A Literature Review on the Poor Knights Islands Marine Reserve

Photo: Aerial view of the Poor Knights Islands looking from the south (Keith Hawkins, Department of Conservation).

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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 overall 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. However, owing to funding constraints the document will be written in stages as time and funding allows. This first report covers the physical environment of the reserve, marine vertebrates, fish monitoring, marine macroalgae, subtidal habitats, and biosecurity aspects.

The Poor Knights Islands (Tawhiti Rahi Island and Aorangi Island) 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 and eggs of numerous subtropical 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. One hundred and eighty six species of fish have been recorded from the Poor Knights Islands, of which, approximately 38% are exotic, subtropical species. 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 eggs and larvae from outside New Zealand to sustain population numbers at the Poor Knights Islands. Thus, the population size of these non-breeding species at the Poor Knights Islands varies greatly over time. Fish monitoring studies at the Poor Knights Islands show that fish abundances vary greatly on 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 abundance levels. Four species; banded wrasse (*Notolabrus fucicola*), butterfish (*Odax pullus*), crimson cleanerfish (*Suezichthys aylingi*), and pigfish (*Bodianus vulpinus*); showed a significant decrease in abundance since 1998, and the abundance of 19 other species was not significantly different between 1998 and 2007.

Ten marine mammal species have been recorded from waters around the Poor Knights Islands, consisting of five baleen whales, four toothed whales/dolphins, and the New Zealand fur seal. The most common marine mammals at the Poor Knights Islands are the common dolphin (*Delphinus*

delphis), the bottlenose dolphin (*Tursiops truncatus*), and New Zealand fur seals (*Arctocephalus forsteri*). Four turtle species also occur incidentally at the Poor Knights Islands but do not reside or breed in New Zealand waters.

One hundred and twenty one species of macroalgae have been recorded from the Poor Knights Islands, of which, 62 are intertidal species and 79 are subtidal species (20 species occur both intertidally and subtidally). However, the macroalge of the Poor Knights Islands has not been thoroughly studied and it is likely that this is a conservative estimate. 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. Several rare species of macroalgae are found at the Poor Knights Islands incuding *Gelidium allani, Palmophyllum umbracola,* and *Pedobesia clavaeformis*. A general pattern of zonation exists on intertidal rocky habitats. *Porphyra columbina* dominates the upper littoral zone, followed by *Apophlaea sinclairii* around mid-tide level, and then a band of thin encrusting red or coralline algae. *Xiphophora chondrophylla* dominates the lower intertidal zone on moderately exposed shores, but is replaced by *Durvillea antarctica* when wave exposure is extreme. In subtidal habitats *Carpophyllum angustifolium* and *C. maschalocarpum* dominate shallow waters (< 2 m), *Lessonia variegata* and red turfing algae dominate the 4–6 m depths, and *Ecklonia radiata* dominates deeper waters (6–18 m).

Schiel (1984) initially identified five subtidal habitat types at the Poor Knights Islands in waters less than 30 m deep; vertical reef walls and caves, macroalgal reef habitats, coralline flats/echinoid-dominated reefs, broken rock, and sand. Habitat mapping studies conducted by the National Institute of Water and Atmospheric Research (NIWA) at the Poor Knights Islands have identified two additional, deep water habitats; encrusting corallines, and Centro barrens (named after the moderately high abundances of the Australian sea urchin, *Centrostephenus rodgersii*). The vertical reef wall habitat and macroalgal reef habitat have been well described in the literature, but there is currently a paucity of available information on the other habitat types. NIWA's subtidal habitat mapping studies to be published in 2009 will provide us with detailed information on the other subtidal habitats at the Poor Knights Islands.

The Poor Knights Islands Marine Reserve is a high value area of national significance and the unique marine assemblages present in the reserve need to be protected from modification by invasive pest organisms. To date the only likely invasive pest species recorded from the Poor Knights Islands is the parchment tubeworm, *Chaetopterus* sp., though it is uncertain whether this species is endemic or introduced. The introduced clubbed tunicate, *Styela clava,* has been found in the nearby Tutukaka marina and good management practices need to be put in place to prevent the introduction of invasive species to the Poor Knights Islands.

In summary, this updated literature review of the Poor Knights Islands Marine Reserve has reviewed and interpreted over 60 new references relevant to the marine biota of the Poor Knights Islands since Kelly's 1983 bibliography. Significant new research has been conducted on fish abundance, fish diets, subtidal macroalgal communities, and vertical reef wall communities. Future work will review the biological marine environment, marine invertebrates, marine seabirds, and human use of the Poor Knights Islands marine reserve.

1. Introduction

The Poor Knights Islands Marine Reserve located 24 km off the northeastern coastline of New Zealand (Fig. 1) covers approximately 1890 ha of water, encompassing the waters within 800 m of the Poor Knights Islands (Tawhiti Rahi Island and Aorangi Island) and associated islets, and also includes waters within 800 m of the High Peak Rocks (Pinnacles or Poor Knights Rocks) and Sugar Loaf Rock that lie approximately 8 km to the south of the Poor Knights Islands (Fig. 2 & 3). The region was designated a marine reserve on 18th February 1981. At that time commercial fishing was prohibited 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.

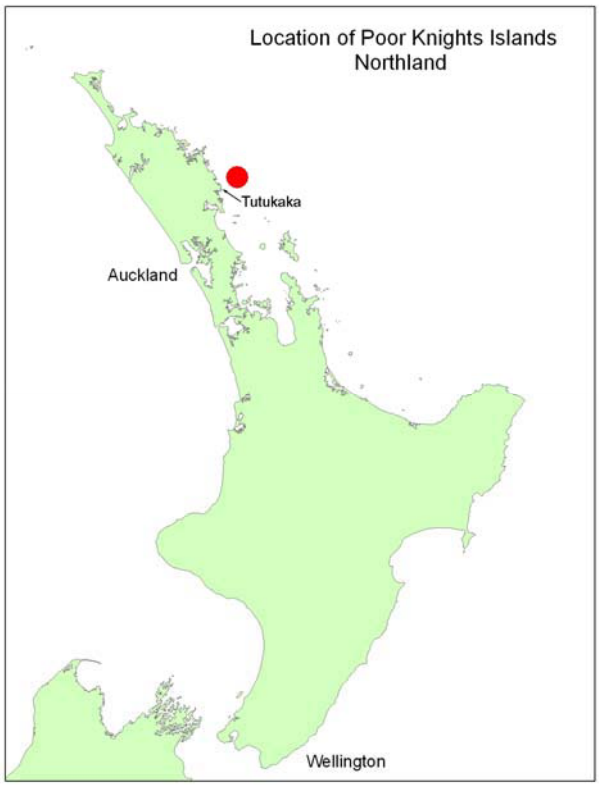

Figure 1 **Location of the Poor Knights Islands Marine Reserve (red dot) (Map: Department of Conservation, Northland Conservancy).**

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

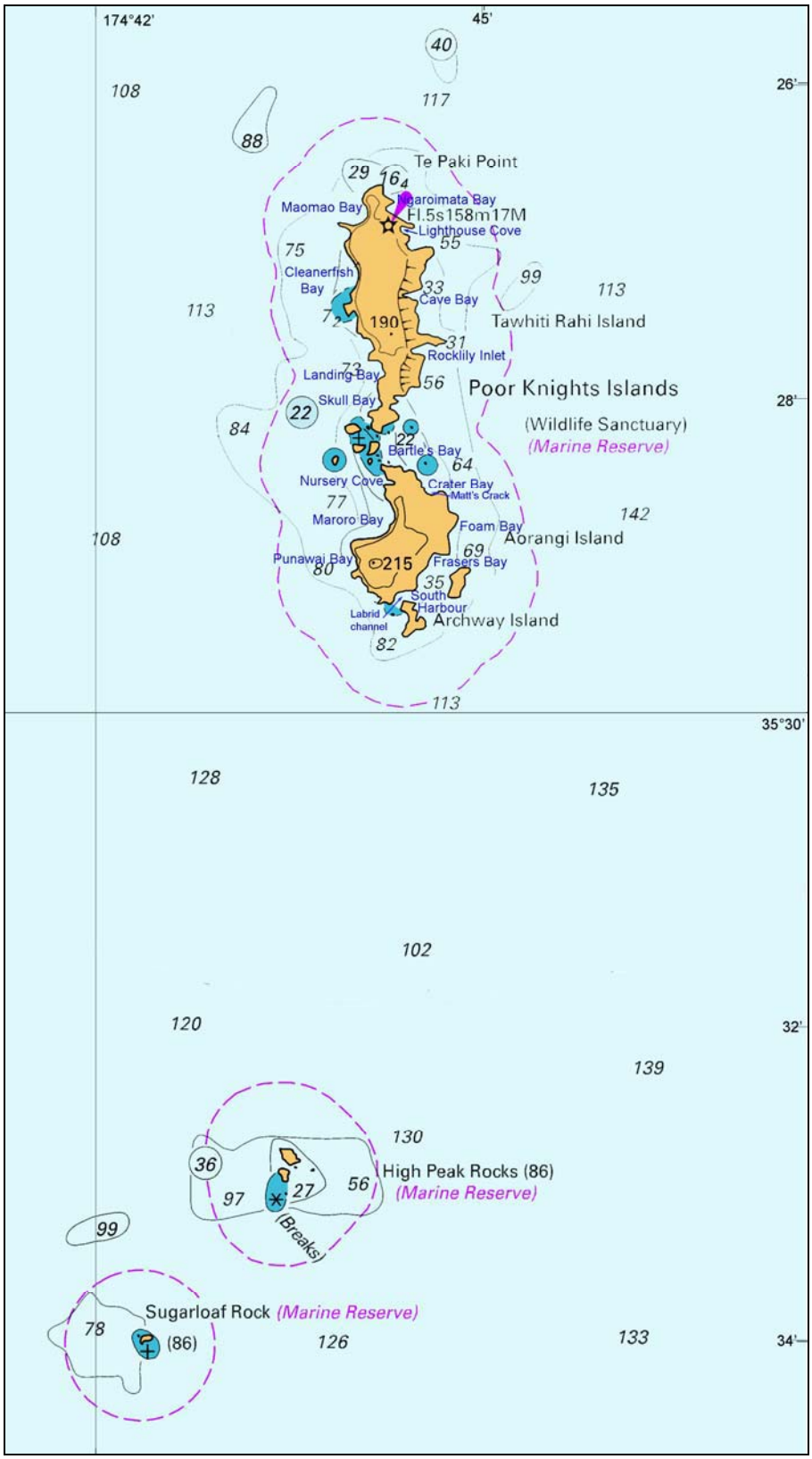

Figure 2 **The Poor Knights Islands Marine Reserve. The purple dashed line shows the reserve boundaries. (Map adapted from Land Information NZ chart NZ521).**

Figure 3 **Tawhiti Rahi Island (foreground) and Aorangi Island. The High Peak Rocks (Pinnacles) and Sugar Loaf Rock can be seen in the distance. (Photo: Keith Hawkins, Department of Conservation).**

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 from the direction of Lord Howe Island and brings warm water and 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 in 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 overall 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

eventual aim is to provide a single, comprehensive document on the Poor Knights Islands Marine Reserve that can be used to assist managers of the reserve to make appropriate management decisions. However, owing to funding constraints the document will be written in stages as time and funding allows. This first report covers the physical environment of the reserve, marine vertebrates, marine macroalgae, subtidal habitats, and biosecurity aspects.

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).

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 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

[2] Skeletal carbonate sands
[3] Rock/stone