently fail to establish successful breeding populations in New Zealand, presumably relying on the continual transport of larvae from outside New Zealand to sustain populations at the Poor Knights Islands. Thus, the population size of these non-breeding species varies greatly at the Poor Knights Islands. For example, four species of labrids,

Anampses elegans, Coris picta, Pseudojuloides elongatus, and *Suezichthys arquatus*, were relatively common in the Poor Knights Islands prior to 1974, but declined to near extinction by 1979 and were rare or absent until 1988, when there was a strong recruitment event (Schiel, 1984; Choat *et al.*, 1988) (See Section 6.1.1 for more details).

6.1.1 Fish monitoring

One of the aims of the Poor Knights Islands Marine Reserve is to protect the reef fish population around the islands, particularly those species that are long-lived or have low reproductive rates. When the reserve was first established in 1981 recreational fishing of snapper, kingfish, trevally, mackerel, kahawai, shark, billfish, tuna, and pink maomao was permitted in 95% of the reserve. At the time it was thought that these species were pelagic and thus, were not a permanent part of the reserve's fish population (Denny, 2008). However, recent studies have found that trevally, snapper, pink maomao, and kingfish are largely or partially resident around reefs (Saul & Holdsworth, 1992; Willis *et al.*, 2001; Francis, 2002; Parsons *et al.*, 2003). The abundance of a number of common, conspicuous fish species at the Poor Knights Islands has been monitored since the establishment of the marine reserve.

Planktivorous fish

Planktivorous fish are the most conspicuous and abundant fish at the Poor Knights Islands, with schools numbering in the hundreds commonplace. Accurate monitoring of planktivorous fish is difficult because of the schooling nature of these fish. Two studies on planktivorous fish at the Poor Knights Islands have been conducted by Kingsford & MacDiarmid (1988) and Kingsford (1989). The most abundant planktivorous reef fish in the upper 30 m of the water column was *Chromis dispilus* (two spot demoiselle), which had a mean density of 1125 $\pm$ 181 S.E. per 9000 m^3 and accounted for 85% of all planktivorous reef fish sampled at the Poor Knights Islands. Densities of *C. dispilus* were relatively stable between sites and times as the fish have a strong association with reefs and do not venture far from the reef during daytime. *Scorpis violaceus* (blue maomao), *Caprodon longimanus* (pink maomao), and *Decapterus koheru* (koheru) were also common, but typically travelled around the reserve in large schools, and thus, their abundance varied greatly between sites and times, with mean densities ranging between 0 and 436 fish per 9000 m^3. All other planktivorous reef fish sampled[13] were found at low densities.

The localised distribution of planktivorous fish was influenced by current direction, with higher abundances of fish always present on the upcurrent side of archways. The feeding activity of these dense schools of fish was capable of causing a significant reduction in zooplankton numbers directly downstream of the school. Diurnal planktivorous fish were absent from the reef at night, seeking shelter in deeper waters away from the islands (Kingsford & MacDiarmid, 1988).

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13 *Caesioperca lepidoptera*, *Pseudocaranx dentex*, *Scorpis aequipinnis*, *Chromis hypsilepsis*, *Trachurus novaezelandiae*, *Labracoglossa nitida*, and *Scomber australasicus*.

Figure 19. Two spot demoiselles (*Chromis dispilus*) in Long Cave, Poor Knights Islands.

Photo: Dive Tutukaka

The abundance of planktivorous fish at the Poor Knights Islands differs from other nearby locations (Hen and Chickens Islands, Goat Island, Mokohinau Islands, Needles, Kawau Island, Little Barrier Island, and Whangarei Heads). There were significantly higher numbers of *C. dispilus, S. violaceus, D. koheru*, and *C. longimanus* at the Poor Knights Islands than other sites. However, there were significantly lower numbers of *Scorpis aequipinnis* (sea sweep) at the Poor Knights Islands than Goat Island, and significantly lower numbers of *Arripis trutta* (kahawai) at the

Poor Knights Islands than the Mokohinau Islands (Kingsford, 1989). Note that these results need to be interpreted with care as there is limited temporal data for many of the locations.

Labrids and other families

Labrid diversity at the Poor Knights Islands is higher than anywhere else in New Zealand (Ward & Roberts, 1986), with 18 species recorded. All these wrasses are sex-changing hermaphrodites, starting life as females and later changing sex to become males. Labrids are especially abundant around tropical coral reefs, and some warm water species such as *Thalassoma lunare* (moon wrasse), *Thalassoma amblycephalum* (blueheaded wrasse), and *Suezichthys arquatus* (rainbow fish) are uncommon at the Poor Knights Islands and may only be transient visitors. These species arrive in northeastern New Zealand, and particularly around the Poor Knights Islands, at the end of summer but do not appear to survive the cold winter months well and populations gradually dwindle (Doak, 2001a). One notable labrid found at the Poor Knights Islands is the rare *Suezichthys aylingi,* (crimson cleanerfish), which is restricted to eastern Australia, the Three Kings Islands, and northeastern New Zealand. *Suezichthys aylingi* is only abundant at the Three Kings Islands and it is most likely that the Poor Knights Island population is derived from there (Choat *et al.*, 1988).

Choat *et al*. (1988) monitored 12 labrid species and 4 other fish species at the Poor Knights Islands over a period of 12 years from 1975 to 1986. The fish species were divided into three distributional groups; 1) widespread coastal species that are also found in southern temperate waters, 2) northern coastal species that are abundant on offshore islands, and 3) subtropical species that are normally rare in New Zealand (Table 2).

TABLE 2 . SPECIES OF FISH MONITORED BY CHOAT *ET AL.* (1988) AT THE POOR KNIGHTS ISLANDS.

DISTRIBUTIONAL GROUPING AND SPECIES	COMMON NAME
1. Widespread coastal species with southern distribution	
Cheilodactylus spectabilis	red moki
Nemadactylus douglasii	porae
Meuschenia scaber	leatherjacket
Notolabrus celidotus	spotty
Notolabrus fucicola	banded wrasse
Pseudolabrus miles	scarlet wrasse
2. Northern coastal species abundant on offshore islands	
Bodianus vulpinus	pigfish
Coris sandageri	Sandager's wrasse
Parma alboscapularis	black angelfish
Notolabrus inscriptus	green wrasse
Pseudolabrus luculentus	orange wrasse
Suezichthys aylingi	crimson cleanerfish
3. Transient species of subtropical origin	
Anampses elegans	elegant wrasse
Coris picta	combfish
Pseudojuloides elongatus	long green wrasse
Suezichthys arquatus	rainbow fish

Results from the study showed distinct patterns in both temporal and spatial abundance. Temporal patterns in fish abundance at Nursery Cove varied between the three groups. Total mean abundance of the subtropical group gradually decreased from approximately 13 fish per 500 m^2 in 1975 to 0 fish per 500 m^2 in 1979, and did not increase for the remainder of the study period. These subtropical species appear to be unable to successfully reproduce in New Zealand waters and thus populations at the Poor Knights Islands are dependent on recruitment from populations outside of New Zealand. Size structures of sampled fish indicate that populations at the Poor Knights Islands were derived from a single large recruitment event that occurred prior to 1975. The northern coastal group showed a similar decline in abundance between 1975 and 1982. Total mean abundance of *P. luculentus*, *C. sandageri*, and *S. aylingi* declined from >100 fish per 500 m^2 in 1975 to ~20 fish per 500 m^2 in 1982. However, abundance of all three species increased slightly between 1982 and 1985 suggesting recruitment to the local population. In contrast, the mean abundance of the widespread coastal species showed no consistent temporal pattern over the study period.

Distinct, localised spatial patterns also existed between sites and habitats. For example, high numbers of *S. aylingi* and *C. sandageri* were recorded at Nursery Cove, whereas the nearby Bartle's Bay had very low numbers of these two species, but high numbers of *P. alboscapularis.* Species abundances were also strongly influenced by habitat. *Coris sandageri* was most abundant on shallow, sandy reefs; *P. alboscapularis* was most abundant on exposed shores amongst algal stands; and *Meuschenia scaber* was more abundant over *E. radiata* beds in waters deeper than 10 m. These variations in spatial distribution were emphasized, not masked, by temporal variations in abundances. The results of the study by Choat *et al.* (1988) showed that fish abundances vary greatly on both a temporal and spatial scale, and that temporal patterns can sometimes span several years. Management decisions based on fish abundance counts need to take into careful consideration the numerous factors that affect fish counts including species sampled, habitat, location, season, and sampling method.

Snapper (*Pagrus auratus*) and other reef fish species

Snapper are the most abundant demersal predatory fish in northeastern New Zealand and are thought to have an impact on the structure of coastal marine ecosystems (Shears & Babcock, 2002). Snapper are also heavily fished, both commercially and recreationally, and prior to implementation of full marine reserve status in October 1998 recreational fishing of snapper was permitted within the Poor Knights Islands Marine Reserve, with the exception of two small areas around Nursery Cove Reef/Bartle's Bay and Frasers Bay (~100 ha). Snapper abundances were monitored at the Poor Knights Islands biannually from September 1998 to September 2002 (Denny *et al.*, 2004). Two further surveys were conducted in autumn 2004 (Denny & Shears, 2004) and autumn 2007 (Denny, 2008). In 1998 there was no difference in snapper density between the small fully protected areas and partially protected areas where snapper could be fished within the reserve, indicating that full protection of small areas was of little value for protecting targeted fish species. Four years after the implementation of full marine reserve status

snapper abundance at the Poor Knights Islands had increased by nearly seven times, whereas snapper abundance at the nearby Mokohinau Islands and Cape Brett were unchanged. Abundances of snapper continued to increase until autumn 2004[14] but there was no significant change in snapper abundances between autumn 2004 and autumn 2007[15].

Although snapper abundance at the Poor Knights Islands appears to have reached a plateau, the mean size of snapper within the reserve appears to have steadily increased since the implementation of full marine reserve status. Mean fork length of snapper at the Poor Knights Islands increased from 274 ± 9 mm (S.E.) in 1999, to 324 ± 5 mm in 2001, to 354 ± 5 mm in 2004, to 384 ± 5 mm in 2007 (Denny *et al.*, 2003; Denny, 2008). The difference in the mean size of snapper between 1999 and 2001 is too large to be attributed to growth alone, and thus adult snapper must have immigrated into the reserve. It should be noted that it is possible that the increase in mean size between 2004 and 2007 may not be an accurate estimate of the real change in size between the two sampling dates owing to different methods being used to measure snapper size in 2004 and 2007 (see Denny, 2008 for more details).

A number of other fish species showed significant abundance changes of more than 100% in the four years following implementation of full marine reserve status at the Poor Knights Islands. Abundance of orange wrasse (*Pseudolabrus lucentus*), blue maomao, and pink maomao, were significantly higher in 2002 than in 1998, whereas abundances of banded wrasse (*Notolabrus fucicola*), butterfish (*Odax pullus*), crimson cleanerfish (*Suezichthys aylingi*), goatfish (*Upeneichthys lineatus*), red moki (*Cheilodactylus spectabilis*), and scarlet wrasse (*Pseudolabrus miles*) were significantly lower[16]. These results show that the reef fish community at the Poor Knights Islands changed rapidly following the establishment of a full marine reserve. Fish species targeted by recreational fishers such as snapper and pink maomao (Denny & Shears, 2004) increased significantly, whereas most non-target species showed no significant increase in abundance, with the exception of orange wrasse and blue maomao (Denny *et al.*, 2003).

However, by 2007 snapper was the only monitored species at the Poor Knights Islands to show a significant increase in abundance in comparison to 1998 abundance levels. Four species (banded wrasse, butterfish, crimson cleanerfish, and pigfish (*Bodianus vulpinus*)), had significantly decreased in abundance since 1998, and 19 other species showed no significant change. Denny (2008) suggested that the lack of any long-term significant increase in fish densities, with the exception of snapper, nine years after implementation of full marine reserve status at the Poor Knights Islands, may be explained by several reasons: 1) the large increase in snapper numbers may have caused a decrease in abundances of prey species or competing species, 2) high snapper abundances may have caused habitat changes, 3) different divers used in different surveys had different fish estimates, and/or 4) long-term climatic changes many affect

14 Taking into account the seasonal fluctuations in abundances of snapper

15 Note that snapper abundances in 2007 may have been underestimated owing to a change in sampling method.

16 These changes were not seen in the control sites (Mokohinau Islands and Cape Brett).

recruitment and subsequent survival of subtropical species to the Poor Knights Islands. Choat *et al*. (1988) recorded similar long-term declines in labrid abundances prior to implementation of full marine reserve status at the Poor Knights Islands (see above).

Hapuku (*Polyprion oxygeneios*)

Adult hapuku are deep water (50–350 m), demersal fish that are typically found near rocky reefs, particularly those with caves. Juvenile fish are pelagic for a number of years and are rarely caught (Roberts, 1986; Paul, 2002). Schools of around 30 large hapuku (≤1.8 m) were commonly seen in waters <40 m deep around the Poor Knights Islands in the 1960s, but the majority of the Poor Knights Islands hapuku population was caught prior to establishment of the full marine reserve (Doak, 1991, 2001a).

A tagging study conducted in 1988 around the vicinity of the Poor Knights Islands found that the median size of hapuku in deep waters around the reserve was 81.5 cm total length (TL), greater than the median size of fish from South Island (64.2 cm TL) or the Cook Strait (67.0 cm TL). Hapuku captured from around the Poor Knights Islands were mostly resident, with fish recaptured within 51 km of their release location after a period of up to 3 years. In comparison, fish from South Island populations travelled distances of up to 1389 km before recapture. There was no evidence of mixing between the northeast Northland hapuku population and South Island populations suggesting that the northeast Northland hapuku population may be genetically distinct from South Island populations (Beentjes & Francis, 1999). Anecdotal reports state that the hapuku population around the Poor Knights Islands may be recovering with diver sightings of hapuku becoming more frequent (Grace, 2006).

Seasonal abundances

Snapper have a strong seasonal abundance at the Poor Knights Islands with higher abundance in autumn than in spring. It is thought that the snapper population at the Poor Knights Islands consists of 'resident' fish that are present all year round, and migratory fish that move in and out of the reserve seasonally. The influx of these migratory fish can clearly

Figure 20. An aggregation of short-tailed stingrays (*Dasyatis brevicaudata*) at Northern Arch.
Photo: Glen Edney

been seen in the high abundance of snapper at the Poor Knights Islands in autumn (Denny, 2008).

A number of other fish species also show seasonal abundance patterns at the Poor Knights Islands. Scorpionfish (*Scorpaena cardinalis*), orange wrasse, Sandager's wrasse (*Coris sandageri*), pigfish, and spotties are significantly more abundant in autumn than spring, whereas porae, tarakihi (*Nemadactylus macropterus*), banded wrasse, and red moki are significantly more abundant in spring than in autumn (Denny *et al.*, 2003). Stingrays, eagle rays, and manta rays are common in the shallow waters around the Poor Knights Islands during summer and early autumn, sometimes forming large aggregations in the shallow waters (Doak, 2001d; Duffy & Abbott, 2003). Rays are absent from the Poor Knights Islands during winter but there is some evidence that short-tailed stingrays (*Dasyatis brevicaudata*) do not travel far from the islands (<25 km) during winter, but spend increasing amounts of time in deeper waters (150–200 m) (Le Port *et al.*, 2008).

6.1.2 Fish diet

Russell (1983) examined the stomach contents of 50 species of fish common to northeastern New Zealand to provide information on their diet. Dietary information on fish species present at the Poor Knights Islands is given in Table 3. More detailed information on prey species and numerical percentage occurrence can be found in the original paper.

TABLE 3: PERCENTAGE OCCURRENCE (BY VOLUME) OF FOOD IN THE STOMACHS OF COMMON FISH AT THE POOR KNIGHTS ISLANDS (DATA SUMMARISED FROM RUSSELL (1983).

FISH SPECIES	COMMON NAME	FOOD	% VOLUME
Carnivorous fish			
Arripis trutta	kawahai	Fish	66.6
		Euphausiids	33.3
Cheilodactylus spectabilis	red moki	Amphipods	39.7
		Polychaetes	16
		Ophuriods	13
		Crabs	12.6
		Echinoids	8
		Molluscs	6.9
Chironemus marmoratus	hiwihiwi	Molluscs	57.7
		Crabs	23.4
		Amphipods	6.6
		Hermit crabs	5.3
		Echinoids	4.3
Conger wilsoni	short-finned conger eel	Crabs	95
		Hermit crabs	5
Dellichthys morelandi	urchin clingfish	Echinoids	91.7
		Amphipods	8.3
Gilloblennius tripennis	tripenny	Amphipods	30.8
		Hermit crabs	19.5
		Molluscs	19.4
		Crabs	7.5
		Polychaetes	6.3
		Barnacles	5.9
		Opiuroids	5.8
		Isopods	4.2
Gymnothorax prasinus	yellow moray	Crab	86
		Fish	14

FISH SPECIES	COMMON NAME	FOOD	% VOLUME
Helcogramma medium	twister	Amphipods	57.1
		Molluscs	35.5
		Sandflies	4.3
Hypoplectrodes huntii	red banded perch	Fish	58
		Crabs	24
		Hermit crabs	12
		Bivalves	2
		Amphipods	2
		Ophuroids	2
Latridopsis ciliaris	blue moki	Amphipods	37.5
		Crabs	31
		Molluscs	9.9
		Corallina algae	7.2
		Echinoids	5.7
		Polychaetes	5.0
		Isopods	3.5
Pempheris adspersus	big eye	polychaetes	78.3
		gastropods & *Corallina*	9.4
		algae	7.6
		isopods	2.8
		amphipods	
Pseudolabrus miles	scarlet wrasse	hermit crabs	58.9
		crabs	15.1
		ophuroids	12.9
		barnacles	7.9
		molluscs	4.0
Pseudophycis breviuscula	red cod	amphipods	40
		hermit crabs	20
		barnacles	16.6
		crabs	13.3
		shrimps	10
Scorpaena cardinalis	scorpion fish	crabs	66.6
		hermit crabs	16.7
		shrimps	16.7
Seriola lalandii	kingfish	fish	100
Thrysites atun	barracouta	fish	100
Upeneichthys lineatus	goatfish	crabs	66.6
		amphipods	30.0
		bivalves	1.3
Zeus faber	john dory	fish	100
Planktivorous fish			
Caesioperca lepidoptera	butterfly perch	copepods	70.5
		paguran larvae	9.5
		chaetognaths	8.0
		euphausiid larvae	5.3
		other plankton	6.7
Chromis dispilus	demoiselle	copepods	97.3
		other plankton	2.7
Decapterus koheru	koheru	copepods	42.2
		mysids	20
		euphausiid larvae	16.6
		crab larvae	10.5
		larvaceans	9.5
		other plankton	0.9
Hyporhamphus ihi	piper	mysids	40
		crab larvae	23
		paguran larvae	15
		polychaete larvae	13
		ostracods	5
		copepods	3
		cumaceans	1

FISH SPECIES	COMMON NAME	FOOD	% VOLUME
Scorpis aequipinnis	sea sweep	larvaceans	53
		copepods	25
		mysids	12.6
		chaetognaths	4.5
		paguran larvae	2.9
Herbivorous fish			
Aplodactylus arctidens	marblefish	Rhodophyceae	80
		Phaeophyceae	15
		Chlorophyceae	5
Kyphosus sydneyanus	silver drummer	Phaeophyceae	95
		Rhodophyceae	5
Odax pullus	butterfish	Phaeophyceae	100
Parma alboscapularis	black angelfish	Rhodophyceae	80
		Chlorophyceae	20

6.2 MARINE REPTILES

Seven species of marine reptiles have been recorded from New Zealand; the loggerhead turtle (*Caretta caretta*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), olive Ridley turtle (*Lepidochelys olivacea*), leatherback turtle (*Dermochelys coriacea*), yellow-bellied sea snake (*Pelmis platurus*), and the banded sea snake (*Laticauda colubrina*) (Gill, 1997). All these tropical species have been found around northeastern New Zealand, but they only occur incidentally and do not reside or breed in New Zealand waters. Most of the sightings of marine reptiles in New Zealand occur during the summer months as most species, with the exception of the leatherback turtle, are likely to die or move out of New Zealand waters during winter. For example, the lower temperature limit for the yellow-bellied sea snake is 17°C (Whitaker, 2002). While turtles have occasionally been reported from around the Poor Knights Islands very few of the turtles are identified or recorded, therefore actual abundances are unknown. The green turtle, leatherback turtle, loggerhead turtle, and hawksbill turtle have been reported from the Poor Knights Islands (J. Choat, pers. comm. in Kelly, 1983; Gill, 1997; Abbott & Rousseau, 2002; Doak, 2008).

6.3 MARINE MAMMALS

Ten marine mammal species have been recorded from the waters around the Poor Knights Islands consisting of five species of baleen whales, four species of toothed whales/dolphins, and the New Zealand fur seal (Appendix 2, Table 14). Six other marine mammal species have been recorded from the Tutukaka coastline and may also utilise the waters around the Poor Knights Islands (Kelly, 1983). The most common marine mammals at the Poor Knights Islands are the common dolphin (*Delphinus delphis*), the bottlenose dolphin (*Tursiops truncatus*), and the New Zealand fur seal (*Arctocephalus forsteri*).

Common dolphins are most abundant at the Poor Knights Islands during spring and travel in pods ranging from a few individuals to hundreds (Doak, 2001c). Northern New Zealand populations are known to eat jack

mackerel (*Trachurus novaezelandiae*), kahawai (*Arripis trutta*), yellow-eyed mullet (*Aldrichetta forsteri*), flying fish (*Cypselurus lineatus*), parore (*Girella tricuspidata*), and garfish (*Hyporamphus ihi*) (Neumann & Orams, 2003).

Bottlenose dolphins are most abundant at the Poor Knights Islands during winter, but they are also common during January. Pods of up to 200 bottlenose dolphins have been encountered at the Poor Knights Islands. Both common and bottlenose dolphins frequently interact with divers and boats (Doak, 2001c).

New Zealand fur seals are frequent visitors to the High Peak Rocks (Pinnacles) during winter and up to 45 seals have been sighted hauling out on the High Peak Rocks (Northland Regional Council, 2003). Individual fur seals are commonly seen in the waters around the Poor Knights Islands, and on occasion on the wave platform on the northeastern side of Aorangi Island (K. Hawkins, DOC, pers. comm.).

6.4 SEABIRDS

Twenty seven species of seabirds have been recorded from the Poor Knights Islands, of which, 14 species are known to breed on the islands (including the Sugarloaf and High Peak Rocks) (Appendix 2, Table 15). Significantly, the Poor Knights Islands is the only place in the world where the Buller's shearwater (*Puffinus bulleri*) breeds. Australian gannets (*Sula serrator*), fairy prions (*Pachyptila turtur*), and Buller's shearwaters aggregate in the tens of thousands at the Poor Knights Islands during their breeding season. The high density and diversity of seabirds at the Poor Knights Islands is likely to be a result of the long absence of human habituation and mammalian predators, and the geographical position of the islands near the convergence of the subtropical East Auckland Current with cooler coastal waters. This current boundary, which is marked by a significant temperature gradient, may promote the abundance of zooplakton species and other marine organisms that are important to the diets of seabirds (McCallum, 1981; Kelly, 1983). Some of the more notable species of seabirds that occur at the Poor Knights Islands are described below in more detail.

6.4.1 Threatened seabirds

Buller's shearwaters

Buller's shearwaters (*Puffinus bulleri*) are subtropical surface feeders that are only known to nest on the Poor Knights Islands[17]. Their conservation status in the New Zealand Threat Classification System is listed as 'at risk – naturally uncommon' by Miskelly *et al*. (2008). Population numbers dropped to approximately 500,000 birds on Tawhiti Rahi Island in 1940 and Buller's shearwaters were almost extinct on Aorangi Island owing to the presence of feral pigs. After pigs were eliminated from Aorangi Island in 1936 the numbers of breeding pairs rapidly increased from approximatley

17 One bird and chick was found in Motu Purihi Island, Houhora (Taylor & Parrish, 1991).

100 in 1938 to about 200,000 in 1981. The most recent population estimate was by Harper in 1981 who estimated the worldwide population of Buller's shearwaters to be around 2.5 million birds (Harper, 1986).

Breeding birds return to the Poor Knights Islands from their annual trans-equatorial migration to the North Pacific Ocean in early September. The four and a half month migration route is still unknown but birds have been sighted in Tonga, Japan, Chile, Alaska, and on the American Pacific coast. Numbers of Buller's shearwaters increase rapidly on the Poor Knights Islands from early September, with breeding birds digging and refurbishing burrows. Copulation occurs in late October followed by egg laying in late November, and hatching occuring in mid January. By late May most of the new fledglings have left the islands (Harper, 1983, 1986).

Buller's shearwaters feed on a variety of schooling fish and euphausids that are herded to the surface by predatory fish. Most birds forage near the continential shelf between Cape Reinga and East Cape, but Buller's shearwaters have been sighted as far south as Bank's Peninsula and the Chatham Islands (Jenkins, 1988). Analysis of the regurgitations of birds from the Poor Knights Islands during the breeding season found that 76.6% of the stomach contents consisted of the euphausid *Nyctiphanes australis* (Harper, 1983). In late afternoon, birds returning from feeding form dense rafts[18] of up to 20,000 birds on waters near the Poor Knights Islands, before returning to their burrows at night (International Maritime Organization, 2003).

The birds are aggressive colonisers and their population explosion on the Poor Knights Islands may have displaced a number of other breeding petrel species such as the fairy prion *(Pachyptila turtur),* which is now restricted to nesting in rock crevices on the Poor Knights Islands (Taylor, 2000b).

Fairy prion

The fairy prion (*Pachyptila turtur*) is the second most abundant breeding petrel on the Poor Knights Islands with an estimated 40,000 breeding pairs on the islands in the early 1970s (Harper, 1976). The conservation status of the species is listed as 'at risk – relict' by Miskelly *et al.* (2008). The total New Zealand population of fairy prions was estimated to be over one million breeding pairs in 1984 (Robertson & Bell, 1984), which is thought to account for more than 50% of the world population (Marchant & Higgins, 1990).

The fairy prion population at the Poor Knights Islands is the only known breeding colony in northern New Zealand. Fairy prions are restricted to nesting in rock crevices on the Poor Knights Islands as soil burrows are prone to interference by the more aggressive Buller's shearwaters (Taylor, 2000b). Breeding commences in September with egg laying occurring in mid to late October. During the breeding season the birds forage up to 100 km east of the Poor Knights Islands, returning to their nests each night. Fledglings begin to leave the Poor Knights Islands in January and travel to the subtropical waters off Australia and South Africa (Kelly, 1983; New Zealand Birds, 2007).

18 A dense flock of swimming birds on the water. Rafts at the Poor Knights Islands may also include fairy prions, Northern diving petrels, and fluttering shearwaters.

Pycroft's petrel

Pycroft's petrel (*Pterodroma pycrofti*) is an endemic species that breeds on 11 of New Zealand's offshore islands including Aorangi Island. The petrel is listed as 'at risk – recovering' by Miskelly *et al.* (2008). The population dropped to less than 300 breeding pairs in the 1960s–1970s but has since recovered to around 10,000–20,000 individuals in 1998 (Taylor, 2000a). Little research has been conducted on the presence of Pycroft's petrels on the Poor Knights Islands and it is uncertain whether the birds still breed at the Poor Knights Islands (Taylor, 2000a). The last published study was by Bartle (1968) who estimated that there were 12 pairs of breeding birds present on Aorangi Island in 1963–1964.

North Island little shearwater

The North Island little shearwater (*Puffinus assimilus haurakiensis*) is an endemic subspecies that breeds on both Aorangi and Tawhiti Rahi Island. The species is listed as 'at risk – recovering' by Miskelly *et al.* (2008) and worldwide population numbers are estimated to be around 10,000 breeding pairs (Taylor, 2000a). McCallum (1981) found several hundred breeding pairs on Tawhiti Rahi Island in 1980, burrowing amoung fluttering shearwater colonies and beneath low coastal vegetation. The birds breed on the Poor Knights Islands from June to October. Fledging occurs in November and the birds leave the island in January (Harper *et al.*, 1964). No recent studies have been conducted on the population of North Island little shearwaters on the Poor Knights Islands.

Red-billed gull

The red-billed gull (*Larus novaehollandiae scopulinus*) is a native subspecies that breeds throughout New Zealand and its offshore islands. Red-billed gulls used to be common throughout New Zealand, however, population numbers have declined by more than 50% over the past 10 years, and thus, they are now classified as 'threatened – nationally vulnerable' (Miskelly *et al.*, 2008). Little is known about current utilisation of the Poor Knights Islands by red-billed gulls. A breeding colony of more than 500 red-billed gulls was observed on the Sugarloaf Rock in 1965 (Gurr & Kinsky, 1965), but no more recent information is available on the presence of breeding colonies on the Poor Knights Islands. Red-billed gulls were occasionally sighted around the Poor Knights Islands, High Peak Rocks, and Sugarloaf Rock during faunal surveys conducted during the 1980s (Aviss, 1986; DOC unpub. data).

6.4.2 Non-threatened seabirds

Australian gannet

Thousands of Australian gannets (*Sular serrator*)[19] congregate to breed on the High Peak Rocks and Sugarloaf Rock every year from winter to early summer. Australian gannets were first recorded breeding on Sugarloaf Rock in 1892 (Fleming & Wodzicki, 1952). The number of breeding pairs on the Sugarloaf and High Peak Rocks has increased from approximately 1500 pairs in 1946–1947 to approximately 4170 pairs in 1980–1981 (Wodzicki *et al.*, 1984).

Fledgings migrate westward towards eastern and southern Australia, returning to New Zealand between the ages of 2–5 years. Breeding commences between 4–7 years of age and birds generally mate for life, which can be up to 25–28 years (Wodzicki *et al.*, 1984; Taylor, 2000b).

Figure 21. A feeding frenzy of schooling trevally and Buller's shearwaters.
Photo: Kent Ericksen

19 The taxonomy of this species is currently unresolved and Australian gannets are sometimes placed in the genus *Morus*

7. Human use

7.1 COMMERCIAL FISHING

Very little specific information is available on commercial fishing activities that used to occur around the Poor Knights Islands. Commercial fisheries known to occur around the islands include; 1) purse-seining for trevally with by-catches of blue maomao and kahawai, 2) potting for spiny crayfish, particularly packhorse crayfish, 3) drop-lining for hapuku, 4) long-lining for snapper with significant by-catches of trevally and, 5) stray-lining for snapper (Ritchie *et al.*, 1979). With the exception of purse-seining for trevally, it appears that commercial fishing catches around the Poor Knights Islands were typically small and opportunistic in nature. Commercial fishermen would often used the Poor Knights Islands as a sheltered anchorage in adverse weather conditions (Kelly, 1983).

Purse-seining was the main commerical fishery that occurred around the Poor Knights Islands, targeting the huge surface schools[20] of trevally that aggregated around the High Peak Rocks and Sugarloaf Rock (Kelly, 1983). In the mid 1970s a Bay of Plenty purse-seiner caught 400 tonnes of trevally around the High Peak Rocks in two weeks. This huge catch increased the demands from marine reserve advocates for the creation of a marine reserve around the Poor Knights Islands (Lilly, 1995). To date, schools of trevally around the Poor Knights Islands have not returned to their existing levels prior to the start of purse-seining (Q. Bennett in Department of Conservation, 1997; Enderby & Enderby, 2008). In 1981, when the Poor Knights Islands Marine Reserve was established, commercial fin fishing, except for long-lining, was banned within a 3 nautical mile radius of the mean high-water mark of the Poor Knights Islands, High Peak Rocks, and Sugarloaf Rock. Furthermore, no commercial fin fishing was permitted within 1 nautical mile of the Poor Knights Islands, High Peak Rocks, and Sugarloaf Rock. Commercial lobster fishing is permitted up to the boundary of the marine reserve (Fisheries (Auckland and Kermadec Areas Commercial Fishing) Regulations 1986, SR1986/216).

7.2 RECREATIONAL FISHING

When the Poor Knights Islands Marine Reserve was established in 1981 the Minister of Conservation issued a notice that permitted restricted recreational fishing within the reserve, with the exception of two fully protected areas around Nursery Cove Reef/Bartle's Bay/Maroro Bay and Frasers Bay/South Harbour. In 1989 the Minister of Conservation issued a further fishing notice which allowed recreational fishing to continue within the reserve until 10 December 1994. Three methods of fishing were permitted within the reserve; trolling, spearfishing, and stray-

20 Ritchie *et al.* (1979) estimated that the size of these surface schools of trevally was around 100 tonnes or more

lining[21]; and recreational fishers were permitted to take the following fish species using the methods listed below:

- By trolling: pink maomao, tuna, mackerel, kahawai, kingfish, shark, billfish, barracouta.
- By spearfishing: pink maomao, snapper, trevally, kahawai, tuna, mackerel, shark, billfish, kingfish, barracouta.
- By stray-lining: pink maomao, snapper, trevally, kingfish, barracouta.

From the time of establishment of the Poor Knights Islands Marine Reserve the fishing restrictions were complex and difficult to understand. Anglers were required to know what areas were open and closed to fishing, the respective boundaries of each, what species of fish could be caught, and by what methods. For example, anglers were allowed to take a kahawai, mackerel, or shark by trolling or spear, but if they caught one with a floating line it was unlawful. Anglers also needed to be able to identify the fish species that could be taken.

No information is available on the size of the recreational fishing harvest that was taken from the Poor Knights Islands Marine Reserve prior to 1998, or the quantity of non-allowed fish taken. There are anecdotal reports of non-allowed fish species being targeted by spearfishers, and use of illegal fishing techiques within the reserve including jigging, jagging, spinning, and live baiting[22]. Permitted stray-lining also had a high inadvertant by-catch rate of non-allowed fish species such as wrasses, moray eels, hapuku, hiwihiwi, and blue maomao, and it is not known what percentage of the by-catch survived. If a protected species that had swallowed a hook was injured or killed while the hook was being retrieved the angler had committed an offence under the Marine Reserves Act (Department of Conservation, 1994, 1997).

Open-water gamefishing was very popular around the Poor Knights Islands and Sugarloaf and High Peak Rocks. The Whangarei Deep Sea Anglers' Club (WDSAC) begain fishing around the Poor Knights Islands in 1951, although the many of their gamefishing locations were outside the marine reserve boundaries (see Kelly, 1983 for locations). Three hundred and thirty nine gamefish were caught by the WDSAC in the three year period between mid 1980 and mid 1983. The main gamefish species caught were striped marlin (56%), mako shark (17%), hammerhead shark (9%), and blue shark (9%) (Kelly, 1983).

Charterboat fishing was the main income for Tutukaka prior to 1998 and up to 17 charter boats operated in the vicinity of the Poor Knights Islands. In winter open water gamefishing was replaced with line fishing at the Poor Knights Islands (Lilly, 1995). Between May 1982 and April 1983 the Tutukaka Charter Boat Association (TCBA) took 2611 customers gamefishing, and 520 customers line-fishing (Kelly, 1983).

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21 Stray-lining is fishing from an anchored or drifting boat using an unweighted line that is allowed to slowly sink to the bottom by the weight of the bait alone.

22 Jigging is fishing with a weighted lure from an anchored or drifting boat, jagging is the casting of a multi-pronged hook into a school of fish to try and foul hook them, spinning is the casting and retrieving of a lure, and live-baiting involves fishing with a live fish hooked through the back that is free-swimming commonly under a floating balloon.

The underlying purpose of the Poor Knights Island Marine Reserve is to protect the marine ecosystem, and the debate over whether fishing should be allowed within the reserve saw a review of recreational fishing initiated by the Department of Conservation (DOC) in 1994. Of the 4225 submissions received from the public 73% did not want recreational fishing to continue within the reserve, whereas 27% supported the continuation of recreational fishing within the reserve. Greatest support for the continuation of fishing within the reserve came from the communities that were closest to the Poor Knights Islands, with 66.8% and 34.6% of submissions from Tutukaka and Whangarei, respectively, supporting the continuation of fishing.

In December 1994 the Minister of Conservation decided not to re-issue the permit that allowed recreational fishing within the reserve. Following this decision the WDSAC and the TCBA lodged an application with the High Court for a judicial review of the Minister's decision, and also sought an interim order that would allow recreational fishing to continue until such time as the Minister made a new decision. In May 1995, prior to the High court date, the Minister of Conservation and the WDSAC/TCBA reached an out-of-court settlement. The two parties agreed that the Minister would make a new decision on whether to permit recreational fishing within the marine reserve after reviewing further information (Department of Conservation, 1995). A second round of public consultation was conducted in 1996 and the results were analysed by Gabites Porter Consultants (1996). Of the 3813 submissions received in the second round, 57% did not want recreational fishing to continue within the reserve, while 43% supported the continuation of some form of restricted recreational fishing within the reserve.

In May 1997 the Minister of Conservation announced that he would not be renewing the recreational fishing provision for the Poor Knights Islands Marine Reserve. Fishing around Aorangi Island ceased in October 1997, and fishing around Tawhiti Rahi Island, High Peak Rocks, and Sugarloaf Rock ceased in October 1998 (Smith, 1997).

7.3 DIVING AND TOURISM

The primary recreational activity at the Poor Knights Islands changed from fishing to diving, following the expiry in 1998 of the provision that permitted restricted recreational fishing at the Poor Knights Islands Marine Reserve. In the four years prior to 1998 the main activity of 484 boats surveyed within the marine reserve was fishing (73%), followed by diving (22%). In contrast, in the four years following 1998 the main activity of the 355 boats surveyed within the reserve was diving (80%) (Hawkins, 2002).

The number of charter boat visits to the Poor Knights Islands and the number of passengers has been estimated for the period between 1999 and 2004 (Fig. 22), based on Tutukaka coastguard records and estimates by charter boat operators. These visitor estimates only include charter boats that are based in Tutukaka, though the number of charter boats visiting from other ports is thought to be very small. In 2003–2004 approximately 1053 commercial trips were made to the Poor Knights

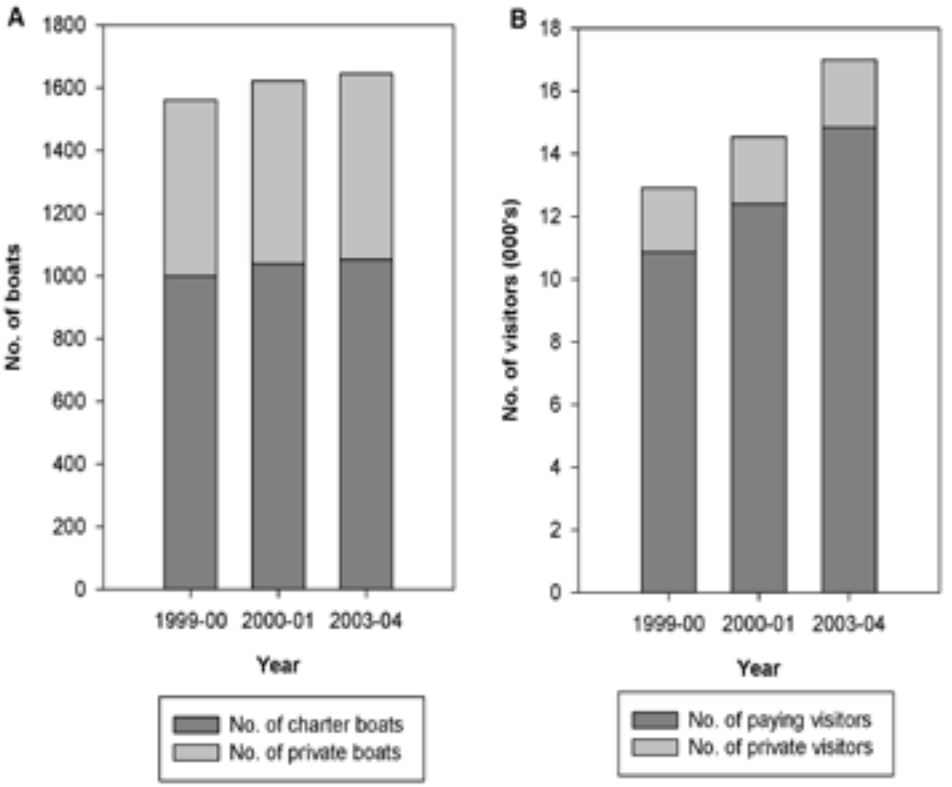

Figure 22. A) Estimated number of charter and private boat trips per annum, and B) estimated number of visitors per annum, to the Poor Knights Islands Marine Reserve between July 1999 and June 2004. Data from Saul (2001), Edney (2004), and Hawkins (2007).

Islands, carrying a total of 14,836 passengers. Between 1999 and 2004 the number of charter boats trips to the Poor Knights Islands only increased by 5%, however, the number of paying visitors to the island increased by 36% (Saul, 2001; Edney, 2004). A survey conducted in the summer of 1999 showed that approximately 80% of charter boat passengers visiting the Poor Knights Islands were international tourists, and 26% of passengers had come to New Zealand specifically to visit the Poor Knights Islands (Teague, 1999). December and January are the busiest months of the year with up to 16 charter boat vists per day (Hawkins, 2007). Visitor numbers have not been monitored since 2004 but it is likely that visitor numbers have increased as the total passenger capacitiy of the charter boats has increased. As at June 2008 the size of the Tutukaka charterboat fleet that is primarily focused on dive-eco charter work in Poor Knights Marine Reserve comprised 10 companies with a combine capacity to transport a total of 333 passengers per trip to the reserve, though the companies only load a maximum of 250 passengers on board. The lower loading figure reflects operators awareness of safety, passenger experience, and extra space warranted when passengers are largely divers. The past 6–12 months has seen two vessels leave the business due to economic conditions (K. Hawkins, DOC, pers. comm.).

Accurate estimates of the number of private boats visiting the Poor Knights Islands Marine Reserve are much harder to determine. Between December 2004 and February 2005 the Department of Conservation commissioned a survey to estimate the number of commercial and private boats that visit the reserve, and the number of passengers that they carry. Over the 17 days of the survey an average of 13 boats per day visited the reserve, of which 63% were commercial charter boats, 35% were private boats, and 2% were of unknown status. Commercial boats had an average of 14.2 passangers, while private boats had an average of 3.7

passengers. These numbers were used to estimate the number of private boats and passengers visiting the island between 1999 and 2004 (Hawkins, 2007) (Fig. 22). It should be noted that these estimates are only ballpark figures as they are based on a number of assumptions including; 1) the ratio of private boats to charter boats remained constant between 1999 to 2004, 2) the number of private boat visits during the survey period is consistent with the remainder of the year (which is unlikely as the survey was conducted during the busiest months of the year, 3) the area covered in the survey was representative of the whole marine reserve.

Information on the number of private and commercial boat visits to the Poor Knights Islands prior to 1998 is limited. Data from DOC surveillance trips indicate that the number of private boats visits decreased after 1998 when all recreational fishing was banned from the reserve. Between 1994–1998 DOC recorded approximately 7.5 private boats/day at the Poor Knights Islands, whereas between 1998–2001 only 3.3 private boats/day were recorded (Hawkins, 2002).

7.3.1 Visitor impacts

Potential adverse visitor impacts include damage to benthic organsims by boat anchors, pollution from boats exhausts & bilges, copper leachate from antifouling, sewage discharge from boats (although illegal), littering, and disruption of seabird breeding. Adverse diver impacts include damage to benthic communites, modification of fish behaviour, modification of fish diet, illegal poaching and shell collecting, and possible disturbance of overhanging reef wall and roof communities by the impact and ponding of air bubbles exhaled by divers (McCrone, 2001).

Anchor damage

The most common sites where boats anchor are, in decreasing order of popularity, Maroro Bay, Jan's tunnel, Middle Arch, North Arch, and South Harbour (see Fig. 8 for locations), with most boats anchoring between 15–40 m depth (Duffy, 2000; Hawkins, 2007).

The majority of shallow subtidal rocky habitats (<24 m) suitable for anchoring at the Poor Knights Islands have biotas dominated by macroalgae that are relatively resilient to anchor damage. Observations of anchored boats in calm conditions show that the damage caused by anchors is relatively minor, primarily breakage of macroalgae laminae, and some disturbance of crustose corralline algae and benthic bryozoans. This shallow subtidal habitat is regularly exposed to strong wave action and therefore any fragile benthic organisms are generally restricted to rock crevices. Thus, boats that anchor at depths <24 m probably have little adverse impact. Below 24 m depth the macroalgae cover decreases and coverage of benthic organisms such as sponges, bryozoans, and gorgonians increases. Boats that do anchor below 24 m are likely to cause significant damage to these slow growing benthic organisms, which may take years to recover. Existing information on benthic communities at the Poor Knights Islands below 30 m depth is poor, and therefore it is difficult to predict the degree of impact that is caused by anchor damange. Identification of unique or particularly vulnerable deep water benthic communites is needed in order to protect them from potential anchor damage (Duffy, 2000).

Disruption of natural animal behaviours

Visitors to the Poor Knights Islands can intentionally or unintentionally disrupt natural animal behaviours, particularly feeding and mating. For example, divers at the Poor Knights Islands are commonly seen breaking open sea urchins underwater to feed fish (Duffy, 2000). This behaviour is likely to cause fish to be unnaturally attracted to divers, as well as depleting urchin population numbers at popular dive sites. Urchins are an important habitat forming species and their removal may have impacts on both the benthic community and their predators.

Anecdotal evidence suggests that divers can temporarily disrupt large aggregations of stingrays, which frequently occur at the Poor Knights Islands from November to March. These aggregations are thought to be a mating behaviour and the consequences of these disruptions are unknown (Duffy, 2000).

7.4 BIOSECURITY

The Poor Knights Islands Marine Reserve is an area of national significance and the unique marine assemblages present need to be protected from modification by invasive exotic organisms. Vessel movement in the vicinity of the Poor Knights Islands is the most likely method for the introduction of invasive organisms to the islands via hull fouling, ballast water, and sea chests (water-intake recesses in hull). International and local shipping traffic to and from the port of Whangarei pass near the Poor Knights Islands, and could discharge ballast water containing the larvae or spores of invasive species in the vicinity of the islands (Dodgshun *et al.*, 2007), which are then distributed at a local scale by water currents. Pleasure crafts visiting the Poor Knights Islands are also a significant biosecurity risk as many of these vessels remain inactive for long periods of time in sheltered marinas where invasive organisms are prevalent.

Biosecurity New Zealand has identified a number of non-indigenous marine organisms present in the country that have the potential to cause major changes to native species assemblages or cause large economic losses to our aquaculture and marine industries. These unwanted organisms include the Asian kelp *Undaria pinnatifida*, the Mediterranean fan worm *Sabella spallanzanii*, and the ascidians; *Styela clava, Didemnum vexillum, Ciona intestinalis*, and *Eudistoma elongatum* (Biosecurity New Zealand, 2008). Of the six invasive marine organisms listed above, the clubbed tunicate, *Styela clava*, has been recorded nearest to the Poor Knights Islands. This solitary ascidian has already been detected from the nearby Tutukaka Marina and Marsden Cove Marina (Whangarei) (Biosecurity New Zealand, 2008). *Styela clava* can reach densities of 50–100 individuals/m^2 on natural substrates (Lutzen, 1999), and has the potential to cause significant environmental and economic impact through high-density fouling.

To date, the only likely invasive species recorded at the Poor Knights Islands is the parchment tubeworm, *Chaetopterus* sp., though it is not certain whether or not this worm is native to New Zealand (Tricklebank *et al.*, 2001). The earliest records of *Chaetopterus* sp. in New Zealand date back to circa 1966, but abundances around the country remained low until the mid 1990's when northern populations increased dramatically,

particularly around the Hauraki Gulf region (Acosta, 2001). Taxonomic descriptions of the 'Hauraki' *Chaetopterus* sp. show that the species is new to science (Tricklebank *et al.*, 2001) and different from a species in the same genus found around the Marlborough Sounds (G. Read, NIWA, pers. comm.). The 'Hauraki' *Chaetopterus* sp. was first discovered at the Poor Knights Islands in 1999 and underwent a major population explosion in the following years. Benthic surveys conducted at the Poor Knights Islands in 2001 recorded *Chaetopterus* sp. densities of up to ~20,000 individuals/m^2 on coarse soft sediments at Maroro Bay, Skull Bay, and Shag Bay, at depths down to 69 m. The polychaete was also found on rocky reefs at much lower densities (Brook *et al.*, 2001). However, abundance of *Chaetopterus* sp. at the Poor Knights Islands drastically decreased in the years following the survey, and dense mats of the tubeworm at the Poor Knights Islands were no longer present by ~2003–2004 (F. Brooks, pers. comm.). The ecological impact of *Chaetopterus* sp. on the benthic communities at the Poor Knights Islands is unknown.

7.5 MANAGEMENT ACTIONS (BY KEITH HAWKINS)

7.5.1 Shipping routes

Figure 23. Chart of Cape Brett to Bream Tail showing the area protected from commercial shipping traffic (within purple line).

Chart sourced from Land Information New Zealand data. Crown copyright reserved.

The region between Whangarei and Auckland is one of the busiest waterways in the country, with vessels transporting oil to and from the Marsden Point Oil Refinery, and sailing to and from the Port of Auckland. About four thousand 45 m-long vessels travel past the Poor Knights Islands each year (International Maritime Organization, 2003). In May 2004 the International Maritime Organisation (IMO) prohibited commercial shipping traffic greater than 45 m in length from travelling within the coastal region between Bream Head and Cape Brett, including the area around the Poor Knights Island (Fig. 23), to protect this unique area of coastline from potential oil spills and other environmental damage. The boundary of the protected area[23] extends 5 nautical miles (9 km) from land and passes east of the Poor Knights Islands. The only commercial ships exempt from this rule are fishing ships that are engaged in fishing operations and barges under tow, provided the cargo is not oil or other harmful substances (Maritime New Zealand, 2006).

7.5.2 Moorings

Between 1987 and 1989 the Department of Conservation, Tutukaka Big Game Fishing Club and individual donations funded the installation of five

23 The protected area is bounded by the co-ordinates; 35° 51.30'S 174° 35.50'E, 35° 34.55'S 174° 49.20'E, 35° 29.60'S 174° 50.80'E, 35° 24.70'S 174° 50.20'E, and 35° 10.20'S 174° 20.10'E

permanent mooring sites at Middle Arch, Nursery Cove, South Harbour, Hope Point, and Blue Maomao Arch/Ngaio Rock. The moorings consisted of a large concrete block connected to heavy mooring chain, which was in turn connected to a rope mooring line that ran to a surface buoy. Although the moorings were not critical to charter boat operations, charter boat operators found them convenient, and they were regularly used by the larger charter boat vessels when they visited the sites. The moorings were generally used for 1–2 hours by charter boats while dives were conducted at the site, but on occasion they were also used for overnight mooring by both recreational and commercial vessels. The moorings received little on-going maintenance, and in 1996 the Department of Conservation initiated an investigation into whether or not permanent moorings should be replaced, and who should be responsible for the costs. Issues that were considered included 1) the need for a costly maintenance programme to avoid potential legal liability arising from mooring failure, and 2) optimal mooring design, as it was evident that the natural movement of the heavy mooring chain over the seabed at several sites resulted in damage to the benthic biota. After discussion with charter boat operators it was decided not to replace any of the permanent mooring because of the following reasons (Hawkins, 1999, 2004):

1. Moorings were not critical for the operation of charter boats, and the small number of moorings proposed would not be sufficient to prevent anchoring in the bays where moorings were present.
2. The new moorings needed to be located further from the shore than the previous moorings, and thus boats may have preferred to anchor closer to shore rather than use the moorings.
3. The cost of installation of the moorings was high.
4. It was uncertain whether the proposed mooring design would be suitable for the boulder-strewn terrain at South Harbour, one of the proposed mooring sites.
5. Installation of new moorings would have required a resource consent, and the agreement of Iwi.

There have been no moorings in the marine reserve since 2004.

7.5.3 Compliance

The establishment of the Poor Knights Islands Marine Reserve in 1981 gave rise to an immediate need to inform and educate the public of the marine reserve restrictions in the hope of achieving compliance. A reserve handout was produced, and permanent signage was established at boating departure locations at Tutukaka and Whangarei. While commercial fishing was not permitted within the reserve boundaries, recreational fishers could use permitted fishing methods to take certain fish species in all but two areas within the reserve (see Section 7.2 for more detail). All other marine life was totally protected.

From the beginning, education and enforcement of the marine reserve restrictions was problematic as; 1) the fishing restrictions were complex and difficult to understand, and 2) the Ministry of Fisheries officers, who were responsible and empowered to enforce the rules, were limited in number and consequently their coverage of the Poor Knights Islands Marine Reserve was limited. The Poor Knights Islands Marine Reserve

committee (PKIMRC), which was responsible to the Minister of Fisheries for the management of the reserve, recommended that the Minister appoint honorary marine reserve rangers to assist the Ministry of Fisheries Officers. In January 1984 a report documenting frequent incidences of illegal fishing occurring inside the prohibited areas prompted the PKIMRC to re-request with some urgency that the Minister appoint some honorary rangers.

In 1985 a number of private individuals, including local charter boat operators, were appointed as honorary rangers. Their primarily role was to provide information on the marine reserve rules to users of the reserve, and to inform Fisheries Officers of any offences that occurred within the reserve.

Offending was occasionally reported though very rarely resulted in prosecution owing to the lack of sufficient evidence to identify the alleged offender(s) or prove the offence. The earliest prosecution is believed to have occurred in 1986 for fishing in the closed area at South Harbour. In mitigation the offender claimed that he thought the area was open to fishing as he had seen a navy boat fishing there a couple weeks earlier.

On the 1 April 1987, the reorganisation of responsibility of Government conservation work resulted in the establishment of the Department of Conservation (DOC), and the transfer of the responsibilities of the Marine Reserve Act from the Ministry of Fisheries to DOC. DOC became responsible for the management of the reserve, and enforcement of the regulations was carried out by its warranted Conservation Officers. Over the ten year period between 1992 and 2002, 67 individuals were apprehended by DOC officers for conducting illegal activities within the reserve boundaries (Hawkins, 2002).

On the 10 April 1990, the enactment of the Conservation Law Reform Act 1990 amended the Marine Reserve Act 1971 and abolished the PKIMRC. By this time the use of honorary marine reserve rangers had diminished as they were required to carry out a more proactive enforcement role by making apprehensions rather than just providing information.

In October 1998 the provisions that permitted restricted recreational fishing at the Poor Knights Islands Marine Reserve expired and the entire reserve became a fully protected marine reserve. This saw a significant change in compliance interactions. For example, in the four years prior to 1998, 16.5% of boating parties surveyed said that they did not know where the marine reserve boundaries were, whereas, in the four years following 1998 only 5.5% of boating parties did not know where the marine reserve boundaries were (Hawkins, 2002). Likewise, there was a significant reduction in the number of apprehensions for the most common offence, the use of weighted fishing lines within the reserve, as fishing was not longer permitted within the reserve.

The cessation of recreational fishing also saw an increase in ecotourism activity (see Section 7.3). As a result, charterboat operators who visited the reserve regularly undertook stronger "ownership" of the reserve and were more proactive in protecting the reserve from illegal activity and reporting offences. Compliance and advocacy have remained key priorities for DOC with resources (staff and vessels) dedicated to ensure the provisions of the Act are achieved. Offending continues to occur as some individuals are unable to resist poaching from the abundant marine life.

8. Conclusions

This updated literature review of the Poor Knights Islands Marine Reserve has reviewed and interpreted over 130 new references on the marine habitats and biota of the Poor Knights Islands, following on from Kelly's 1983 review. Significant new research has been conducted on fish abundance, subtidal macroalgal communities, and vertical reef wall communities. An updated species checklist was compiled, with a total of 1259 marine species recorded from the Poor Knights Islands Marine Reserve. The number of protozoan, molluscan, and fish species recorded at the Poor Knights Islands has greatly increased since the previous inventories conducted by Kelly (1983) and Batthershill (1986). Numbers of macroalgae, cnidarian, and arthropod species showed a moderate increase (10–25 new records), while poriferans, bryozoans, ascidians, annelids, echinoderms, brachiopods, seabirds, reptiles, and marine mammals increased by less than 10 species per phylum (Table 4).

TABLE 4. NUMBER OF SPECIES RECORDED AT THE POOR KNIGHTS ISLANDS MARINE RESERVE

TAXON	REFERENCE		
	KELLY (1983)	BATTERSHILL (1986)	THIS REPORT
Macroalgae	–	102	121
Protozoa	4	–	114
Porifera	49	140	140
Cnidaria	30	58	68
Ectoprocta (Bryozoa)	6	36	42
Annelida	15	17	21
Brachiopoda	1	3	4
Mollusca	200	131*	353
Arthropoda	32	30*	57
Echinodermata	35	43	52
Ascidiacea	26	57	59
Fish	117	110**	187
Seabirds	22	–	27
Reptiles	3	–	4
Marine mammals	2	–	10

* Does not include sand flat or intertidal species

** Does not include fully pelagic species

It is likely that the number of vertebrate species (fish, birds, reptiles, and mammals) recorded from the Poor Knights Islands Marine Reserve are representative of the actual species diversity of these taxa at the Poor Knights Islands, as these groups are conspicuous, well-known, and easily identified from photos. The recorded species diversities of marine invertebrate taxa at the Poor Knights Islands are most likely underestimates, given that there have been no significant research collections of these groups undertaken at the Poor Knights Islands in the last 20 years.

The Poor Knights Islands Marine Reserve contains a high proportion of subtropical flora and fauna as a result of its location near the edge of the continental shelf, on the margin of the East Auckland Current.

The reserve also supports a number of rare and locally endemic flora and fauna including; the macroalgae *Gelidium allani, Palmophyllum umbracola,* and *Pedobesia clavaeformis*, the sponge *Ircinia fistulosa*, the barnacle *Tetraclita aoranga*, the black coral *Lillipathes lillei*, the branching stony coral *Oculina virgosa*, the echnioderms *Knightaster bakeri*, *Astrobrachion constrictum*, and *Cenolia novaezelandiae,* the molluscs *Prototyphis paupereques, Thoristella davegibbsi*, *Novastoa lamellosa, Sypharochiton aorangi*, and *Phenacovolva wakayamaensis*, the fish *Odax cyanoallix* and *Suezichthys aylingi*, and Buller's shearwater *Puffinus bulleri.*

The rich diversity and unique assemblage of marine flora and fauna, and the unusual subtidal habitats present in the Poor Knights Islands Marine Reserve, illustrate the uniqueness of the islands and its important contribution to New Zealand's biodiversity. Continued protection and good management of the reserve will ensure that the Poor Knights Islands Marine Reserve is enjoyed by generations to come.

Figure 24. A delicate ctenophore floating in the waters around Bartle's Bay.
Photo: Kent Ericksen

9. Acknowledgements

Many thanks to Fred Brooks, Vince Kerr, and Keith Hawkins for reviewing the draft report and providing helpful comments. Thanks also to Glen Edney, Kent Ericksen, Roger Grace, Keith Hawkins, Vince Kerr, Mark Morrison, Matthew Oldfield, Richard Parrish, David Schiel, Ian Skipworth, Dive Tutukaka and James Williams who kindly provided images and maps for this report.

Figure 25. The unique Poor Knights Islands marine environment sees thousands of visitors each year. Maroro Bay (below) is one of the most popular dive sites.
Photo: K. Hawkins, DOC

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Appendix 2:

CHECKLIST OF MARINE SPECIES RECORDED FROM THE POOR KNIGHTS ISLANDS MARINE RESERVE

This checklist of marine species has been compiled from published and unpublished scientific literature, newspapers, magazines, electronic resources, unpublished dive records, and personal communications. Taxonomy is an ever-changing discipline and while every effort has been made to list the correct species name the scope of this report did not include the verification of the correct identification of specimens. In some references new species were initially given an operational taxonomic name (e.g. sp. A). If new species of the same genus are described in latter publications it is presumed that these species names replace the operational taxonomic names.

TABLE 1. MACROALGAL SPECIES RECORDED FROM THE POOR KNIGHTS ISLANDS (I=INTERTIDAL, S=SUBTIDAL).

FAMILY	SPECIES	ZONE	REFERENCE
PHYLUM CHLOROPHYTA			
CLASS BRYOPSIDOPHYCEAE			
Order Bryopsidales			
Caulerpaceae	*Caulerpa brownii*	S	Schiel (1984)
	Caulerpa flexilis	S	Nelson & Adams (1987)
	Caulerpa geminata	S	Nelson & Adams (1987)
Derbesiaceae	*Bryopsis plumosa*	I	Battershill (1986)
	Derbesia novae-zelandiae	I	Battershill (1986)
	Pedobesia clavaeformis	S	Nelson & Adams (1987)
CLASS ULVOPHYCEAE			
Order Cladophorales			
Anadyomenaceae	*Microdictyon umbilicatum*	S	Nelson & Adams (1987)
Cladophoraceae	*Cladophora crinalis*	I	Battershill (1986)
	Cladophoropsis herpestica	I	Nelson & Adams (1987)
	Rhizoclonium riparium	I	Battershill (1986)
Order Codiales			
Codiaceae	*Codium convolutum*	I & S	Battershill (1986)
	Codium cranwelliae	I & S	Nelson & Adams (1987)
Order Tetrasporales			
Palmellopsidaceae	*Palmophyllum umbracola*	S	Nelson & Ryan (1986)
Order Ulvales			
Ulvaceae	*Ulva lactuca*	I & S	Nelson & Adams (1987)
PHYLUM OCHROPHYTA			
CLASS PHAEOPHYCEAE			
Order Dictyotales			
Dictyotaceae	*Dictyota ocellata*	I	Battershill (1986)
	Distromium skottsbergii	S	Nelson & Adams (1987)

FAMILY	SPECIES	ZONE	REFERENCE
	Padina sp.	I	Battershill (1986)
	Glossophora kunthii	S	Schiel (1984)
	Taonia australasica	S	Battershill (1986)
	Zonaria turneriana	S	Shears & Babcock (2004)
Order Durvillaeales			
Durvillaeaceae	*Durvillaea antarctica*	I	Nelson & Adams (1987)
Order Ectocarpales			
Chordariaceae	*Leathesia difformis*	S	Schiel (1984)
Ectocarpaceae	*Ectocarpus* sp.	S	Schiel (1984)
Order Fucales			
Cystoseiraceae	*Landsburgia quercifolia*	S	Nelson & Adams (1987)
Fucaceae	*Xiphophora chondrophylla* var. *minus*	I & S	Nelson & Adams (1987)
Hormosiraceae	*Hormosira banksii*	I	Battershill (1986)
Sargassaceae	*Carpophyllum angustifolium*	S	Nelson & Adams (1987)
	Carpophyllum maschalocarpum	S	Shears & Babcock (2004)
	Carpophyllum plumosum	I & S	Nelson & Adams (1987)
	Cystophora retroflexa	I	Battershill (1986)
	Cystophora torulosa	S	Battershill (1986)
	Sargassum sinclairii	S	Ayling (1974c)
Order Laminariales			
Alariaceae	*Ecklonia radiata*	S	Nelson & Adams (1987)
Lessoniaceae	*Lessonia variegata*	S	Shears & Babcock (2004)
Order Ralfsiales			
Ralfsiaceae	*Ralfsia verrucosa*	I & S	Battershill (1986)
Order Scytothamnales			
Splachnidiaceae	*Splachnidium rugosum*	I	Battershill (1986)
Order Scytosiphonales			
Scytosiphonaceae	*Hydroclathrus clathratus*	S	Battershill (1986)
	Hydroclathrus clathratus	I & S	Battershill (1986)
Order Sphacelariales			
Stypocaulaceae	*Halopteris paniculata*	S	Nelson & Adams (1987)
	Stypocaulon paniculatum	I	Nelson & Adams (1987)
Order Sporochnales			
Sporochnaceae	*Carpomitra costata*	S	Nelson & Adams (1987)
PHYLUM RHODOPHYTA			
CLASS BANGIOPHYCEAE			
Bangiaceae	*Bangia atropurpurea*	I	Battershill (1986)
	Porphyra columbina	I	Cranwell & Moore (1938)
CLASS FLORIDEOPHYCEAE			
Order Balliales			
Balliaceae	*Ballia callitricha*	S	Battershill (1986)
	Ballia scoparia	S	Battershill (1986)
Order Bonnemaisoniales			
Bonnemaisoniaceae	*Delisea compressa*	S	Nelson & Adams (1987)
	Delisea elegans	S	Shears & Babcock (2004)
	Delisea pulchra	S	Battershill (1986)
	Ptilonia mooreana	S	Schiel (1984)
Order Ceramiales			
Ceramiaceae	*Antithamnion* sp.	S	Battershill (1986)
	Callithamnion sp.	S	Battershill (1986)
	Centroceras clavulatum	I	Nelson & Adams (1987)

FAMILY	SPECIES	ZONE	REFERENCE
	Ceramium sp.	I	Cranwell & Moore (1938)
	Cladhymenia oblongifolia	I	Battershill (1986)
	Euptilota formosissima	S	Nelson & Adams (1987)
	Griffithsia traversii[24]	I	Cranwell & Moore (1938)
	Microcladia novae-zelandiae	I	Battershill (1986)
	Spyridia sp.	S	Battershill (1986)
Rhodomelaceae	*Aphanocladia delicatula*	I	Battershill (1986)
	Laurencia distichophylla	I	Battershill (1986)
	Osmundaria colensoi	I	Nelson & Adams (1987)
	Polysiphonia sp.	I	Cranwell & Moore (1938)
Delesseriaceae	*Abroteia orbicularis*	S	Nelson & Adams (1987)
	Hymenena sp.	S	Battershill (1986)
	Phycodrys profunda	S	Nelson & Adams (1987)
	Platyclinia purpurea	S	Nelson & Adams (1987)
Rhodomelaceae	*Aphanocladia delicatula*	S	Battershill (1986)
	Dasyclonium bipartitum	S	Nelson & Adams (1987)
	Dasyclonium incisum	S	Nelson & Adams (1987)
	Laurencia distichophylla	S	Battershill (1986)
	Osmundaria colensoi[25]	S	Nelson & Adams (1987)
Order Corallinales			
Corallinaceae	*Amphiroa anceps*	S	Nelson & Adams (1987)
	Arthrocardia corymbosa	I & S	Nelson & Adams (1987)
	Cheilosporum sagittatum	S	Nelson & Adams (1987)
	Corallina officialis	I	Battershill (1986)
	Haliptilon rosea	I & S	Nelson & Adams (1987)
	Jania micrarthrodia	I	Battershill (1986)
	Jania novae-zelandiae	I	Nelson & Adams (1987)
	Melobesia sp.	I	Cranwell & Moore (1938)
Order Gelidiales			
Gelidiaceae	*Gelidium allanii*	I	Nelson *et al.* (1994)
	Gelidium caulacantheum	I	Battershill (1986)
	Gelidium pusillum	I	Battershill (1986)
	Pterocladia capillacea	I & S	Nelson & Adams (1987)
	Pterocladia lucida	I & S	Nelson & Adams (1987)
Order Gigartinales			
Acrosymphytaceae	*Acrosymphyton firmum*	S	Nelson & Adams (1987)
Areschougiaceae	*Placentophora colensoi*	I & S	Nelson & Adams (1987)
Catenellopsidaceae	*Catenellopsis oligarthra*[26]	I	Cranwell & Moore (1938)
	Catenellopsis sp.	I	Cranwell & Moore (1938)
Caulacanthaceae	*Caulacanthus ustulatus*	I	Nelson & Adams (1987)
	Taylorophycus filiformis	S	Shears & Babcock (2004)
Gigartinaceae	*Gigartina alveata*	I	Cranwell & Moore (1938)
	Gigartina chapmanii	I	Battershill (1986)
	Gigartina macrocarpa	S	Shears & Babcock (2004)
Halymeniaceae	*Pachymenia crassa*	S	Nelson & Adams (1987)
	Pachymenia lusoria	I	Battershill (1986)
Kallymeniaceae	*Callophyllis decumbens*	I	Cranwell & Moore (1938)
	Callophyllis dichotoma	S	Nelson & Adams (1987)
	Kallymenia berggrenii	S	Shears & Babcock (2004)
Peyssonneliaceae	*Peyssonnelia sp.*	S	Nelson & Adams (1987)
Phacelocarpaceae	*Phacelocarpus labillardieri*	S	Nelson & Adams (1987)

24 Previously known as *Pandorea traversii*
25 Previously known as *Vidalia colensoi*
26 Previously known as *Nemostoma oligarthra*

FAMILY	SPECIES	ZONE	REFERENCE
Plocamiaceae	*Plocamium costatum*	S	Nelson & Adams (1987)
	Plocamium sp.	I	Cranwell & Moore (1938)
Pseudoanemoniaceae	*Hummbrella hydra*	S	Nelson & Adams (1987)
Rhizophyllidaceae	*Nesophila hoggardii*	S	Nelson & Adams (1996)
Sarcodiaceae	*Trematocarpus acicularis*	I	Cranwell & Moore (1938)
Order Gracilariales			
Gracilariaceae	*Curdiea codioides*	S	Shears & Babcock (2004)
	Curdiea coriacea	I & S	Nelson & Adams (1987)
	Melanthalia abscissa	I & S	Nelson & Adams (1987)
Order Halymeniales			
Halymeniaceae	*Cryptonemia latissima*	S	Nelson & Adams (1987)
Order Hildenbrandiales			
Hildenbrandiaceae	*Apophlaea sinclairii*	I	Nelson & Adams (1987)
	Hildenbrandia sp.	I	Cranwell & Moore (1938)
Order Nemaliales			
Galaxauraceae	*Nothogenia pulvinata*	I	Battershill (1986)
	Scinaia sp.	S	Battershill (1986)
Liagoraceae	*Liagora harveyana*	I &S	Battershill (1986)
	Nemalion sp.	I	Cranwell & Moore (1938)
Order Rhodymeniales			
Champiaceae	*Champia laingii*	I	Battershill (1986)
	Champia novae-zelandiae	S	Shears & Babcock (2004)
Faucheaceae	*Gloioderma saccatum*	S	Nelson & Adams (1987)
	Gloiodermatopsis setchellii	S	Nelson & Adams (1987)
Lomentariaceae	*Lomentaria* sp.	I	Battershill (1986)
Rhodymeniaceae	*Rhodymenia australis*	I & S	Nelson & Adams (1987)
	Rhodymenia leptophylla	I & S	Nelson & Adams (1987)
	Rhodymenia sp. aff. *R. hancockii*	S	Nelson & Adams (1987)
	Rhodymenia sp.	S	Nelson & Adams (1987)

TABLE 2. PROTOZOAN SPECIES RECORDED AT THE POOR KNIGHTS ISLANDS MARINE RESERVE

FAMILY	SCIENTIFIC NAME	REFERENCE
CLASS GRANULORETICULOSEA		
Order Foraminiferida		
Acervulinidae	*Acervulina inhaerens*	B. Hayward (unpub. data)
	Gypsina vesicularis	B. Hayward (unpub. data)
Alabaminidae	*Oridorsalis umbonata*	B. Hayward (unpub. data)
Ammodiscidae	*Ammodiscus mestayeri*	B. Hayward (unpub. data)
Astrorhizidae	*Hyperammina novaezealandiae*	B. Hayward (unpub. data)
Bolivinitidae	*Bolivina cacozela*	B. Hayward (unpub. data)
	Bolivina robusta	B. Hayward (unpub. data)
	Bolivina spathulata	B. Hayward (unpub. data)
	Bolivina variabilis	B. Hayward (unpub. data)
Buliminidae	*Bulimina marginata* f. *acanthia*	B. Hayward (unpub. data)
	Bulimina marginata f. *marginata*	B. Hayward (unpub. data)
Cassidulinidae	*Cassidulina carinata*	B. Hayward (unpub. data)
	Ehrenbergina aspinosa	B. Hayward (unpub. data)
	Ehrenbergina mestayeri	B. Hayward (unpub. data)
	Evolvocassidulina orientalis[27]	Headley *et al.* (1967)
	Globocassidulina canalisuturata	B. Hayward (unpub. data)
	Globocassidulina minuta	B. Hayward (unpub. data)
Caucasinidae	*Sigmavirgulina tortuosa*	B. Hayward (unpub. data)
Cibicididae	*Cibicides corticatus*	B. Hayward (unpub. data)
	Cibicides dispars	B. Hayward (unpub. data)
	Cibicides pachyderma	B. Hayward (unpub. data)
	Dyocibicides sp.	B. Hayward (unpub. data)
	Rupertina pustulosa	Hayward *et al.* (1999)
Cornuspiridae	*Cornuspira foliacea*	B. Hayward (unpub. data)
	Cornuspira involvens[28]	Headley *et al.* (1967)
Cymbaloporidae	*Cymbaloporetta bradyi*	B. Hayward (unpub. data)
Discorbidae	*Bronnimannia disparilis*	Hayward *et al.* (1999)
	Cancris oblongus	B. Hayward (unpub. data)
	Discorbinella bertheloti	B. Hayward (unpub. data)
	Discorbinella complanata	B. Hayward (unpub. data)
	Discorbinella subcomplanata	B. Hayward (unpub. data)
	Discorbinella timida	B. Hayward (unpub. data)
	Gavelinopsis pragerí	B. Hayward (unpub. data)
	Laticarinina altocamerata	B. Hayward (unpub. data)
	Neoconorbina terquemi	B. Hayward (unpub. data)
	Rosalina irregularis	B. Hayward (unpub. data)
	Rosalina paupereques	B. Hayward (unpub. data)
	Trochulina dimidiatus	B. Hayward (unpub. data)
Ellipsolagenidae	*Palliolatella* sp.	B. Hayward (unpub. data)
Elphidiidae	*Elphidium charlottense*	B. Hayward (unpub. data)
	Notorotalia depressa	B. Hayward (unpub. data)
Epistominidae	*Hoglundia elegans*	B. Hayward (unpub. data)
Eponididae	*Albaminella weddellensis*	B. Hayward (unpub. data)
Glabratellidae	*Pileolina calcarata*	B. Hayward (unpub. data)
	Pileolina gracei	Hayward *et al.* (1999)
	Pileolina patelliformis	B. Hayward (unpub. data)
	Pileolina radiata	B. Hayward (unpub. data)
	Pileolina zealandica	B. Hayward (unpub. data)

27 Previously known as *Cassidulina orientalis*
28 Previously known as *Cyclogyra involvens*

FAMILY	SCIENTIFIC NAME	REFERENCE
	Planoglabratella opercularis	B. Hayward (unpub. data)
Glandulinidae	*Fissurina* sp.	B. Hayward (unpub. data)
	Oolina sp.	B. Hayward (unpub. data)
Heterolepidae	*Anomalinoides sphericus*[29]	B. Hayward (unpub. data)
Hormosinidae	*Reophax spiculifer*	B. Hayward (unpub. data)
	Reophax pseudodistans	B. Hayward (unpub. data)
Lituolidae	*Ammobaculites agglutinans*	B. Hayward (unpub. data)
	Cribrostomoides jeffreysii	B. Hayward (unpub. data)
	Haplophragmoides pusillus	B. Hayward (unpub. data)
Miliolidae	*Massilina granulocostata*	B. Hayward (unpub. data)
	Miliolinella labiosa	Headley *et al.* (1967)
	Miliolinella subrotundata	B. Hayward (unpub. data)
	Nummuloculina contraria	B. Hayward (unpub. data)
	Pyrgo anomala	B. Hayward (unpub. data)
	Pyrgo depressa	B. Hayward (unpub. data)
	Pyrgo ringens	B. Hayward (unpub. data)
	Quinqueloculina auberiana	B. Hayward (unpub. data)
	Quinqueloculina bicornis	Hayward *et al.* (1999)
	Quinqueloculina biscostoides	B. Hayward (unpub. data)
	Quinqueloculina boueana	B. Hayward (unpub. data)
	Quinqueloculina seminula	B. Hayward (unpub. data)
	Quinqueloculina suborbicularis	B. Hayward (unpub. data)
	Quinqueloculina subpolygona	B. Hayward (unpub. data)
	Scutuloris hornibrooki	B. Hayward (unpub. data)
	Sigmoilopsis elliptica	B. Hayward (unpub. data)
	Sigmoilopsis wanganuiensis	B. Hayward (unpub. data)
	Triloculina insignis	B. Hayward (unpub. data)
	Triloculina tricarinata	B. Hayward (unpub. data)
Mississippinidae	*Stomatorbina concentrica*	B. Hayward (unpub. data)
Nodosariidae	*Amphicoryna separans*	B. Hayward (unpub. data)
	Dentalina cuvieri	B. Hayward (unpub. data)
	Grigelis orectus	B. Hayward (unpub. data)
	Grigelis sp.	B. Hayward (unpub. data)
	Laevidentalina badenensis	B. Hayward (unpub. data)
	Laevidentalina haueri	B. Hayward (unpub. data)
	Laevidentalina inornata	B. Hayward (unpub. data)
	Lenticulina suborbicularis	B. Hayward (unpub. data)
	Lenticulina tasmanica	B. Hayward (unpub. data)
	Planularia australis	B. Hayward (unpub. data)
	Saracenaria altifrons	B. Hayward (unpub. data)
	Saracenaria latifrons	B. Hayward (unpub. data)
	Vaginulinopsis gnamptina	B. Hayward (unpub. data)
	Vaginulinopsis tasmanica	B. Hayward (unpub. data)
Nonionidae	*Astrononion novozealandicum*	B. Hayward (unpub. data)
	Zeaflorilus parri	B. Hayward (unpub. data)
Nubeculariidae	*Spiroloculina communis*	B. Hayward (unpub. data)
Placentulinidae	*Patellinella inconspicua*	B. Hayward (unpub. data)
Planulinoididae	*Planulinoides biconcavus*	B. Hayward (unpub. data)
Polymorphinidae	*Guttulina bartschi*	B. Hayward (unpub. data)
	Pseudopolymorphina cf. *australis*	B. Hayward (unpub. data)
Siphogenerinoididae	*Saidovina karreriana*	B. Hayward (unpub. data)
Spirillinidae	*Patellina corrugata*	B. Hayward (unpub. data)
	Spirillina vivipara	Headley *et al.* (1967)

29 Previously known as *A. spherica*

FAMILY	SCIENTIFIC NAME	REFERENCE
Spiroloculinidae	*Inaequalina disparilis*	B. Hayward (unpub. data)
Spiroplectamminidae	*Spiroplectinella proxispira*	B. Hayward (unpub. data)
	Spirotextularia fistulosa	B. Hayward (unpub. data)
Textulariidae	*Siphotextularia blacki*	B. Hayward (unpub. data)
	Siphotextularia mestayerae	B. Hayward (unpub. data)
	Textularia candeiana	B. Hayward (unpub. data)
	Textularia pseudogramen	B. Hayward (unpub. data)
	Textularia stricta	B. Hayward (unpub. data)
Uvigerinidae	*Neouvigerina interrupta*	B. Hayward (unpub. data)
	Neouvigerina proboscidea	B. Hayward (unpub. data)
	Trifarina angulosa	B. Hayward (unpub. data)
	Uvigerina peregrina	B. Hayward (unpub. data)
Valvulinidae	*Gaudryina convexa*	B. Hayward (unpub. data)
	Gaudryina quadrangularis	B. Hayward (unpub. data)

TABLE 3. SPONGE SPECIES RECORDED AT THE POOR KNIGHTS ISLANDS MARINE RESERVE[30]

FAMILY	SCIENTIFIC NAME	REFERENCE
CLASS CALCAREA		
Order Clathrinida		
Clathrinidae	*Clathrina coriacea*[31]	Battershill (1986)
Order Leucettida		
Leucaltidae	*Lettcettusa lancifera*	Edney (2001)
Leucettidae	*Leucetta* sp.	Kelly (1983)
Order Leucosolenida		
Leucosoleniidae	*Ascute asconoides*[32]	Battershill (1986)
Sycettidae	*Scypha ciliata*	Battershill (1986)
	Scypha sp.	Battershill (1986)
	Sycon sp.	Kelly (1983)
CLASS DEMOSPONGIAE		
Order Astrophorida		
Ancorinidae	*Ancorina alata*	Edney (2001)
	Ancorina sp.	Battershill (1986)
	Jaspis sp.	Battershill (1986)
	Penares tylotaster	Battershill (1986)
	Stelletta arenaria	Battershill (1986)
	Stelletta conulosa	Kelly (1983)
	Stelletta crater	Edney (2001)
	Stelletta maori	Battershill (1986)
	Stelletta sandalinum	Kelly (1983)
	Tethyopsis mortenseni	Battershill (1986)
Geodiidae	*Geodia regina*	Battershill (1986)
Order Dendroceratida		
Darwinellidae	*Aplysilla rosea*	Kelly (1983)
	Aplysilla sulfurea	Battershill (1986)

30 Note, a number of species listed in Battershill (1986) are now invalid and have been omitted from this list. Numerous species were only identified to genus level by Battershill and were given an operational taxonomic name, e.g. sp. A. Latter papers identifying new species at the Poor Knights Islands are presumed to replace those species that were given operational taxonomic names by Battershill.

31 Previously known as *Leucosolenia coriacea*

32 Previously known as *Leucosolenia asconoides*

FAMILY	SCIENTIFIC NAME	REFERENCE
	Aplysilla sp.	Battershill (1986)
	Chelonaplysilla sp. 1	Battershill (1986)
	Chelonaplysilla sp. 2	Battershill (1986)
	Chelonaplysilla violacea	Battershill (1986)
	Darwinella gardineri	Bergquist (1996)
	Darwinella oxeata	Bergquist (1996)
	Dendrilla rosea	Edney (2001)
Dictyodendrillidae	*Dictyodendrilla dendyi*	Bergquist (1996)
Order Dictyoceratida		
Dysideidae	*Dysidea fragilis*	Battershill (1986)
	Dysidea sp.	Kelly (1983)
Irciniidae	*Ircinia fistulosa*	Cook & Bergquist (1999)
	Ircinia novaezelandiae	Battershill (1986)
	Ircinia sp. 1	Battershill (1986)
	Ircinia sp. 2[33]	Battershill (1986)
	Psammocinia bawere	Cook & Bergquist (1996)
	Sarcotragus sp.	Battershill (1986)
Spongiidae	*Spongia (Heterqfibria) gorgonocephalus*	Cook & Bergquist (2001)
	Spongia (Heterofibria) mokohinau	Cook & Bergquist (2001)
	Spongia reticulata	Kelly (1983)
Thorectidae	*Fasciospongia* sp.	Battershill (1986)
	Semitaspongia bactriana	Cook & Bergquist (2000)
	Semitaspongia nigrachorda	Cook & Bergquist (2000)
	Thorectandra papillosa	Cook & Bergquist (1996)
Order Hadromerida		
Clionaidae	*Cliona celata*	Kelly (1983)
Polymastiidae	*Polymastia aurantium*[34]	Kelly (1983)
	Polymastia fusca	Kelly (1983)
	Polymastia hirsuta	Battershill (1986)
	Polymastia sp.	Battershill (1986)
Suberitidae	*Aaptos tentum*[35]	Kelly (1983)
	Suberites australiensis	Battershill (1986)
	Suberites axinelloides	Battershill (1986)
	Suberites perfectus	Battershill (1986)
	Suberites sp.	Battershill (1986)
Tethyidae	*Tethya bergquistae*[36]	Battershill (1986)
	Tethya burtoni [37]	Kelly (1983)
	Tethya fastigata	Ayling & Schiel (2003)
	Tethya sp. 1	Battershill (1986)
Timeidae	*Timea aurantiaca*	Battershill (1986)
Trachycladidae	*Trachycladus stylifer*	Kelly (1983)
Order Halichondrida		
Axinellidae	*Axinella australiensis*	Kelly (1983)
	Axinella sp.	Battershill (1986)
	Dragmacidon australe[38]	Battershill (1986)
	Pararhaphoxya pulchra	Battershill (1986)
	Pararhaphoxya sp.	Battershill (1986)

33 Listed as *I. fasciculata* in Batthershill (1986) but this species is not longer accepted
34 Previously known as *P. granulosa*
35 Previously known as *Aaptos aaptos*
36 Previously known as *T. ingalli*
37 Previously known as *T. aurantium*
38 Previously known as *Pseudaxinella australis*

FAMILY	SCIENTIFIC NAME	REFERENCE
	Phakellia dendyi	Battershill (1986)
Halichondriidae	*Ciocalypta penicillus*	Battershill (1986)
	Halichondria (Halichondria) panicea	Battershill (1986)
	Halichondria sp.	Battershill (1986)
	Hymeniacidon haurakii	Battershill (1986)
	Hymeniacidon perlevis[39]	Battershill (1986)
	Spongosorites sp.	Battershill (1986)
Heteroxyidae	*Acanthoclada prostrata*	Battershill (1986)
	Desmoxya sp.	Battershill (1986)
Order Haplosclerida		
Callyspongiidae	*Callyspongia (Callyspongia) fistulosa*	Battershill (1986)
	Callyspongia (Cladochalina) diffusa	Battershill (1986)
	Callyspongia latituba	Edney (2001)
	Callyspongia ramosa	Edney (2001)
	Dactylia australis[40]	Battershill (1986)
	Siphonochalina sp.	Ayling & Schiel (2003)
Chalinidae	*Haliclona (Gellius)*[41] sp.	Battershill (1986)
	Haliclona (Reniera)[42] sp.	Battershill (1986)
	Haliclona (Rhizoniera) rosea[43]	Battershill (1986)
	Haliclona parietalioides[44]	Battershill (1986)
	Haliclona sp.	Battershill (1986)
	Haliclona stelliderma	Battershill (1986)
	Haliclona venustina[45]	Battershill (1986)
Petrosiidae	*Petrosia (Petrosia) hebes*	Kelly (1983)
	Xestospongia sp.	Battershill (1986)
Phloeodictyidae	*Calyx imperialis*[46]	Ayling & Schiel (2003)
Order Homosclerophorida		
Plakinidae	*Plakortis* sp.	Battershill (1986)
Order Lithistid Demospongiae		
Scleritodermidae	*Aciculites pulchra*	Edney (2001)
Order Poecilosclerida		
Acarnidae	*Iophon laevistylus*	Kelly (1983)
	Iophon minor	Ayling & Schiel (2003)
	Iophon proximum	Battershill (1986)
Chondropsidae	*Chondropsis kirkii*	Battershill (1986)
	Chondropsis sp.	Battershill (1986)
	Psammoclema[47] sp.	Battershill (1986)
Crellidae	*Crella fristedi*	Battershill (1986)
	Crella incrustans	Battershill (1986)
Dendoricellidae	*Fibulia novaezealandiae*[48]	Battershill (1986)
Desmacellidae	*Biemna rufescens*	Bergquist & Fromont (1988)
	Desmacella dendyi	Battershill (1986)

39 Previously known as *H. perleve*
40 Previously known as *Chalinopsilla australis*
40 Previously known as *Chalinopsilla australis*
41 Previously known as *Sigmadocia*
42 Previously known as *Reniera*
43 Previously known as *Haliclona heterofibrosa*
44 Previously known as *Adocia parietalioides*
45 Previously known as *Adocia venustina*
46 Previously known as *Haliclona imperialis* or *Vagocia imperialis*
47 Previously known as *Psammascus*
48 Previously known as *Plumocolumella novaezealandiae*

FAMILY	SCIENTIFIC NAME	REFERENCE
Desmacididae	*Desmacidon* sp.	Battershill (1986)
Guitarridae	*Tetrapocillon novaezealandiae*	Edney (2001)
Hymedesmiidae	*Hamigera* n. sp. 2	Battershill (1986)
	Hymedesmia (Hymedesmia) lundbecki	Battershill (1986)
	Hymedesmia (Stylopus) n. sp. 1	Battershill (1986)
	Hymedesmia (Stylopus) n. sp. 2	Battershill (1986)
	Phorbas[49] *fulvu*s	Bergquist & Fromont (1988)
	Phorbas n. sp. 1	Battershill (1986)
	Phorbas sp. 2	Battershill (1986)
Latrunculiidae	*Latrunculia (Latrunculia) brevis*	Battershill (1986)
	Latrunculia sp. 1	Battershill (1986)
	Latrunculia sp. 2	Battershill (1986)
Microcionidae	*Antho (Acarnia) novizelanicum*[50]	Battershill (1986)
	Clathria (Axosuberites)[51] *macrotox*a	Bergquist & Fromont (1988)
	Clathria (Axosuberites) sp.	Battershill (1986)
	Clathria (Isociella) incrustans[52]	Battershill (1986)
	Clathria (Microciona)[53] *coccine*a	Battershill (1986)
	Clathria (Microciona) leighensis[54]	Battershill (1986)
	Clathria (Microciona) sp. 1	Battershill (1986)
	Clathria (Microciona) n. sp. 2	Battershill (1986)
	Clathria (Thalysias)[55] *coriocrassu*s	Bergquist & Fromont (1988)
	Clathria (Thalysias) sp. 1	Battershill (1986)
	Ophlitaspongia n. sp.	Battershill (1986)
Mycaliidae	*Mycale (Aegogropila)*[56] *flagelliformi*s	Bergquist & Fromont (1988)
	Mycale (Carmia) macilenta	Battershill (1986)
	Mycale sp.	Battershill (1986)
Myxillidae	*Myxilla (Ectyomyxilla)*[57] *ramos*a	Bergquist & Fromont (1988)
Raspailiidae	*Eurypon hispidum*[58]	Battershill (1986)
	Raspailia (Clathriodendron) arbuscula[59]	Battershill (1986)
	Raspailia topsenti	Edney (2001)
Tedaniidae	*Tedania (Tedania) connectens*	Battershill (1986)
	Tedania (Tedania) diversiraphidiophora	Battershill (1986)
	Tedania (Tedania) battershilli	Bergquist & Fromont (1988)
	Tedania (Tedania) purpurescens	Bergquist & Fromont (1988)
	Tedania n. sp. 1	Battershill (1986)
	Tedania n. sp. 2	Battershill (1986)
Order Spirophorida		
Tetillidae	*Cinachyra* sp.	Kelly (1983)

49 Previously known as *Pronax*
50 Previously known as *Plocamia novizelanicum*
51 Previously known as *Axociella*
52 Previously known as *Isociella incrustans*
53 Previously known as *Microciona*
54 Previously known as *Microciona rubens*
55 Previously known as *Rhaphidophlus*
56 Previously known as *Aegogropila*
57 Previously known as *Ectyomyxilla*
58 Previously known as *Eurypon hispida*
59 Previously known as *Raspailia agminata*

FAMILY	SCIENTIFIC NAME	REFERENCE
	Tetilla sp.	Battershill (1986)

TABLE 4. CNIDARIANS RECORDED FROM THE POOR KNIGHTS ISLANDS MARINE RESERVE

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
CLASS ANTHOZOA			
Order Actiniaria			
Actiniidae	*Actinia tenebrosa*	red beadlet	Edney (2001)
	Anthopleura aureoradiata		Battershill (1986)
	Bunodactis sp.		Edney (2001)
	Phlyctenactis tuberculosa	wandering anemone	Battershill)1986)
Sagartiidae	*Actinothoe albocincta*		Edney (2001)
Order Alcyonacea			
Alcyoniidae	*Alcyonium aurantiacum*	deadmans's fingers	Edney (2001)
Clavulariidae	*Clavularia novaezelandiae*		Battershill (1986)
Melithaeidae	*Mopsella* sp.		Battershill (1986)
Plexauridae	*Euplexaura* sp.	yellow gorgonian	Gordon & Smith (2007a)
	Psammogorgia sp.		Battershill (1986)
Primnoidae	*Primnoeides* sp.[60]	pink gorgonian	Edney (2001)
Order Antipatharia			
Schizopathidae	*Lillipathes lillei*[61]	black coral	Battershill (1986)
Order Ceriantharia			
Cerianthidae	*Cerianthus* sp.	burrowing anemone	Battershill (1986)
Order Corallimorpharia			
Corallimorphidae	*Corynactis australis*	jewel anemone	Ayling & Schiel (2003)
	Corynactis haddoni	jewel anemone	Battershill (1986)
Order Scleractinia			
Oculinidae	*Oculina virgosa*	ivory coral	Cairns (1995)
Caryophylliidae	*Caryophyllia profunda*		Battershill (1986)
	Hoplangia durotrix		Cairns (1995)
	Stephanocyathus (Acinocyathus) spiniger		Cairns (1995)
	Tethocyathus cylindraceus[62]		Cairns (1995)
Guyniidae	*Pedicellocyathus keyesi*		Cairns (1995)
Rhizangiidae	*Culicia rubeola*		Edney (2001)
Turbinoliidae	*Kionotrochus suteri*		Cairns (1995)
	Sphenotrochus ralphae		Battershill (1986)
Flabellidae	*Monomyces rubrum*[63]	red cup coral	Cairns (1995)
Order Zoanthidea			
Parazoanthidae	*Parazoanthus* sp.		Edney (2001)
unknown	*Zoanthid* sp. 1		Battershill (1986)
	Zoanthid sp. 2		Battershill (1986)
	Zoanthid sp. 3		Battershill (1986)
CLASS HYDROZOA			
Order Anthoathecatae			
Corynidae	*Syncoryne tenella*		Battershill (1986)
Eudendriidae	*Eudendrium novaezelandiae*		Battershill (1986)
Solanderiidae	*Solanderia ericopsis*		Schuchert (1996)
	Solanderia ramosa		Kelly (1983)

60 Frequently mispelled as *Primnoides* sp. (Cairns & Bayer, 2009)
61 Previously known as *Antipathes lillei* or *Aphanipathes lillei*
62 Has been misidentified as *Paracyathus conceptus* in NZ
63 Previously known as *Flabellum rubrum*

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
Tubulariidae	*Ectopleura* sp.		Warne (2006)
	Tubularia sp.		Edney (2001)
Order Leptothecatae			
Aglaopheniidae	*Aglaophenia acanthocarpa*		Battershill (1986)
	Aglaophenia ctenata		Battershill (1986)
	Aglaophenia laxa		Edney (2001)
	Aglaophenia plumosa		Battershill (1986)
Campanulariidae	*Clytia hemisphaerica*[64]		Battershill (1986)
	Gonothyraea loveni		Battershill (1986)
	Obelia dichotoma[65]		Battershill (1986)
	Obelia geniculata		Battershill (1986)
	Obelia longissima		Battershill (1986)
Halopteridídae	*Antennella africana*		Battershill (1986)
	Halopteris minuta[66]		Battershill (1986)
Lafoeidae	*Cryptolaria* sp.		Battershill (1986)
Phialellidae	*Opercularella* sp.		Battershill (1986)
Plumulariidae	*Plumularia diploptera*		Battershill (1986)
	Plumularia setacea		Battershill (1986)
	Plumularia setaceoides		Battershill (1986)
	Plumularia spinulosa		Battershill (1986)
	Thecocarpus spiralis		Battershill (1986)
	Thecocarpus subdichotomus		Battershill (1986)
Sertulariidae	*Amphisbetia fasciculate*		Battershill (1986)
	Salacia buski		Battershill (1986)
	Sertularella crassiuscula		Battershill (1986)
	Sertularella gayi		Battershill (1986)
	Sertularella simplex		Battershill (1986)
	Sertularia marginata		Battershill (1986)
	Sertularia unguiculata		Battershill (1986)
	Stereotheca elongate		Battershill (1986)
	Symplectoscyphus fuscus		Battershill (1986)
	Symplectoscyphus johnstoni		Battershill (1986)
	Symplectoscyphus subarticulatus		Kelly (1983)
Order Narcomedusae			
Solmarisidae	*Pegantha*[67] sp.		Kingsford & MacDiarmid (1988)
CLASS SCYPHOZOA			
Order Semaeostomeae			
Pelagiidae	*Pelagia noctiluca*	purple striped jellyfish	Abbott & Rousseau (2002)
CLASS STAUROZOA			
Order Stauromedusae			
Lipkeidae	*Lipkea* sp.		Cairns *et al.* (In press)

64 Previously known as *C. johnstoni*
65 Previously known as *O. australis*
66 Previously known as *H. constricta*
67 Previously known as *Aequoria*

TABLE 5. BRYOZOANS RECORDED FROM THE POOR KNIGHTS ISLANDS MARINE RESERVE

FAMILY	SCIENTIFIC NAME	REFERENCE
CLASS GYMNOLAEMATA		
Order Cheilostomata		
Aeteidae	*Aetea* sp.	Battershill (1986)
Bugulidae	*Bugula dentata*	Edney (2001)
	Bugula neritina	Battershill (1986)
	Cornucopina sp.	Shears (2007)
Calloporidae	*Foveolaria (Odontionella) Cyclops*	Battershill (1986)
Candidae	*Menipea vectifera*	Battershill (1986)
Catenicellidae	*Catenicella alata*	Cranwell & Moore (1938)
	Catenicella cribraria	Beutler *et al.* (1993)
	Cribricellina cribraria	Battershill (1986)
	Orthoscuticella aff. *margaritacea*	Willian (1986)
	Pterocella vesiculosa	Ayling & Schiel (2003)
Cellariidae	*Cellaria* sp.	Battershill (1986)
	Cellaria tenuirostris	Gordon & Smith (2007b)
Celleporariidae	*Celleporaria agglutinans*	Battershill (1986)
	Celleporaria sp.	Schiel (1984)
Celleporidae	*Galeopsis grandiporus*	Battershill (1986)
	Galeopsis polyporus	Battershill (1986)
Cribrilinidae	*Reginella vas*	D. Gordon, NIWA, pers. comm.
Flustridae	*Gregarinidra serrata*	Battershill (1986)
Hippoporinidae	*Hippoporina cincta*	Battershill (1986)
Margarettidae	*Margaretta barbata*[68]	Edney (2001)
Membraniporidae	*Membranipora* sp.	Battershill (1986)
Mucronellidae	*Smittina* sp.	Battershill (1986)
Phidoloporidae	*Hippellozoon novaezelandiae*	Ayling & Schiel (2003)
Reteporidae	*Phidolopora avicularis*	Kelly (1983)
Schizoporellidae	*Schizomavella immersa*	Schiel (1984)
	Schizoporella sp.	Battershill (1986)
Scrupocellariidae	*Caberea rostrata*	Battershill (1986)
	Caberea zelandica	Battershill (1986)
	Emma crystallina?	Cranwell & Moore (1938)
	Emma rotunda	Schiel (1984)
	Emma triangula	Ayling & Schiel (2003)
Steginoporellidae	*Steginoporella magnifica*[69]	Battershill (1986)
	Steginoporella neozelanica	Edney (2001)
Order Ctenostomata		
Vesiculariidae	*Amathia wilsoni*	Battershill (1986)
	Bowerbankia sp.	Battershill (1986)
Order Cyclostomata		
Cinctiporidae	*Attinopora zealandica*	D. Gordon, NIWA, pers. comm.
Entalophoridae	*Mecynoecia purpurascens*	Battershill (1986)
Lichenoporidae	*Disporella* sp.	Battershill (1986)
	Lichenopora novaezelandiae	Battershill (1986)
Stigmatoechidae	*Hornera* sp.	Edney (2001)
Tubuliporidae	*Tubulipora andersonii*	Schiel (1984)

68 Incorrectly called *Margaretta hirsuta* in Battershill (1986)

69 Previously known as *S. neozelandica magnifica*

TABLE 6. BRACHIOPODS RECORDED FROM THE POOR KNIGHTS ISLANDS MARINE RESERVE

FAMILY	SCIENTIFIC NAME	REFERENCE
CLASS INARTICULATA		
Order Acrotretida		
Craniidae	*Neocrania buttoni*[70]	Battershill (1986)
	Crania sp.	Battershill (1986)
CLASS RHYNCHONELLATA		
Order Terebratulida		
Terebratellidae	*Calloria variegata*	Cooper & Doherty (1993)
	Calloria inconspicua[71]	Battershill (1986)

TABLE 7. ANNELIDS RECORDED FROM THE POOR KNIGHTS ISLANDS MARINE RESERVE

FAMILY	SCIENTIFIC NAME	REFERENCE
CLASS POLYCHAETA		
Order Aciculata		
Nereidadae	*Neris* sp.	Cranwell & Moore (1938)
Order Canalipalpata		
Chaetopteridae	*Chaetopterus* sp.	Brook *et al.* (2001)
Sabellidae	*Branchiomma* sp.	Doak (1971)
Serpulidae	*Amplicaria spiculosa*	Vine (1977)
	Filograna sp.[72]	Battershill (1986)
	Janua (Janua) pagenstecheri	Vine (1977)
	Metalaeospira clansmani	Vine (1977)
	Paralaeospira levinseni	Vine (1977)
	Pileolaria (Pileolaria) tegwyni	Vine (1977)
	Pomatoceros caeruleus	Morton & Miller (1968)
	Protolaeospira augeneri	Vine (1977)
	Protolaeospira gracei	Vine (1977)
	Protolaeospira lebruni	Vine (1977)
	Romanchella perrieri	Vine (1977)
	Romanchella solea	Vine (1977)
	Simplaria ovata[73]	Vine (1977)
	Spirobranchus cariniferus	Doak (1971)
	Spirobranchus latiscapus	Battershill (1986)
	Spirorbis bidentatus	Vine (1977)
	Vinearia koehleri [74]	Vine (1977)

70 Previously known as *Crania buttoni*

71 Previously known as *Terebratella inconspicua*. May be an incorrect identification of *C. variegata* (F. Brook, pers. comm.).

72 Listed as *Filograna dysteri* in Battershill (1986), which is now a synonym for *Salmacina dysteri*. However, *S. dysteri* is not considered to be present New Zealand (Read, 2004).

73 Previously known as *Pileolaria (Simplicaria) ovata*

74 Previously known as *Pileolaria (Dulpicaria) koehleri* or *Spirorbis koehleri*

TABLE 8. MOLLUSCS RECORDED FROM THE POOR KNIGHTS ISLANDS MARINE RESERVE[75]

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
CLASS POLYPLACOPHORA			
SUBCLASS NEOLORICATA			
Order Acanthochitonina			
Acanthochitonidae	*Acanthochitona zelandica*		Battershill (1986)
	Cryptoconchus porosus	butterfly chiton	Battershill (1986)
	Notoplax violacea	violet chiton	Battershill (1986)
	Pseudotonicia cuneata		Battershill (1986)
Order Ischnochitonina			
Chitonidae	*Onithochiton neglectus neglectus*		Battershill (1986)
	Ryssoplax aerea		Kelly (1983)
	Sypharochiton aorangi[76]		Creese & O'Neill (1987)
	Sypharochiton pelliserpentis	snakeskin chiton	Battershill (1986)
Ischnochitonidae	*Eudoxochiton nobilis*	noble chiton	Shears (2007)
	Ishnochiton maorianus	variable chiton	Battershill (1986)
Mopaliidae	*Plaxiphora caelata*[77]		Cranwell & Moore (1938)
	Plaxiphora obtecta[78]		Cranwell & Moore (1938)
CLASS GASTROPODA			
SUBCLASS PROSOBRANCHIA			
Order Docoglossa			
Lottiidae	*Notoacmea parviconoidea*		Kelly (1983)
	Notoacmea pileopsis	black-edged limpet	Creese & Ballantine (1986)
	Notoacmea scopulina		Creese & Ballantine (1986)
	Patelloida corticata	encrusted limpet	Creese & Ballantine (1986)
	Radiacmaea inconspicua		Creese & Ballantine (1986)
Nacellidae	*Cellana denticulata*	dentate limpet	Battershill (1986)
	Cellana ornata	ornate limpet	Battershill (1986)
	Cellana radians	radiate limpet	Battershill (1986)
	Cellana stellifera		Shears (2007)
Order Neogastropoda			
Buccinidae	*Cumia adjuncta*[79]		Powell (1976)
Buccinulidae	*Austrofusus glans*	knobbed whelk	Battershill (1986)
	Buccinulum fuscozonatum		Battershill (1986)
	Buccinulum linea[80]	lined whelk	Shears (2007)
	Buccinulum pallidum powelli		Battershill (1986)
	Buccinulum n. sp. aff *robustum*		Kelly (1983)
	Cominella quoyana		Brook *et al.* (2001)
	Penion benthicolus[81]		Kelly (1983)
	Penion sulcatus[82]	siphon whelk	Battershill (1986)
Cancellariidae	*Oamaruia deleta*		Kelly (1983)
Conidae	*Antiguraleus fenestratus*		Kelly (1983)
	Bathytoma (Micantapex) murdochi murdochi[83]		Kelly (1983)
	Conus lischkeanus		Powell (1976)
	Heterocithara mediocris[84]		Kelly (1983)
	Nepotilla nitidula		Kelly (1983)

75 Spencer *et al.* (2004) is used for the current taxanomic nomenclature
76 Previously known as *Chiton aorangi*
77 Previously known as *Maorichiton caelatus*
78 Previously known as *Guildingia obtecta*
79 Previously known as *Ratifusus adjunctus*
80 Referred to as *B. lineum* in Shears (2007)
81 Previously known as *P. benthicola delli*
82 Previously known as *P. dilatatus*
83 Previously known as *B. finlayi*
84 Previously known as *H. mediocris odhner*

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
	Scrinium neozelanicum		Kelly (1983)
	Tomopleura albula		Brook *et al*. (2001)
Cystiscidae	*Cystiscus vidae*[85]		Kelly (1983)
Drilliidae	*Splendrillia aoteana*		Brook *et al*. (2001)
Fasciolariidae	*Fusinus genticus*		Powell (1976)
Marginellidae	*Dentimargo*[86] *fusul*a		Kelly (1983)
	Dentimargo[86] *wormaldi*		Kelly (1983)
	Mesoginella ?aupouria[87]		Brook (2001)
	Mesoginella ?larochei[87]		Brook (2001)
	Mesoginella tryphenensis[87]		Brook (2001)
	Serrata fasciata[88]		Battershill (1986)
	Serrata maoriana[89]		Battershill (1986)
Mitridae	*Mitra carbonaria*		Battershill (1986)
Muricidae	*Agnewia tritoniformis*		Battershill (1986)
	Babelomurex (Echinolatiaxis) wormaldi		Kelly (1983)
	Dicathais[90] *orbit*a	whilte rock shell	Shears (2007)
	Haustrum haustorium	dark rock shell	Battershill (1986)
	Latiaxis wormaldi		Powell (1976)
	Lepsiella scobina	oyster borer	Cranwell & Moore (1938)
	Morula chaidea		Brook (2001)
	Morula palmeri		Brook (2001)
	Muricopsis (Murexsul) mariae		Battershill (1986)
	Muricopsis (Murexsul) octogonus	octagonal murex	Battershill (1986)
	Muricopsis (Rolandiella) scotti		Marshall & Burch (2000)
	Neothais smithi[91]		Brook (2001)
	Poirieria zelandica		Brook *et al.* (2001)
Nassariidae	*Nassarius (Alectrion) aoteanus*		Kelly (1983)
Olividae	*Amalda novaezelandiae*		Battershill (1986)
Terebridae	*Terebra circumcincta*		Brook (2001)
Turbinellidae	*Coluzea wormaldi*[92]		Kelly (1983)
Turridae	*Leucosyrinx pikei*		Kelly (1983)
Typhidae	*Monstrotyphis pauperis*[93]		Battershill (1986)
	Prototyphis[94] *eo*s	dawn murex	Battershill (1986)
	Prototyphis paupereques		Brook (2001)
Volutidae	*Alcithoe larochei*		Kelly (1983)
	Provocator mirabilis[95]	golden volute	Kelly (1983)
Volutomitridae	*Microvoluta marginata*		Kelly (1983)
	Perculator hedleyi		Brook *et al.* (2001)
	Volutomitra obscura[96]		Cranwell & Moore (1938)
Order Neotaenioglossa			
Aclididae	*Aclis terebra*		
	Awanuia dilatata		Kelly (1983)

85 Previously known as *Marginella* (*Microvulina*) *vidae*
86 Previously known as *Marginella* (*Volvarinella*)
87 Previously known as *Sinuginella*
88 Previously known as *Marginella mustelina*
89 Previously known as *Marginella maoriana*
90 Previously known as *Thais*
91 Previously known as *Morula smithi*
92 Previously known as *Columbarium wormaldi*
93 Previously known as *Typhina pauperis*
94 Previously known as *Pterotyphis*
95 Previously known as *Iredalina mirabilis*
96 Previously known as *Proximitra obscura* or *Waimatea obscura*

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
	Awanuia porcellana		Kelly (1983)
	Larochella alta		Kelly (1983)
Anabathridae	*Anabathron (Scrobs)*[97] *excelsus*		Kelly (1983)
	Anabathron (Scrobs)[97] *hedleyi*		Kelly (1983)
	Microdryas striatus		Kelly (1983)
	Pisinna[98] *olivacea impressa*		Kelly (1983)
	Pisinna[98] *rekohuana lactorub*ra		Kelly (1983)
	Pisinna[98] *zosterophila*		Kelly (1983)
Barleeidae	*Fictonoba rufolactea*		Kelly (1983)
Batillariidae	*Zeacumantus subcarinatus*	darker horn shell	Creese & Ballantine (1986)
Bursidae	*Bursa verrucosa*[99]		Powell (1976)
	Tutufa (Tutufa) bubo		Powell (1976)
	Tutufa (Tutufa) bufo[100]		Powell (1979)
Caecidae	*Caecum digitulum*		Kelly (1983)
Calyptraeidae	*Sigapatella tenuis*[101]		Brook *et al*. (2001)
Capulidae	*Antisabia* cf. *foliacea*		Brook (2001)
	Krebsia (Tenpetasus) liberatus		Kelly (1983)
Cassidae	*Casmaria perryi*		Battershill (1986)
	Semicassis labiata[102]		Battershill (1986)
	Semicassis royana[103]	royal bell's bonnet	Powell (1976)
Cerithiidae	*Zebittiurn editum*[104]		Kelly (1983)
Cerithiopsidae	*Alipta crenistria*		Kelly (1983)
	Ataxocerithium huttoni		Kelly (1983)
	Cerithiella stiria[105]		Kelly (1983)
	Retilaskeya (Marshallaskeya) elegantula[106]		Kelly (1983)
	Seila (Lyroseila) maoria		Kelly (1983)
Cingulopsidae	*Eatonina atomaria*		Battershill (1986)
	Eatonina maculosa		Battershill (1986)
	Eatonina micans		Battershill (1986)
	Eatonina (Rufodardanula) spadix		Battershill (1986)
	Tubbreva exigua[107]		Kelly (1983)
Columbellidae	*Liratilia sinuta*		Battershill (1986)
Cypraeidae	*Cypraea (Erosaria) cernica*[108]	Poor Knights cowrie	Powell (1976)
	Cypraea (Lyncina) vitellus[109]	Pacific deer cowrie	Ayling & Schiel (2003)
Eatoniellidae	*Eatoniella atervisceralis*		Battershill (1986)
	Eatoniella atropurpurea[110]		Battershill (1986)
	Eatoniella limbata		Battershill (1986)
	Eatoniella mortoni		Battershill (1986)
	Eatoniella olivacea		Battershill (1986)
	Eatoniella puniceomacer		Kelly (1983)
	Eatoniella roseocincta		Kelly (1983)
	Eatoniella roseola		Kelly (1983)

97 Previously known as *Scrobs*
98 Previously known as *Estea*
99 Previously known as *Annaperenna verrucosa*
100 Previously known as *Bursa bubo lissotoma*
101 Previously known as *Zegalerus tenuis*
102 Previously known as *Xenophalium labiatum labiatum*
103 Previously known as *Xenophalium royanum*
104 Previously known as *Bittiurn (Zebittiurn) editum*
105 Previously known as *Mendax stiria*
106 Previously known as *Socienna elegantula*
107 Previously known as *Rufodardanula (Tubbreva) exigua*
108 Previously known as *Erosaria cernica tomlini*
109 Previously known as *Lyncina vitellus*
110 Previously known as *E. minutocrassa*

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
Epitoniidae	*Epitonium lamellosa*[111]		Battershill (1986)
	Epitonium minorum[112]		Brook *et al*. (2001)
	Eptonium sp.		Brook *et al*. (2001)
Eulimidae	*Eulima perspicua*		Kelly (1983)
	Pelseneeria bountyensis[113]		Kelly (1983)
Hipponicidae	*Hipponix* cf. *foliaceus*		Powell (1976)
	Leptonis perplexus[114]		Kelly (1983)
Janthinidae	*Janthina exigua*		Kelly (1983)
	Janthina globosa		Battershill (1986)
Littorinidae	*Austrolittorina unifasciata*[115]	banded periwinkle	Creese & Ballantine (1986)
	Risellopsis varia	ridged winkle	Creese & Ballantine (1986)
Naticidae	*Notocochlis migratoria*[116]		Battershill (1986)
	Tanea lemniscata[117]		Morley & Hayward (1999)
	Polinices simiae		Brook (2001)
	Polinices tawhitirahia	moon shell	Powell (1976)
	Proxiuber australe		Brook *et al*. (2001)
Ovulidae	*Phenacovolva wakayamaensis*[118]	gorgonian cowrie/ spindle cowrie	Powell (1976)
Ranellidae	*Cabestana spengleri*		Shears (2007)
	Cabestana tabulata[119]		Battershill (1986)
	Charonia lampas	trumpet shell	Shears (2007)
	Cymatium (Monoplex) exaratum[120]		Brook (2001)
	Cymatium (Turritriton) labiosum[121]		Brook (2001)
	Cymatium (Monoplex) parthenopeum[122]	hairy trumpet	Battershill (1986)
	Ranella australasia[123]		Battershill (1986)
	Ranella olearium		Battershill (1986)
	Sassia palmeri[124]		Brook (2001)
	Sassia parkinsonia[125]		Brook (2001)
Rissoidae	*Alvania (Linemera) gallinacea*		Battershill (1986)
	Attenuata[126]*bollon*si		Kelly (1983)
	Attenuata[126] *finlayi*		Kelly (1983)
	Merelina coronata		Kelly (1983)
	Merelina gemmata		Kelly (1983)
	Merelina paupereques		Kelly (1983)
	Merelina superba		Kelly (1983)
	Onoba iredalei[127]		Kelly (1983)
	Onoba (Ovirissoa) paupereques[128]		Kelly (1983)
	Powellisetia bilirata		Kelly (1983)

111 Previously known as *E. perplexu*m or *E. perplexa*
112 Previously known as *E. minora*
113 Previously known as *Venustilifer bountyensis*
114 Previously known as *Neojanacus perplexus*
115 Previously known as *Littorina unifasciata* or *Melaraphe oliveri*
116 Previously known as *Natica migratoria*
117 Previously known as *Natica lemniscata*
118 Previously known as *Volva longirostrata* or *Primovula longirostris*
119 Previously known as *C. waterhousei*
120 Previously known as *Turritriton tabulatus exaratus*
121 Previously known as *Turritriton labiosus*
122 Previously known as *Monoplex parthenopeus*
123 Previously known as *Mayena australasia australasia*
124 Previously known as *Proxicharonia palmeri*
125 Previously known as *Austrotriton parkinsonia*
126 Previously known as *Lironoba (Nobolira)*
127 Previously known as *Ovirissoa iredalei*
128 Previously known as *Zebina (Badenia) paupereques*

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
	Powellisetia porcellanoides		Kelly (1983)
	Powellisetia subtenuis		Kelly (1983)
	Powellisetia unicarinata		Kelly (1983)
	Pusillina (Haurakia) mobilicosta[129]		Battershill (1986)
	Rissoina ?achatina		Brook *et al.* (2001)
	Rissoina chathamensis		Kelly (1983)
	Rissoina fictor		Battershill (1986)
	Rissoina fucosa		Brook *et al.* (2001)
	Rissoina powelli		Battershill (1986)
	Rissoina zonata		Kelly (1983)
Siliquariidae	*Tenagodus*[130] *maoria*		Battershill (1986)
	Tenagodus weldii		Battershill (1986)
Triphoridae	*Bouchetriphora pallida*[131]		Kelly (1983)
Triviidae	*Trivia (Ellatrivia) merces*	bean cowrie	Battershill (1986)
Turridae	*Leucosyrinx eremita*[132]		Battershill (1986)
Turritellidae	*Maoricolpus roseus*		Brook *et al.* (2001)
	Vermicularia sp.		Cranwell & Moore (1938)
	Zeacolpus (Stiracolpus) mixtus		Kelly (1983)
	Zeacolpus (Stiracolpus) pagoda		Brook *et al.* (2001)
	Zeacolpus vittatus		Brook *et al.* (2001)
Velutinidae	*Lamellaria* sp.		Brook *et al.* (2001)
Vermetidae	*Novastoa lamellosa*		Battershill (1986)
	Serpulorbis zelandicus		Battershill (1986)
Vitrinellidae	*Scrupus hyalinus*		Kelly (1983)
Order Neritopsida			
Neritidae	*Nerita atramentosa*	black nerita	Creese & Ballantine (1986)
Order Vetigastropoda			
Calliostomatidae	*Calliostoma (Maurea) pellucidum*[133]		Battershill (1986)
	Calliostoma (Maurea) punctulatum[134]	beaded top shell	Shears (2007)
	Calliostoma (Maurea) tigris[135]	tiger shell	Shears (2007)
Fissurellidae	*Tugali elegans*	grooved limpet	Kelly (1983)
Haliotidae	*Haliotis australis*	yellow-footed paua/ silver paua	Shears (2007)
	Haliotis iris	black-footed paua	Shears (2007)
	Haliotis virginea crispata		Battershill (1986)
Scissurellidae	*Incisura lyttletonensis*		Kelly (1983)
	Incisura rosea		Kelly (1983)
	Scissurella sp.		Kelly (1983)
	Sinezona iota		Kelly (1983)
	Sinezona laqueus		Kelly (1983)
Skeneidae	*Lodderena formosa*		Kelly (1983)
	Lodderia iota		Kelly (1983)
	Lodderia waitemata		Kelly (1983)
	Lissotesta oblata		Kelly (1983)
	Zalipais lissa		Kelly (1983)
Solariellidae	*Solariella plicatula*		Brook (2001)
	Solariella tryphenensis[136]		Brook (2001)

129 Previously known as *Rissoa mobilicosta*
130 Previously known as *Siliquaria*
131 Previously known as *Triphora infelix*
132 Previously known as *Liratilia eremita*
133 Previously known as *Maurea pellucida pellucida* or *M. pellucida spirata*
134 Previously known as *Maurea punctulata*
135 Previously known as *Maurea tirgris*
136 Previously known as *S. tryphenense*

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
Trochidae	*Antisolarium egenum*		Brook *et al*. (2001)
	Cantharidus opalus	opal top shell	Battershill (1986)
	Cantharidus purpureus	small opal top shell	Shears (2007)
	Clanculus peccatus		Battershill (1986)
	Fossarina rimata		Creese & Ballantine (1986)
	Herpetopoma larochei		Brook *et al*. (2001)
	Herpetopoma sp. A		Brook *et al*. (2001)
	Herpetopoma sp. B		Brook *et al*. (2001)
	Liotella polypleura		Kelly (1983)
	Liotella rotula		Kelly (1983)
	Melagraphia aethiops	spotted top shell	Creese & Ballantine (1986)
	Micrelenchus dilatus		Battershill (1986)
	Thoristella davegibbsi		Marshall (1998)
	Trochus camelophorus		Battershill (1986)
	Trochus viridis	green top shell	Shears (2007)
Turbinidae	*Argalista*[112] *fluctua*ta		Battershill (1986)
	Argalista[137] *imperforata*		Battershill (1986)
	Argalista[137] sp.		Kelly (1983)
	Astraea heliotropium	circular saw shell	Battershill (1986)
	Cookia sulcata	Cook's turban	Shears (2007)
	Modelia granosa[138]	southern cat's eye/ granose turban	Shears (2007)
	Turbo smaragdus	cat's eye	Creese & Ballantine (1986)
SUBCLASS HETEROBRANCHIA			
Order Heterostropha			
Architechtonicidae	*Heliacus (Torinista) implexus*[139]		Brook (2001)
	Psilaxis radiatus		Brook (2001)
Mathildidae	*Tuba valkyrie*[140]		Kelly (1983)
Orbitestellidae	*Orbitestella parva*[141]		Kelly (1983)
	Orbitestella toreuma		Kelly (1983)
Pyramidellidae	*Agatha georgiana*		Brook *et al*. (2001)
	Ividella maoria		Kelly (1983)
	Linopyrga rugata rugata		Kelly (1983)
	Puposyrnola missile		Kelly (1983)
	Syrnola menda		Kelly (1983)
	Terelimella larochei		Kelly (1983)
	Turbonilla eques		Kelly (1983)
Rissoellidae	*Rissoella elongatospira*		Battershill (1986)
	Rissoella (Zelaxitas) micra		Battershill (1986)
SUBCLASS OPISTHOBRANCHIA			
Order Anaspidea			
Aplysiidae	*Aplysia dactylomela*	common sea hare	Battershill (1986)
	Aplysia parvula		Battershill (1986)
	Aplysia sagamiana		Rudman (2006)
	Dolabrifera brazieri[142]		Rudman (2006)
Order Cephalaspidea			
Acteonidae	*Acteon variegatus*		Powell (1976)
	Pupa kirki		Brook *et al*. (2001)
Aglajidae	*Chelidonura hirundinina*		Rudman (2006)

137 Previously known as *Homalopoma*
138 Previously known as *Turbo granosus*
139 Previously known as *Heliacus maorianus*
140 Previously known as *Gegania valkyrie*
141 Previously known as *O. vera*
142 Referred to as *Dolabrifera dolabrifera* in Willan & Morton (1984).

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
Bullidae	*Bulla quoyii*		Brook *et al*. (2001)
Bullinidae	*Bullina lineata*		Brook *et al*. (2001)
Cylichnidae	*Cylichna thetidis*		Kelly (1983)
Haminoeidae	*Limulatys* sp.		Brook *et al*. (2001)
Hydatinidae	*Hydatina physis*		Battershill (1986)
Philinidae	*Philine* sp.		Brook *et al*. (2001)
Rucinidae	*Runnica katipoides*		Rudman (2006)
	Runcinella zelandica		Rudman (2006)
Order Notaspidea			
Pleurobranchidae	*Pleurobranchaea maculata*[143]	grey side-gilled slug	Battershill (1986)
Umbraculidae	*Umbraculum umbraculum*		Rudman (2006)
Order Nudibranchia			
Aeolidiidae	*Protaeolidiella atra*		Skipworth (2008)
	Spurilla macleayi		Skipworth (2008)
Chromodorididae	*Cadlina willani*		Rudman (2006)
	Cadlinella ornatissima		Rudman (2006)
	Ceratosoma amoena[144]	clown nudibranch	Willan (2003)
	Chromodoris aureomarginata		Rudman (2006)
	Hypselodoris kaname		Skipworth (2008)
Dendrodorididae	*Dendrodoris citrina*	lemon nudibranch	Rudman (2006)
	Dendrodoris denisoni[145]	gem nudibranch	Willan (2003)
Discodorididae	*Alloiodoris lanuginata*		Battershill (1986)
Doridiidae	*Aphelodoris luctuosa*		Skipworth (2008)
	Archidoris wellingtonensis	warty sea slug/ Wellington nudibranch	Rudman (2006)
	Doriopsis flabellifera[146]		Battershill (1986)
	Rostanga muscula[147]		Battershill (1986)
Dotidae	*Doto* sp. 10 (yellow with pink tips)		Rudman (2006); Skipworth (2008)
	Doto sp. 2 (white)		Skipworth (2008)
Flabellinidae	*Flabellina albomarginata*		Skipworth (2008)
	Tularia bractea		Skipworth (2008)
Glaucidae	*Babakina caprinsulensis*		Skipworth (2008)
	Cratena cf *lineata*		Skipworth (2008)
	Favorinus tsuruganus		Rudman (2006)
	Jason mirabilis	Jason's nudibranch	Rudman (2006)
Goniodorididae	*Goniodoris* sp.		Rudman (2006)
	Okenia atkinsonorum		Rudman (2006)
	Okenia hiroi		Skipworth (2008)
	Trapania brunnea		Rudman (2006)
	Trapania rudmani		Rudman (2006)
Polyceridae	*Kaloplocamus* cf *ramosus*		Rudman (2006)
	Nembrotha kubaryana		Powell (1976)
	Nembrotha morosa		Powell (1976)
	Plocamopherus imperialis		Rudman (2006)
	Roboastra luteolineata		Willan (2003)
	Tambja affinis		Brook (2001)
	Tambja morosa		Skipworth (2008)
	Tambja tenuilineata		Skipworth (2008)
	Tambja verconis	Verco's nudibranch	Willan (2003)
Tergipedidae	*Cuthona scintillans*		Rudman (2006)

143 Previously known as *Pleurobranchaea movaezelandiae*
144 Previously known as *Glossodoris amoena*
145 Previously known as *Dendrodoris gemmacea*
146 Previously known as *Ctenodoris flabellifera*
147 Previously known as *Rostanga rubicunda*

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
Tritoniidae	*Tritonia incerta*		Battershill (1986)
	Tritonia flemingi		Skipworth (2008)
Zephyrinidae	*Caldukia rubignosa*		Skipworth (2008)
	Janolus eximius		Skipworth (2008)
	Janolus ignis		Skipworth (2008)
	Janolus mokohinau		Skipworth (2008)
	Janolus cf. *novozealandicus*		Rudman (2006)
	Galeojanolus ioannae		Rudman (2006)
Order Sacoglossa			
Elysiidae	*Elysia* sp. 4		Rudman (2006)
	Thuridilla sp. 2		Rudman (2006)
Limapontiidae	*Placida dendritica?*[148]		Rudman (2006)
	Stiliger aureomarginatus		Rudman (2006)
Order Thecosomata			
Limacinidae	*Limacina bulimoides*		Kelly (1983)
SUBCLASS PULMONATA			
Order Basommatophora			
Siphonariidae	*Siphonaria australis*[149]	siphon limpet	Battershill (1986)
	Williamia radiata nutata[150]		Powell (1976)
CLASS BIVALVIA			
SUBCLASS PALAEOTAXODONTA			
Order Nuculoida			
Nuculanidae	*Saccella bellula*		Brook *et al.* (2001)
Nuculidae	*Nucula* cf. *nitidula*		Brook *et al.* (2001)
SUBCLASS PTERIOMORPHA			
Order Arcoida			
Glycymeridae	*Glycymeris modesta*	small dog cockle	Brook *et al.* (2001)
	Tucetona laticostata	large dog cockle	Brook *et al.* (2001)
Philobryidae	*Cosa serratocostrata*		Kelly (1983)
Order Mytiloida			
Mytilidae	*Crenella radians*		Brook *et al.* (2001)
	Modiolus areolatus	hairy mussel	Battershill (1986)
	Septifer bilocularis		Powell (1976)
Order Pterioida			
Anomiidae	*Anomia trigonopsis*	golden oyster	Battershill (1986)
Limidae	*Limaria orientalis*	file shell	Brook *et al.* (2001)
	Limatula maoria		Brook *et al.* (2001)
Pectinidae	*Mesopeplum convexum*	wavy fan shell	Brook *et al.* (2001)
	Pecten novaezelandiae	scallop	Brook *et al.* (2001)
	Talochlamys[151] *gemmula*ta		Battershill (1986)
	Talochlamys zelandiae	fan shell	Battershill (1986)
Propeanussiidae	*Cyclopecten* sp.		Kelly (1983)
Pteriidae	*Pteria levitata*		Powell (1976)
SUBCLASS HETERODONTA			
Order Myoida			
Corbulidae	*Corbula zelandica*		Brook *et al.* (2001)

148 Taxonomy of this species is uncertain. It is referred to in earlier work as *Placida aoteana.*
149 Previously known as *S. zelandica*
150 Previously known as *Roya kermadecensis*
151 Previously known as *Chlamys*

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
Order Veneroida			
Cardiidae	*Pratulum pulchellum*[152]	strawberry cockle	Kelly (1983)
Carditidae	*Cardita brookesi*	heart cockle	Kelly (1983)
	Pleuromeris zelandica		Brook *et al.* (2001)
	Purpurocardia purpurata[153]	purple cockle	Brook *et al.* (2001)
Condylocardiidae	*Condylocuna concentrica*		Kelly (1983)
Crassatellidae	*Talabrica bellula*		Brook *et al.* (2001)
Lasaeidae	*Lasaea hinemoa*		Kelly (1983)
	Melliteryx parva		Kelly (1983)
Lucinidae	*Divalucina cumingi*[154]		Brook *et al.* (2001)
	Epicodakia neozelanica		Brook *et al.* (2001)
	Gonimyrtea concinna		Kelly (1983)
Mactridae	*Scalpomactra scalpellum*		Brook *et al.* (2001)
Montacutidae	*Mysella hounselli*		Kelly (1983)
	Tellimya vitrea aupouria[155]		Kelly (1983)
Neoleptonidae	*Neolepton antipodum*		Kelly (1983)
Psammobiidae	*Gari stangeri*	purple sunset shell	Brook *et al.* (2001)
Ungulinidae	*Felaniella zelandica*		Brook *et al.* (2001)
Veneridae	*Dosinia maoriana*		Brook *et al.* (2001)
	Notocallista multistriata		Brook *et al.* (2001)
	Tawera spissa	morning star shell	Brook *et al.* (2001)
SUBCLASS ANOMALODESMATA			
Order Pholadomyoida			
Cuspidariidae	*Cuspidaria willetti*		Brook *et al.* (2001)
	Rhinoclama (Austroneaera) finlayi[156]		Kelly (1983)
Myochamidae	*Hunkydora novozelandica*		Brook *et al.* (2001)
	Myadora novaezelandiae	large myadora	Kelly (1983)
CLASS CEPHALOPODA			
SUBCLASS COLEOIDA			
Order Octopoda			
Argonautidae	*Argonauta nodosa*	paper nautilus	Ayling & Schiel (2003)
Octopodidae	*Octopus gibbsi*	octopus	Edney (2001)
	Octopus maorum	Maori octopus	Abbott & Rousseau (2002)
	Pinnoctopus cordiformis[157]	common NZ octopus	Battershill (1986)
Order Teuthida			
Loliginidae	*Sepioteuthis australis*[158]	broad squid/ southern calamary	Battershill (1986)
Ommastrephidae	*Nototodarus sloanii*	arrow squid	Kelly (1983)
SUBCLASS NAUTILOIDEA			
Order Nautilida			
Nautilidae	*Nautilus* sp.		Kelly (1983)

152 Previously known as *Nemocardium (Pratulum) pulchellum*
153 Previously known as *Venericardia purpurata*
154 Previously known as *Divaricella huttoniana*
155 Previously known as *Montacuta (Tellimya) vitrea aupouria*
156 Previously known as *Austroneaera finlayi*
157 Previously known as *Octopus maorum*
158 Previously known as *S. bilineata*

TABLE 9. ARTHROPODS RECORDED FROM THE POOR KNIGHTS ISLANDS MARINE RESERVE

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
CLASS BRANCHIOPODA			
Order Diplostraca			
Podonidae	*Evadne nordmanni*		Kelly (1983)
Sididae	*Penilia avirostris*		Kelly (1983)
CLASS MALACOSTRACA			
Order Decapoda			
Belliidae	*Heterozius rotundifrons*	big hand crab	Battershill (1986)
Cancridae	*Cancer novaezelandiae*	NZ pie crust crab	Battershill (1986)
Dromiidae	*Dromia wilsoni*[159]	sponge crab	Battershill (1986)
Grapsidae	*Leptograpsus variegatus*	purple rock crab	Cranwell & Moore (1938)
Leucosiidae	*Ebalia laevis*		Bennett (1964)
	Ebalia tubercubosa		Kelly (1983)
Majidae	*Leptomithrax longipes*		Cryer *et al.* (2000)
	Leptomithrax tuberculatus mortenseni		Battershill (1986)
	Notomithrax minor	seaweed crab	Battershill (1986)
	Notomithrax ursus	hairy decorator crab	Battershill (1986)
Menippidae	*Ozius truncatus*	black-finger crab	Battershill (1986)
Hippolytidae	*Hippolysmata* sp.	cleaner shrimp	Doak (1971)
Paguridae	*Pagurus novaezelandiae*	NZ hermit crab	Battershill (1986)
	Pagurus sp.	hermit crab	Edney (2001)
Palaemonidae	*Palaemon affinis*	NZ glass shrimp	Battershill (1986)
Palinuridae	*Jasus edwardsii*	red rock lobster	Edney (2001)
	Sagmariasus verreauxi	packhorse crayfish	Edney (2001)
Plagusiidae	*Plagusia chabrus*[160]	red rock crab	Cranwell & Moore (1938)
	Percnon guinotiae		Abbott & Rousseau (2002)
Pilumnidae	*Pilumnus novaezelandiae*	NZ bristle crab	Cranwell & Moore (1938)
Portunidae	*Ovalipes catharus*	NZ swimming crab	Doak (1971)
Raninidae	*Lyreidus tridentatus*		Kelly (1983)
Scyllaridae	*Arctides antipodum*	spanish lobster/ slipper lobster	Edney (2001)
	Scyllarus aoteanus		Battershill (1986)
Stenopididae	*Stenopus hispidus*	coral shrimp	Brook (2001)
Order Euphausiacea			
Euphausiidae	*Nyctiphanes australis*		Kingsford & MacDiarmid (1988)
Order Stomatopoda			
Squillidae	*Squilla* sp.		Kingsford & MacDiarmid (1988)
CLASS MAXILLOPODA			
Order Calanoida			
Acartiidae	*Acartia* sp.		Kelly (1983)
Calanidae	*Calanus australis*		Kelly (1983)
	Nannocalanus minor		Kelly (1983)
Clausocalanidae	*Clausocalanus arcuicornis?*		Kelly (1983)
	Ctenocalanus citer		Kelly (1983)
Eucalanidae	*Eucalanus elongatus?*		Kelly (1983)
Paracalanidae	*Paracalanus indicus*		Kelly (1983)
Temoridae	*Temora turbinata*		Kelly (1983)

159 Previously known as *Petalomera wilsoni*
160 Previously known as *P. capense*

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
Order Cyclopoida			
Oithonidae	*Oithona* sp.		Kelly (1983)
	unidentified cyclopoid		Kingsford & MacDiarmid (1980)
Order Harpacticoida			
Euterpinidae	*Euterpina acutifrons*		Kelly (1983)
	unidentified harpacticoid		Kingsford & MacDiarmid (1980)
Order Poecilostomatoida			
Corycaeidae	*Corycaeus* sp.[161]		Kelly (1983)
Oncaeidae	*Oncaea mediterranea*		Kelly (1983)
Sapphirinidae	*Sapphirina* sp.		Kelly (1983)
Order Sessilia			
Balanidae	*Balanus (Solidobalanus) auricoma*		Foster (1978)
	Balanus decorus	pink barnacle	Battershill (1986)
	Balanus trigonus		Battershill (1986)
	Megabalanus linzei[162]		Foster (1978)
Order Siphonostomatoida			
Caligidae	*Caligus* sp.		Kelly (1983)
Order Thoracica			
Poecilasmatidae	*Trilasmis (Poecilasma) kaempferi*		Foster (1978)
Order Pedunculata			
Calanticidae	*Calantica spinilatera*		Battershill (1986)
Chthamalidae	*Chamaesipho brunnea*	brown surf barnacle	Creese & Ballantine (1986)
	Chamaesipho columna		Battershill (1986)
Iblidae	*Ibla segmentata*		Kelly (1983)
Oxynaspididae	*Oxynaspis indica*	goose-necked barnacle	Foster (1978)
Tetraclitidae	*Epopella plicata*		Kelly (1983)
	Tetraclita aoranga		Foster (1978)

TABLE 10. ECHINODERMS RECORDED FROM THE POOR KNIGHTS ISLANDS MARINE RESERVE

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
CLASS ASTERIODEA			
Order Forcipulatida			
Asteriidae	*Astrostole scabra*	7 armed starfish	Battershill (1986)
	Coscinasterias calamaria	Spiny starfish	Edney (2001)
	Coscinasterias muricata	11 armed starfish	Shears (2007)
Order Paxillosida			
Astropectinidae	*Astropecten dubiosus*		Clark & McKnight (2000)
	Astropecten polyacanthus	comb star	Battershill (1986)
	Psilaster acuminatus		Kelly (1983)
Luidiidae	*Luidia varia*		Battershill (1986)
	Luidia neozelanica		Clark & McKnight (2000)
Order Spinulosida			
Echinasteridae	*Henricia* sp.		Kelly (1983)
	Stegnaster inflatus	large cushion star	Battershill (1986)
Order Valvatida			
Asterodiscididae	*Asterodiscides truncatus*[163]	firebrick starfish	Edney (2001)

161 This species is listed as *C. acklandicas* in Kelly (1983) but the species could not be validated.
162 Previously known as *Balanus tintinnabulum linzei*
163 Previously known as *Asterodiscus truncatus*

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
Ganeriidae	*Knightaster bakeri*	yellow seastar/ Baker's sea star	Clark (1972)
Goniasteridae	*Pentagonaster pulchellus*	biscuit star	Battershill (1986)
Ophidiasteridae	*Ophidiaster kermadecensis*		Kelly (1983)
	Ophidiaster macknighti		Ayling & Schiel (2003)
CLASS CRINOIDEA			
Order Comatulida			
Antedonidae	*Argyrometra mortenseni*		Battershill (1986)
Order Millericrinida			
Comasteridae	*Cenolia novaezelandiae*	Poor Knights feather star	Kelly (1983)
	Cenolia trichoptera		Kelly (1983)
	Comanthus wahlbergi		Doak (1971)
	Comanthus novaezelandiae	feather star	Edney (2001)
CLASS ECHINOIDEA			
Order Cidaroida			
Cidaridae	*Goniocidaris corona*		Baker (1968b)
	Prionocidaris australis		McKnight (1984)
Order Clypeasteroida			
Clypeasteridae	*Clypeaster australasiae*	sand dollar urchin	Brook (2001)
	Clypeaster (Anomalanthus) tumidus	hat urchin	Kelly (1983)
	Clypeaster (Stolonoclypus) virescens		Kelly (1983)
Order Diadematoida			
Diadematidae	*Centrostephanus rogersii*		Baker (1968a)
	Diadema palmeri		Brook (2001)
	Diadema savignyi	long-spined sea urchin	Francis & Evans (1993)
Order Echinoida			
Echinometridae	*Evechinus chloroticus*	kina	Edney (2001)
	Heliocidaris tuberculata	brown sea urchin	Shears (2007)
Toxopneustidae	*Pseudoboletia indiana*	purple-tipped urchin	Brook (2001)
	Tripneustes gratilla	priest-hat urchin	Francis & Evans (1993)
Order Spatangoida			
Brissidae	*Brissus agassizii*	heart urchin	Brook (2001)
	Brissus gigas	giant heart urchin	Baker (1968a)
Loveniidae	*Echinocardium cordatum*		Brook (2001)
Order Temnopleuroida			
Temnopleuridae	*Amblypneustes elevatus*	brown urchin	Kelly (1983)
	Holopneustes inflatus		Battershill (1986)
	Pseudechinus variegatus		Kelly (1983)
CLASS HOLOTHUROIDEA			
Order Aspidochirotida			
Holothuriidae	*Holothuria (Vaneyothuria) neozelanica*[164]		Doak (1971)
Stichopodidae	*Australostichopus mollis*[165]	sea cucumber	Edney (2001)
Order Dendrochirotida			
Cucumariidae	*Ocnus brevidentis*		Kelly (1983)
CLASS OPHIUROIDEA			
Order Euryalida			
Gorgonocephalidae	*Astrothorax waitei*		Battershill (1986)
Order Ophiurida			
Asteroschematidae	*Astrobranchion constrictum*	black coral tree star	Kelly (1983)
Ophiactidae	*Ophiactis birta*		Kelly (1983)
	Ophiactis resiliens		Kelly (1983)

164 Previously known as *Vaneyothuria neozelanica*
165 Previously known as *Stichopus mollis*

FAMILY	SCIENTIFIC NAME	COMMON NAME	REFERENCE
Ophiocomidae	*Ophiopteris papillosa*[166]	oar sand star	Battershill (1986)
Ophiodermatidae	*Ophiopeza cylindrica*[167]		Kelly (1983)
	Ophiopsammus maculata[168]	snake star	Battershill (1986)
Ophiolepidina	*Ophiozonoida picta*		Kelly (1983)
Ophionereididae	*Ophionereis fasciata*	mottled brittle star	Doak (1971)
Ophiothricidae	*Ophiothrix (Ophiothrix) oliveri*		Kelly (1983)
Order Phrynophiurida			
Ophiomyxidae	*Ophiomyxa brevirima*		Kelly (1983)

TABLE 11. ASCIDIANS AND THALIACEANS RECORDED FROM THE POOR KNIGHTS ISLANDS MARINE RESERVE

FAMILY	SCIENTIFIC NAME	REFERENCE
CLASS ASCIDIACEA		
Order Enterogona		
Clavelinidae	*Clavelina* n. sp.[169](bluebell tunicate)	Ayling & Schiel (2003)
	Clavelina sp. 1 (lime)	Battershill (1986)
	Clavelina sp. 2 (orange)	Battershill (1986)
Cionidae	*Ciona intestinalis*	Battershill (1986)
Corellidae	*Corella eumyota*	Kelly (1983)
Didemnidae	*Didemnum candidum*	Edney (2001)
	Didemnum densum	Kelly (1983)
	Didemnum grande	Kelly (1983)
	Didemnum sp.	Battershill (1986)
	Diplosoma listerianum	Battershill (1986)
	Leptoclinides duminus	Battershill (1986)
	Leptoclinides marmoreus	Battershill (1986)
	Leptoclinides sp.	Kelly (1983)
	Lissoclinum sp.	Battershill (1986)
	Polysyncraton chondrilla	Battershill (1986)
	Polysyncraton sp.	Battershill (1986)
	Trididerum sluiteri	Kelly (1983)
Holozoidae	*Hypsistozoa fasmeriana*	Edney (2001)
	Sycozoa sigillinoides	Kelly (1983)
Pseudodistomidae	*Pseudodistoma aureum*	Kelly (1983)
	Pseudodistoma novaezelandiae	Kelly (1983)
	Pseudodistoma sp.	Battershill (1986)
Polycitoridae	*Cystodytes dellechiajei*	Kelly (1983)
	Eucoelium[170] sp. 1 (indigo)	Battershill (1986)
	Eucoelium sp. 2 (white stalked)	Battershill (1986)
	Eudistoma circumvallatum	Battershill (1986)
	Eudistoma sp. 1	Battershill (1986)
Polyclinidae	*Aplidium benhami*	Battershill (1986)
	Aplidium notti	Kelly (1983)
	Aplidium phortax	Kelly (1983)
	Aplidium quadrisiculatum	Kelly (1983)
	Aplidium scabellum	Battershill (1986)
	Aplidium sp. 1 (lemon)	Battershill (1986)
	Aplidium sp. 2 (clear)	Battershill (1986)
	Aplidium sp. 3 (brain)	Battershill (1986)
	Aplidium sp. 4 (pink button)	Battershill (1986)

166 Previously known as *O. antipodum*
167 Previously known as *O. gracilis*
168 Previously known as *Pectinura maculata*
169 Sometimes erroneously referred to as *Pycnoclavellina* sp.
170 Previously known as *Polycitorella*

FAMILY	SCIENTIFIC NAME	REFERENCE
	Aplidium sp. 5 (lime sandy)	Battershill (1986)
	Aplidium sp. 6 (mauve)	Battershill (1986)
	Aplidium sp. 7 (orange button)	Stocker (1985)
	Synoicum kuranui	Kelly (1983)
	Synoicum sp.	Battershill (1986)
Pycnoclavellidae	*Euclavella claviformis*[171]	Kelly (1983)
Ritterellidae	*Dumus* sp. (orange)	Battershill (1986)
	Rittella sigillinoides	Battershill (1986)
	Ritterella sp.	Battershill (1986)
Order Pleurogona		
Pyuridae	*Microcosmus australis*[172]	Kelly (1983)
	Pyura pachydermatina	Doak (1971)
	Pyura trita	Cranwell & Moore (1938)
Styelidae	*Alloeocarpa minuta*	Battershill (1986)
	Asterocarpa coerulea[173]	Cranwell & Moore (1938)
	Botrylloides anceps[174]	Kelly (1983)
	Botrylloides leachii	Battershill (1986)
	Botrylloides schlosseri	Battershill (1986)
	Botrylloides sp.	Battershill (1986)
	Botryllus sp.	Edney (2001)
	Cnemidocarpa bicornuata	Kelly (1983)
	Cnemidocarpa nisiotis	Kelly (1983)
	Metandrocarpa thilenii	Battershill (1986)
	Theodorella sp.	Battershill (1986)
CLASS THALIACEA		
Order Doliolida		
Doliolidae	*Doloilum nationalis*	Kelly (1983)
Order Pyrosomatida		
Pyrosomatidae	*Pyrostremma spinosum*[175]	Baker (1970)

171 Previously known as *Clavelina claviformis*
172 Previously known as *M. kura*
173 Previously known as *Cnemidocarpa coerulea*
174 Previously known as *B. magnicoecus* or *B. magnicoecum*
175 Previously known as *Pyrosoma spinosum*

TABLE 12. FISH SPECIES THAT HAVE BEEN RECORDED FROM THE POOR KNIGHTS ISLANDS MARINE RESERVE.

FAMILY	SPECIES	COMMON NAME	REFERENCE
CLASS CHONDRICHTHYES			
Order Carcharhiniformes			
Carcharhinidae	*Carcharhinus brachyurus*	bronze whaler	Ayling & Schiel (2003)
	Prionace glauca	blue shark	Froese & Pauly (2008)
Scyliorhinidae	*Cephaloscyllium isabellum*	carpet shark	Edney (2001)
Sphyrnidae	*Sphyrna zygaena*	hammerhead shark	Doak (2001d)
Triakidae	*Galeorhinus galeus*	school shark	Denny *et al*. (2003)
Order Hexanchiformes			
Hexanchidae	*Notorynchus cepedianus*	broadnose seven gill shark	D. Abbot (unpub.); Ritchie *et al.* (1979)
Order Orectolobiformes			
Rhincodontidae	*Rhincodon typus*	basking whale shark	Doak (2002)
Order Lamniformes			
Alopiidae	*Alopias vulpinus*	thresher shark	Abbott & Rousseau (2002)
Isuridae	*Isurus oxyrinchus*	mako shark	Abbott & Rousseau (2002)
Order Myliobatiformes			
Dasyatidae	*Dasyatis brevicaudata*	short-tailed stingray	Le Port *et al.* (2008)
	Dasyatis thetidis	long-tailed stingray	Edney (2001)
Mobulidae	*Manta birostris*	manta ray	Duffy & Abbott (2003)
Myliobatidae	*Myliobatis tenuicaudatus*	eagle ray	Edney (2001)
Order Torpediniformes			
Torpedinidae	*Torpedo fairchildi*	NZ Torpedo/Electric ray	Abbott & Rousseau (2002)
CLASS ACTINOPTERYGII			
Order Anguilliformes			
Muraenidae	*Enchelycore ramosa*	mosaic moray	Edney (2001)
	Gymnothorax nubilus	grey moray	Edney (2001)
	Gynonthorax obesus	speckled moray	Edney (2001)
	Gymnothorax prasinus	yellow moray	Edney (2001)
	Gymnothorax prionodon	motttled moray	Edney (2001)
Congridae	*Conger verreauxi*	southern conger eel	Edney (2001)
	Conger wilsoni	short-finned conger eel	Brook (2002)
	Gorgasia japonica	garden eel	Ayling & Cox (1982); Doak (1991); Castle & Randall (1999)
Ophichthidae	*Ophisurus serpens*	snake eel	Doak (2001a)
Order Aulopiformes			
Synodontidae	*Synodus doaki*	common lizardfish	Schiel (1984)
	Synodus similis	lavender lizardfish	Brook (2002)
Order Beloniformes			
Exocoetidae	*Cypselurus lineatus*	flying fish	Doak (2001a)
Hemiramphidae	*Hyporhamphus ihi*	piper	Brook (2002)
Scomberesocidae	*Scormberesox saurus*	saurie	Kelly (1983)
Order Beryciformes			
Berycidae	*Centroberyx affinis*	golden snapper	Edney (2001)
Trachichthyidae	*Optivus elongatus*	slender roughy	Edney (2001)
Order Clupeiformes			
Engraulidae	*Engraulis australis*	anchovy	Kingsford (1989)
Order Gadiformes			
Moridae	*Lotella rhacinus*	rock cod	Brook (2002)
	Pseudophycis bachus	morid cod	Kelly (1983)
	Pseudophycis barbata	bastard cod	Brook (2002)
	Pseudophycis breviuscula	red cod	Kelly (1983)

FAMILY	SPECIES	COMMON NAME	REFERENCE
Order Gasterosteiformes			
Syngnathidae	*Hippocampus adominalis*	seahorse	Doak (2001a)
	Hippocampus jugumus	collared seahorse	Edney *et al.* (2006)
	Hippocampus sp.	pygmy seahorse	Survey Seahorse 2000 (2005)
Order Gobiesociformes			
Gobiesocidae	*Dellichthys morelandi*	urchin clingfish	Kelly (1983)
Order Lampriformes			
Regalecidae	*Regalecus glesne*	oarfish	M. Conmee (unpub.)
Trachipteridae	*Trachipterus trachypterus*	dealfish	W. Doak (unpub.)
Order Lophiiformes			
Antennariidae	*Antennarius* sp.	frogfish	Dive Tutukaka (2008)
Order Perciformes			
Acanthuridae	*Acanthurus dussumieri*	eyestripe surgeonfish	Francis & Evans (1992)
Aplodactylidae	*Aplodactylus arctidens*	marblefish	Schiel (1984)
	Aplodactylus etheridgii	notch-head marblefish	Schiel (1984)
Arripidae	*Arripis trutta*	kahawai	Brook (2002)
Blenniidae	*Parablennius laticlavius*	crested blenny	Edney (2001)
	Plagiotremus rhinorhynchos	blue mimic blenny	Doak (2001a)
	Plagiotremus tapeinosoma	mimie blenny	Edney (2001)
Callanthiidae	*Callanthias allporti*	splendid sea perch	Schiel (1984)
	Callanthias australis	magnificent splendid perch/ northern splendid perch	Brook (2002)
Carangidae	*Decapterus koheru*	koheru	Edney (2001)
	Pseudocaranx dentex	trevally	Edney (2001)
	Seriola lalandi	kingfish	Edney (2001)
	Trachurus declevis	jack mackerel	Kingsford (1989)
	Trachurus novaezelandiae	horse mackerel	Brook (2002)
Chaetodontidae	*Amphichaetodon howensis*	Lord Howe coralfish	Schiel (1984)
	Forcipiger flavissimus	yellow longnose butterflyfish	Francis *et al.* (1999)
Cheilodactylidae	*Cheilodactylus ephippium*	painted moki	Edney (2001)
	Cheilodactylus fuscus	red morwong	Kelly (1983)
	Cheilodactylus nigripes	magpie morwong	Kelly (1983)
	Cheilodactylus spectabilis	red moki	Choat & Ayling (1987)
	Nemadactylus douglasii	porae	Choat & Ayling (1987)
	Nemadactylus macropterus	tarakihi	Schiel (1984)
Chironemidae	*Chironemus marmoratus*	hiwihiwi	Choat & Ayling (1987)
Cirrhitidae	*Cyprinocirrhites polyactis*	lyetail hawkfish/ swallowtail hawkfish	Francis & Evans (1992)
Clinidae	*Cristiceps aurantiacus*	crested weedfish	Battershill (1986)
	Ericentrus rubrus	banded weedfish	D. Abbot (unpub.)
Coryphaenidae	*Coryphaena hippurus*	mahi mahi	Doak (2001d)
Creediidae	*Limnichthys polyactis*	longfinned sand diver	Battershill (1986)
Gemphylidae	*Thrysites atun*	barracouta	Russell (1983)
Istiophoridae	*Makaira indica*	black marlin	Kelly (1983)
	Makaira mazara	Pacific blue marlin	Kelly (1983)
	Tetrapturus audax	striped marlin	Kelly (1983)
Kyphosidae	*Atypichthys latus*	mado	Schiel (1984)
	Bathystethus cultratus	grey knifefish	Brook (2002)
	Girella cyanea	bluefish	Schiel (1984)
	Girella tricuspidata	parore	Brook (2002)
	Kyphosus bigibbus	grey seachub	Francis & Evans (1992)
	Kyphosus sydneyanus	silver drummer	Schiel (1984)
	Labracoglossa nitida	blue knifefish	Francis *et al.* (1999)

176 Recorded as *Bodianus oxycephalus* by Ward & Roberts (1986)
177 Previously known as *Pseudolabrus*

FAMILY	SPECIES	COMMON NAME	REFERENCE
	Scorpis aequipinnis	sea sweep	Kingsford & MacDiarmid (1988)
	Scorpis lineolatus	silver sweep	Edney (2001)
	Scorpis violaceus	blue maomao	Edney (2001)
Labridae	*Anampses elegans*	elegant wrasse	Ward & Roberts (1986)
	Bodianus unimaculatus[176]	red pigfish	Edney (2001)
	Bodianus vulpinus	pigfish	Choat *et al.* (1988)
	Coris dorsomacula	pink-lined wrasse	Brook (2002)
	Coris picta	combfish	Edney (2001)
	Coris sandageri	Sandager's wrasse	Ward & Roberts (1986)
	Notolabrus celidotus[177]	paketi (spotty)	Ward & Roberts (1986)
	Notolabrus fucicola[177]	banded wrasse	Ward & Roberts (1986)
	Notolabrus inscriptus[177]	green wrasse	Ward & Roberts (1986)
	Pseudojuloides elongatus	long green wrasse	Ayling & Russell (1977)
	Pseudolabrus luculentus	orange wrasse	Ward & Roberts (1986)
	Pseudolabrus miles	scarlet wrasse	Ward & Roberts (1986)
	Suezichthys arquatus	rainbow fish	Francis & Evans (1992)
	Suezichthys aylingi	crimson cleanerfish	Ward & Roberts (1986)
	Thalassoma amblycephalum	blueheaded wrasse	Francis *et al.* (1999)
	Thalassoma lunare	moon wrasse	Doak (2001a)
	Thalassoma lutescens	sunset wrasse	Francis *et al.* (1999)
Latridae	*Latridopsis ciliaris*	blue moki	Edney (2001)
	Latridopsis forsteri	copper moki	Edney (2001)
Mugilidae	*Aldrichetta forsteri*	yellow-eyed mullet	F. Brook (unpub.)
Mullidae	*Parupeneus spilurus*	blackspot goatfish	Francis & Evans (1992)
	Upeneichthys lineatus	goatfish/ red mullet	Choat & Ayling (1987)
	Upeneus francisi[178]	bat-tailed goatfish	Randall & Gueze (1992)
Nototheniidae	*Notothenia angustata*	Maori chief	Denny *et al*. (2003)
Odacidae	*Odax pullus*	butterfish	Schiel (1984)
	Odax cyanoallix	bluefinned butterfish	Brook (2002)
Pempheridae	*Pempheris adspersus*	big eye	Edney (2001)
Pentacerotidae	*Evistias acutirostris*	striped boarfish	Brook (2002)
	Paristiopterus labiosus	giant boarfish	Doak (2001a)
	Zanclistius elevatus	long-finned boarfish	Edney (2001)
Percichthyidae	*Polyprion moeone*	bass	Kelly (1983)
	Polyprion oxygenios	hapuku	Beentjes & Francis (1999)
Plesiopidae	*Acanthoclinus littoreus*	NZ rockfish	Battershill (1986)
Pinguipedidae	*Parapercis binivirgata*	red-banded weever	Kelly (1983)
	Parapercis colias	blue cod	Brook (2002)
Pomacentridae	*Chromis abyssicola*	deepsea damselfish	Gregory (2008); D. Freeman, DOC, pers. comm.
	Chromis dispilus	two spot demoiselle	Edney (2001)
	Chromis fumea	yellow demoiselle	Edney (2001)
	Chromis hypsilepis	one spot puller	Brook (2002)
	Chrysiptera rapanui	Easter damselfish	Francis *et al.* (1999)
	Parma alboscapularis	black angelfish	Ward & Roberts (1986)
	Parma kermadecensis	Kermadec scalyfin	Francis *et al.* (1999)
	Parma polylepis	banded parma	Francis (1988)
	Stegastes gascoynei[179]	yellow damselfish	Doak (2001a)
Scaridae	*Leptoscarus vaigiensis*	marbled parrotfish	Kelly (1983)
Scombridae	*Acanthocybium solandri*	wahoo	Francis *et al.* (1999)
	Scomber australasicus	blue mackerel	Kingsford (1989)
	Thunnus alalunga	albacore tuna	Kelly (1983)
	Thunnus albacares	yellow fin tuna	Kelly (1983)

178 Previously reported as *Upeneus bensasi*

179 Previously known as *Eupomacentrus gascognie*

FAMILY	SPECIES	COMMON NAME	REFERENCE
	Thunnus obesus	bigeye tuna	Kelly (1983)
	Katsuwonus pelamis	skipjack tuna	Kelly (1983)
Serranidae	*Acanthistius cinctus*	yellow banded perch	Edney (2001)
	Acanthistius littoreus	black rockfish	Doak (2001a)
	Aulacocephalus temmincki	gold-ribbon grouper	Brook (2002)
	Caesioperca lepidoptera	butterfly perch	Schiel (1984)
	Caprodon longimanus	pink maomao	Edney (2001)
	Epinephelus daemelii	saddled grouper/ black spotted grouper	Brook (2002)
	Epinephelus lanceolatus	giant grouper/ Queensland grouper	Francis & Evans (1992)
	Epinephelus octofasiatus	convict grouper	D. Abbot (unpub.)
	Epinephelus rivulatus	halfmoon grouper	Brook (2002)
	Hypoplectrodes huntii[180]	red banded perch	Schiel (1984)
	Hypoplectrodes sp.	half banded perch	Brook (2002)
	Trachypoma macracanthus	toadstool grouper	Edney (2001)
Sparidae	*Pagrus auratus*	snapper	Schiel (1984)
Sphyraenidae	*Sphyraena* cf. *acutipinnis*	sharp-finned barracuda	Francis *et al.* (1999)
Tripterygiidae	*Forsterygion flavonigrum*	yellow-black triplefin	Edney (2001)
	Forsterygion lapillum	common triplefin	Brook (2002)
	Forsterygion malcolmi	mottled triplefin	Brook (2002)
	Forsterygion varium	striped triplefin	Brook (2002)
	Gilloblennius tripennis	tripenny	Kelly (1983)
	Grahamina capito	spotted robust triplefin	Battershill (1986)
	Bellapiscis medius[181]	twister	Kelly (1983)
	Karalepis stewarti	scaly-head triplefin	Edney (2001)
	Notoclinops caerulepunctus	blue-dot triplefin	Edney (2001)
	Notoclinus fenestratus	topknot	Battershill (1986)
	Notoclinops segmentatus[182]	blue-eyed triplefin	Edney (2001)
	Notoclinops yaldwyni	Yaldwyn's triplefin	Edney (2001)
	Obliquichthys maryannae	oblique-swimming triplefin	Edney (2001)
	Ruanoho decemdigitatus	long-finned triplefin	Battershill (1986)
	Ruanoho whero	spectacled triplefin	Edney (2001)
Uranoscopidae	*Kathetostoma giganteum*	giant banded stargazer	Doak (2001a)
Xiphiidae	*Xiphias gladius*	broadbill swordfish	Kelly (1983)
Order Pleuronectiformes			
Rhombosoleidae	*Rhombosolea plebeia*	flounder	Doak (1991)
Soleidae	*Aseraggodes bahamondei*	South Pacific sole	Francis *et al.* (1999)
Order Scorpaeniformes			
Scorpaenidae	*Helicolenus percoides*	reef ocean perch	Brook (2002)
	Pterois volitans	red lionfish	Francis & Evans (1992)
	Scorpaena cardinalis	scorpion fish	Schiel (1984)
	Scorpaena papillosus	dwarf scorpionfish	Brook (2002)
Triglidae	*Chelidonichthys kumu*	red gurnard/ bluefin gurnard	Battershill (1986)
Order Syngnathiformes			
Fistulariidae	*Fistularia* cf. *commersonii*	bluespotted cornetfish	Francis *et al.* (1999)
Syngnathidae	*Leptonotus norae*	longsnout pipefish	Battershill (1986)
	Stigmatopora macropterygia	long-snouted pipefish	Battershill (1986)

180 Previously known as *Ellerkeldia huntii*
181 Previously known as *Helcogramma medium*
182 Previously known as *Tripterygion bucknilli*

FAMILY	SPECIES	COMMON NAME	REFERENCE
Order Tetraodontiformes			
Diodontidae	*Allomycterus pilatus*[183]	porcupine fish	Brook (2002)
Molidae	*Mola mola*	ocean sunfish	Doak (1991)
	Ranzania laevis	oblong sunfish	W. Doak (unpub.)
Monacanthidae	*Meuschenia scaber*[184]	leatherjacket	Choat & Ayling (1987)
	Thamnaconus analis	triggerfish/ morsecode leather-jacket	Francis & Evans (1992)
Ostraciidae	*Ostracion solorensis*	striped boxfish	Doak (2001d)
Tetradontidae	*Arothron firmamentum*	starry pufferfish	Dive Tutukaka (2009)
	Canthigaster callisterna	sharp-nosed pufferfish	Schiel (1984)
Order Zeiformes			
Zeidae	*Zenion leptolepis*	elongate dory	Kelly (1983)
	Zeus faber[185]	john dory	Edney (2001)

TABLE 13. MARINE REPTILES RECORDED FROM THE POOR KNIGHTS ISLANDS MARINE RESERVE.

FAMILY	SPECIES	COMMON NAME	REFERENCE
CLASS REPTILIA			
Order Testudines			
Cheloniidae	*Caretta caretta*	loggerhead turtle	J. Choat, pers. comm. in Kelly (1983)
	Chelonia mydas	green turtle	J. Choat, pers. comm. in Kelly (1983)
	Eretmochelys imbricata	hawksbill turtle	Doak (2008)
Dermochelyidae	*Dermochelys coriacea*	leatherback turtle	Gill (1997)

TABLE 14. MARINE MAMMALS RECORDED FROM AROUND THE POOR KNIGHTS ISLANDS (PK) OR THE TUTUKAKA (T) COASTLINE.

FAMILY	SPECIES	COMMON NAME	RECORDED FROM PK OR T	REFERENCE
CLASS MAMMALIA				
Order Cetacea				
Balaenidae	*Eubalaena australis*	southern right whale	PK	Patenaude (2003)
	Eubalaena glacialis	northern right whale	T	Kelly (1983)
Balaenopteridae	*Balaenoptera acutorostrata*	minke whale	PK	Doak (2001d)
	Balaenoptera borealis	sei whale	PK	Doak (2001d)
	Balaenoptera edeni	Brydes whale	PK	Abbott & Rousseau (2002)
	Megaptera novaeangliae	humpback whale	PK	Doak (2001d)
Delphinidae	*Delphinus delphis*	common dolphin	PK	Abbott & Rousseau (2002)
	Globicephala melas	long-finned pilot whale	PK	Abbott & Rousseau (2002)
	Grampus griseus	Risso's dolphin	T	Kelly (1983)
	Orcinus orca	orca	PK	Abbott & Rousseau (2002)
	Pseudorca crassidens	false killer whale	T	Kelly (1983)
	Tursiops truncatus	bottlenose dolphin	PK	Abbott & Rousseau (2002)
Kogiidae	*Kogia sima*	dwarf sperm whale	T	Kelly (1983)
Physeteridae	*Physeter catodon*	sperm whale	T	Kelly (1983)
Ziphiidae	*Mesoplodon* sp.		T	Kelly (1983)
Order Carnivora				
Otariidae	*Arctocephalus forsteri*	NZ fur seal	PK	Abbott & Rousseau (2002)

183 Previously known as *Allomycterus jaculiferus*, referred to as *Allomycterus whitleyi* in Russell (1971)
184 Previously known as *Parika scaber*
185 Previously known as *Zeus japonicus*

TABLE 15. SEABIRDS RECORDED FROM THE POOR KNIGHTS ISLANDS MARINE RESERVE AND THEIR NEW ZEALAND THREAT CLASSIFICATION RATING.

FAMILY	SCIENTIFIC NAME	COMMON NAME	THREAT CATEGORY**	REFERENCE
CLASS AVES				
Order Charadriiformes				
Laridae	*Larus dominicanus**	black-backed gull	Not threatened	Kelly (1983)
	*Larus novaehollandiae scopulinus**	red-billed gull	Threatened – nationally vulnerable	Kelly (1983)
	Procelsterna cerulea albivittata	grey ternlet	At risk – naturally uncommon	Mills (2006)
	Sterna striata	white-fronted tern	Threatened – nationally vulnerable	Kelly (1983)
Stercorariidae	*Stercorarius parasiticus*	Arctic skua	Migrant	Mills (Mills, 2006)
Order Ciconiiformes				
Ardeidae	*Ardea novaehollandiae*	white-faced heron***	Not threatened	Kelly (1983)
	Egretta sacra sacra	reef heron***	Threatened – nationally vulnerable	Kelly (1983)
Diomedeidae	*Thalassarche chlororhynchos*	yellow-nosed mollymawk	Vagrant	R. Parrish, pers. comm
	Thalassarche melanophrys	black-browed mollymawk	Coloniser	Kelly (1983)
Phalacrocoracidae	*Phalacrocorax melanoleucos brevirostris*	little shag	At risk – naturally uncommon	Kelly (1983)
	Phalacrocorax varius	pied shag	Threatened – nationally vulnerable	Kelly (1983)
Procellariidae	*Pachyptila turtur**	fairy prion	At risk – relict	Kelly (1983)
	*Pelagodroma marina maoriana**	white-faced storm petrel	At risk – relict	Kelly (1983)
	*Pelecanoides urinatrix urinatrix**	northern diving petrel/ Richdale's diving petrel	At risk – relict	Kelly (1983)
	Pseudobulweria rostrata rostrata	Tahatian petrel	Vagrant	Powlesland & Pickard (1992)
	*Pterodroma macroptera gouldi**	grey-faced petrel	At risk – recovering	Kelly (1983)
	Pterodroma nigripennis	black-winged petrel	Not threatened	Kelly (1983)
	*Pterodroma pycrofti**	Pycroft's petrel	At risk – recovering	Kelly (1983)
	*Puffinus assimilis haurakiensis**	North Island little shearwater	At risk – recovering	Kelly (1983)
	*Puffinus bulleri**	Buller's shearwater	At risk – naturally uncommon	Kelly (1983)
	Puffinus carneipes	flesh-footed shearwater	At risk – declining	Kelly (1983)
	*Puffinus gavia**	fluttering shearwater	At risk – relict	Kelly (1983)
	*Puffinus griseus**	sooty shearwater/ muttonbird	At risk – declining	Kelly (1983)
	Puffinus tenuirostris	short-tailed shearwater	Migrant	Kelly (1983)
Order Coraciiformes				
Alcedinidae	*Todiramphus sanctus vagans*[161]*	sacred kingfisher***	Not threatened	Kelly (1983)
Order Pelecaniformes				
Sulidae	*Sula serrator**	Australian gannet	Not threatened	Kelly (1983)
Order Sphenisciformes				
Spheniscidae	*Eudyptula minor iredalei**	northern blue penguin	At risk – declining	Kelly (1983)

* Birds that breed on the Poor Knights Islands

** Threat categories as assessed by Miskelly *et al.* (2008). Categories are: 1a) Threatened – nationally critical, 1b) Threatened – nationally endangered, 1c) Threatened – nationally vulnerable, 2a) At risk – declining, 2b) At risk – recovering, 2c) At risk – relict, 2d) At risk – naturally uncommon, 3) Not threatened, 4) Coloniser, 5) Migrant, 6) Vagrant, 7) Introduced and naturalised. For defination of the categories see Miskelly *et al.* (2008).

*** Kingfishers and herons are not seabirds although they feed in the marine environment. However, Kelly (1983) included these birds in her species list of the Poor Knights Islands Marine Reserve, and thus, they have also been included in this report for comparison purposes.