Boffa Miskell

# Motiti Natural Environment Management Area

Marine Ecological Literature Review
Prepared for Bay of Plenty Regional Council

# Document Quality Assurance

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*Cover photograph: Otaiti, May 2016, Dr Phil Ross.*

# Executive Summary

The appeal to the Proposed Regional Coastal Environment Plan (2015) requesting the BOPRC provide greater protection (with a focus on fishing restrictions) for Outstanding Natural Features and Landscapes around Motiti Island was novel. Regional Councils around New Zealand had not been asked to manage fishing until this time.

The Bay of Plenty Regional Council have the responsibility to protect the flora and fauna around Motiti Island in three marked protected areas as per section A1 of the court ruling. The Motiti Protection Areas will be no take protected areas, where flora and fauna removal will be prohibited.

The three Motiti Protection Areas focus on high value reef systems;

- Otaiti (Astrolabe), Te Papa (Brewis Shoal), Te Poroiti and Okarapu
- Motuhaku Island (Schooner Rocks)
- Motunau (Plate Island) and Tokoroa

The Bay of Plenty Regional Council (BOPRC) sought a comprehensive review and compilation of the current scientific knowledge in the Motiti Natural Environment Management Area and Motiti Protection Areas and assist their management of those areas.

This report provides a summary of the existing information, collated geo-spatial data where it was available, identifies research gaps and future research priorities that will fulfil BOPRC responsibility to protect the biodiversity and values of the Motiti Natural Environment Management Area and Motiti Protection Areas.

<u>Otaiti</u>

Otaiti is comparable both in ecology and geology to a number of other Bay of Plenty reefs and islands. These include Okarapu Reef, Brewis Shoal, Motuhaku (Schooner Rocks), Tokoroa Shoal and Motunau (Plate Island) to the south, and Penguin Shoal, Tuhua Reef and Tuhua (Mayor Island) to the north. All of these reefs are pinnacles of rock rising out of depths of between 40 and 100m to either break the surface or come within 12m or less of doing so.

The distribution of biology is highly variable across the Otaiti reef, with the distribution of organisms largely determined by water depth and the characteristics of the reef's surface.

This Motiti Protection Area covers 46.3km$^2$ of the Bay of Plenty (Figure 4-1).

As a consequence of the Rena shipwreck, Otaiti is the most extensively studied subtidal reef in the Bay of Plenty. While the bulk of the scientific work has focused on monitoring the distribution and fate of contaminants released from the Rena, a number of ecological studies have also been conducted.

<u>Okarapu</u>

Okarapu consists of two reefs, joined at their base, which rise from a depth of 46m to shallow points of approximately 5m and 6m beneath the ocean surface at low tide. The reef system is approximately 1.4km long (running NW to SE) and 800m wide and covers an estimated 779,687m$^2$ of seafloor. Okarapu is located approximately 17km northeast of the entrance to

Tauranga Harbour. The ecology and geology of Okarapu is comparable to that of Otaiti (described above) and a number of other Bay of Plenty reefs and islands.

<u>Te Poroiti</u>

Te Poroiti is a subtidal reef situated approximately 2km north-east of Okarapu and 4.5km north-west of Motiti. Te Poroiti consists a large area of deep reef covering an estimated 316,056m$^2$ of seafloor with a maximum depth of about 42m. The reef is characterised by a series of reef pinnacles, the tallest of which are located at the southern end of the reef and rise to depths 18 and 6m. There are no known scientific publications documenting the ecology of Te Poroiti.

<u>Te Papa</u>

Te Papa is a subtidal reef situated approximately 3km north of Motiti. Te Papa covers an estimated 126,550m$^2$ of seafloor and the shallowest point on the reef has a depth of 33m and the deepest is 59m. There are no known scientific publications documenting the ecology of Te Papa.

<u>Motuhaku</u>

The Motuhaku reef system covers approximately 115,113m$^2$ of seafloor. The maximum depth of the reef is approximately 77m and the average depth is 35m. The reef system emerges from the ocean at its southern end. The subtidal ecology and geology of Motuhaku is comparable to that of Otaiti.

<u>Tokoroa</u>

Tokoroa is a roughly circular reef system with width of approximately 1km. It occupies approximately 727,518m$^2$ of seafloor with an average depth of 25m, a maximum depth of 51m and a minimum depth of 4m. There are no known scientific publications documenting the ecology of Tokoroa Shoal.

<u>Motiti Island</u>

Motiti Island is the only permanently inhabited offshore island along the Bay of Plenty Coastline. Motiti is less intact than the other features within the grouping and less natural. There is a high abundance and diversity of biological life in the seabed and ocean surrounding reefs within the Motiti Natural Environment Management Area.

A summary is provided of the marine ecological values and species that are within the Motiti Natural Environment Management Area but outside the Motiti Protection Areas (this includes Motiti Island). These areas include the coastal reefs and waters around Motiti Island itself, and reef and soft sediment habitats situated throughout the Motiti Natural Environment Management Area. The Motiti Natural Environment Area is listed in the Regional Coastal Environment Plan as an area of significant conservation value (ASCV 25), yet relatively little is known about the ecology of the area, outside of what is described in the above sections of this report.

There is very little information available on the reef systems of the Motiti Natural Environment Management Area that do not fall within the Motiti Protection Area. The majority are deep (>25 m), have not been mapped, and have not been the subject of scientific investigation. It is likely that the ecology of these reefs is similar to that described for Otaiti.

The Environment Court did not implement any protections over the parts of the Motiti Natural Environment Management Area not falling within the three Motiti Protection Areas. However, the court did conclude that there should be further ecological investigations conducted within the Motiti Natural Environment Management Area and this could lead to the imposition of controls in the future.

Gap Analysis and Recommendations

Survey work conducted at Otaiti provides an excellent picture of the biodiversity present on this reef. It is likely that many of the species present on Otaiti are also found on reefs throughout the Motiti Natural Environment Management Area. It is also possible that there are differences in biodiversity between reefs and there may even be species that are unique to certain reefs within the Motiti Natural Environment Management Area. Benthic ecology data will be key to determining the ecological changes that occur within the Motiti Protection Areas following their implementation.

A considerable amount of time and resources would be required to address all of the knowledge gaps identified in Section 10 and Table 10-1 below relating to marine ecological values.

# Contents

# 1.0 Introduction

The appeal to the Proposed Regional Coastal Environment Plan (2015) requesting the BOPRC provide greater protection (with a focus on fishing restrictions) for Outstanding Natural Features and Landscapes around Motiti Island was novel. Regional Councils around New Zealand had not been asked to manage fishing until this time.

The High Court and Court of Appeal agreed that Regional Councils can manage fishing in order to protect indigenous biodiversity values in their region.

In May 2018 the Environment Court (Decision No. [2018] NZEnvC 067; 11 May 2018) released an interim decision directing three areas for protection (Section A1):

> *"The damage, destruction, removal of flora and fauna within the three marked areas of the Motiti Natural Environment Management Area (MNEMA) in the Bay of Plenty proposed Regional Coastal Environment Plan (PRCEP) shall be prohibited."*

The final decision on the Motiti Protection Areas was released by the Environment Court on 24 April 2020 (Decision No. [2020] NZEnvC 050; 24 April 2020). BOPRC are now required to prepare new rules in the Regional Coastal Environment Plan to protect the three reef systems (see

Figure 1-1), including undertaking additional monitoring to inform future integrated marine management solutions. The taking of organisms from the three Motiti Protection Areas will be prohibited in a couple of months once the new rules have been established, approved by the Minister for Conservation and inserted into the Regional Coastal Plan[1].

The three protection areas are focused on high value reef systems around Motiti Island including: Otaiti (Astrolabe Reef; including Te Papa (Brewis Shoal), Te Poroiti, and Okarapu), Motuhaku Island (Schooner Rocks), and Motunau Island (Plate Island) (

Figure 1-1). The Bay of Plenty Regional Council have the responsibility to protect the flora and fauna around Motiti Island in three marked protected areas as per section A1 of the court ruling (

Figure 1-1). The Motiti Protection Areas will be no take protected areas, where flora and fauna removal will be prohibited. The Bay of Plenty Regional Council (BOPRC) sought a comprehensive review and compilation of the current scientific knowledge in the Motiti Natural Environment Management Area and Motiti Protection Areas and assist their management of those areas.

The three Motiti Protection Areas focus on high value reef systems (

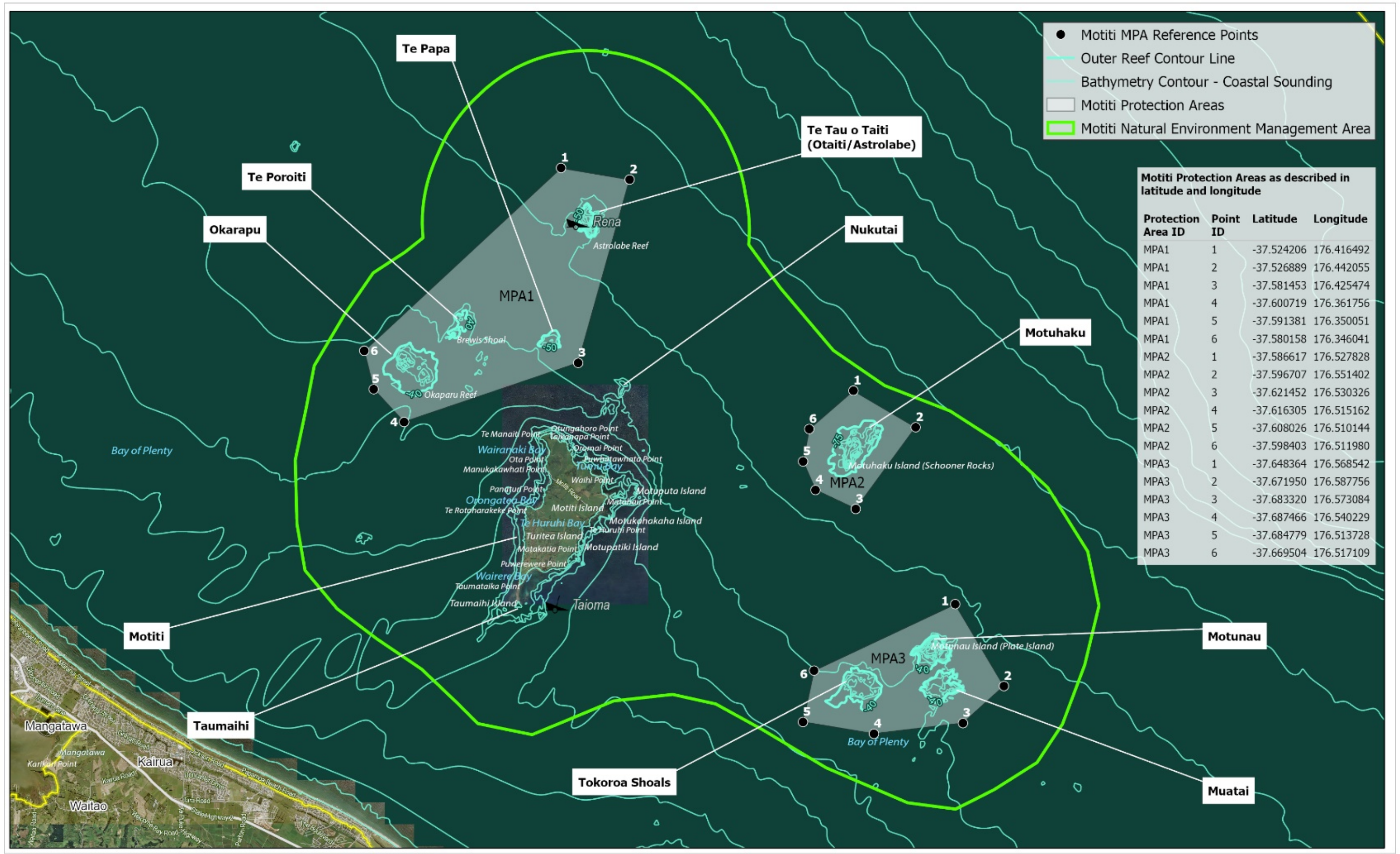
Figure 1-1);

- Otaiti (Astrolabe), Te Papa (Brewis Shoal), Te Poroiti and Okarapu (often incorrectly called Okaparu)
- Motuhaku Island (Schooner Rocks)
- Motunau (Plate Island) and Tokoroa

This report provides a summary of the existing information, collated geo-spatial data where it was available, identifies research gaps and future research priorities that will fulfil BOPRC

[1] https://www.boprc.govt.nz/our-projects/motiti-protection-area/

responsibility to protect the biodiversity and values of the Motiti Natural Environment Management Area and Motiti Protection Areas.




BAY OF PLENTY REGIONAL COUNCIL TOI MOANA

Proposed RCEP data as of published date April 2016

Projection information
This map is in the New Zealand Transverse Mercator and uses both Coastal 2014 aerial photography and RDAM 2011 aerial photography.

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**Motiti Protection Areas within Motiti Natural Environment Management Area**

0 1 2 3 4 5
Kilometers

GSP_584672

Printed: 3/06/2020

*Figure 1-1: Motiti Natural Environment Management Area and Motiti Protection Areas. Also shown are the names of the major reef systems.*

# 2.0 Report Structure

This report outlines the current body of scientific published information by summarising the context of the coastal habitats across the wider Bay of Plenty before focusing on the current information available related to the Motiti Protection Areas. The report summarises the physical description and shares the current scientific knowledge regarding the reef habitats, any relevant consent monitoring and includes anecdotal observations presented as evidence in respective Court Cases.

The project brief included researching the following sources of information:

- Evidence presented by various parties in appeals to the Regional Coastal Plan in the Environment Court case in 2017
- Commercial fisheries data requested from the Ministry of Primary Industries
- Evidence presented by various parties in the Rena Resource Consent Application, hearings and subsequent monitoring (2016-2020)
- University of Waikato and Toi Ohomai field research undertaken after Rena grounding in 2011.

The literature review provides the basis of a gap analysis of the current state of knowledge and identifies steps to build scientific knowledge to support future decision making.

# 3.0 Coastal Habitats of the Bay of Plenty

In 2008, the Department of Conservation (DOC) commissioned scientific research by help identify coastal marine habitats as potential components of a network of marine protected areas (Haggitt et al. 2008). The project had two main objectives. The first, to classify habitats across estuarine and marine environments in accordance with the Marine Protected Areas classification protection standard and implementation guidelines within the Bay of Plenty region (Figure 3-1). The Marine Protected Area classification, protection standard and implementation guidelines developed by the Ministry of Fisheries and the Department of Conservation identified a total of 43 habitat types dependent on environment, depth, and exposure classes. The second objective was to provide a measure of certainty/confidence relating to the habitat classification (Haggitt et al. 2008).

The Bay of Plenty Coastal Marine Area (CMA – estuarine and marine) was assigned to a total of 10 Marine Protected Area habitat classes. These varied considerably in spatial extent (percent cover) across the region (Figure 3-1,Table 3-1).).

*Table 3-1 Percent cover and corresponding number of grid cells for estuarine (intertidal and subtidal) and marine (intertidal, shallow subtidal, and deep subtidal) environments across the Bay of Plenty (from Haggitt et al. 2008).*

| Estuarine Habitat | Percent Cover (total # of 200m$^3$ cells) | |
|---|---|---|
| | Intertidal | Subtidal |
| Mud flat | 2.57 (n=6,351) | |
| Sand flat | | 0.39 (n=963) |

| Marine Habitat | Percent Cover (total # of 200m$^3$ cells) | | |
|---|---|---|---|
| | **Intertidal** | **Shallow Subtidal** | **Deep Subtidal** |
| Gravel beach | 0.01 (n=17) | | |
| Shallow sand | | 11.44 (n=28,232) | |
| Shallow rocky reef | | 1.38 (n=3,406) | |
| Shallow gravel field | | 1.57 (n=3,876) | |
| Unknown | | 3.38 (n=8,332) | |
| Deep sand | | | 67.04 (n=165,472) |
| Deep mud | | | 7.28 (n=17,971) |
| Deep gravel field | | | 4.23 (n=10,439) |
| Deep rocky reef | | | 0.72 (n=1,773) |

Intertidal and subtidal estuarine areas such as Tauranga Harbour and Ohiwa Harbour, were dominated by intertidal mudflats, followed by subtidal sand flat habitat in main channel areas.

Shallow subtidal regions (< 30m depth – Medium exposure) were characterised by extensive sand habitat (*c.* 80 % of the shallow subtidal area), interspersed with gravel and shallow rocky reef habitat (both *c.*10 % of the shallow subtidal area). Gravel fields were spatially dominant in the western Bay of Plenty shallow subtidal, with shallow rocky reef forming a relatively continuous band along the coastline east of Opotiki out to Cape Runaway. Shallow rocky reef also occurred in isolated patches in central and western areas of the Bay of Plenty region (Figure 3-1).

Common habitats in deeper subtidal regions (> 30m depth – low exposure) were sand, gravel patches, rocky reef and mud. Of these, sand was ubiquitous (*c.* 85% of the deep subtidal), whereas mud habitat (10% of the deep subtidal) was spatially variable being abundant east of White Island, in the central Bay of Plenty region and in the north-west tip of the survey boundary. Gravel patches occurred across the entire region accounting for around 5% of the deep subtidal area, with deep rocky reef considerably lower in spatial extent (< 1%) (Figure 3-1).

Intertidal marine environments were dominated by sand and gravel beach habitats, however due to the survey cell size used for analysis (i.e. 200m$^2$), these and other habitats such as intertidal rocky platforms could not be adequately represented.

In November 2012, Kulgemeyer et al. (2016) mapped and analysed the sediment dynamics of the western Bay of Plenty using a newly developed multi-sensor benthic profiler MARUM NERIDIS III. An area of 60km × 7km between 2 and 35m water depth was surveyed with this bottom-towed sled equipped with a high-resolution camera for continuous close-up seafloor photography and a conductivity temperature depth meter with a connected turbidity sensor. This multi-parameter dataset was combined with sidescan sonography and sedimentological analyses to create detailed lithofacies and bedform distribution maps and to derive regional sediment transport patterns (Figure 3-2).

For the assessment of sediment distribution, photographs were classified, and their spatial distribution mapped out according to associated acoustic backscatter from a sidescan sonar. This provisional map was used to choose target locations for surficial sediment sampling and subsequent laboratory analysis of grain size distribution and mineralogical composition. Finally, photographic, granulometric and mineralogical facies were combined into a unified lithofacies map and corresponding stratigraphic model.

Eight distinct types of lithofacies with seawards increasing grain size were discriminated and interpreted as reworked relict deposits overlain by post-transgressional fluvial sediments (Figure 3-3). The dominant transport processes in different water depths were identified based on type and orientation of bed forms, as well as bottom water turbidity and lithofacies distribution. Observed bedforms include subaquatic dunes, coarse sand ribbons and sorted bedforms of varying dimensions, which were interpreted as being initially formed by erosion. Under fair weather conditions, sediment is transported from the northwest towards the southeast by littoral drift. During storm events, a current from the southeast to the northwest is induced which is transporting sediment along the shore in up to 35m water depth. Shorewards oriented cross-shore transport is taking place in up to 60m water depth and is likewise initiated by storm events (Figure 3-2).

## 3.1 Marine Protected Areas and Monitoring in the Bay of Plenty

There are two marine protected areas in the Bay of Plenty. The Tuhua (Mayor Island; 1,060 ha) Marine Reserve established in 1993, and the Te Paepae o Aotea (Volkner Rocks; 1,267 ha) Marine Reserve established in 2006. Neither of these marine protected areas has been monitored by the Department of Conservation to the same extent as other marine reserves, such as Poor Knights Islands, Cape Rodney-Okakarei Point (Goat Island), Tawharanui or Whanganui-A-Hei (Cathedral Cove).

The Department of Conservation has worked with the Tuhua Trust Board and Dr Keith Gregor (and Marine Studies students) of Toi Ohomai (formerly the Bay of Plenty Polytechnic) to monitor fish populations in the marine reserve at Tuhua (Mayor Island). In the most recent report (Morrison and Gregor 2012), it is noted that snapper populations in the marine reserve have increased in size and abundance between 2004 and 2011. Prior to 2011, there was no evidence of snapper populations having increased inside the marine reserve (Young et al. 2006).

Shears et al. (2008) reported on ecological responses in the Tuhua marine reserve in a paper examining the effects of fishing on food web dynamics across marine protected areas on the north-east coast of New Zealand. It was noted that when surveys were conducted (March 2000) there was no evidence that snapper or crayfish were more abundant within the Tuhua Marine Reserve relative to unprotected areas. This is consistent with earlier findings of (Young et al. 2006). Shears et al. (2008) also reported no significant difference in the coverage of urchin barrens habitat or macroalgal biomass in fished vs. protected area. Details on the benthic ecology of Tuhua, including macroalgal and invertebrate biodiversity, are reported in Shears and Babcock (2007).

Underwater visual surveys of fishes, mobile invertebrates and sessile biota were undertaken at Tuhua and Te Paepae o Aotea in 2012 and 2013 as part of a larger survey (Edgar et al. 2017). using the Reef Life Survey methodology (Edgar and Stuart-Smith 2014). Tuhua was unusual among the six reserves examined in that urchin densities were not lower within the protected area (vs. the fished survey sites). Coverage of *Ecklonia* was reported as being greater at within surveyed reserves sites at both Tuhua and Te Paepae o Aotea. Few crayfish were observed at either location.

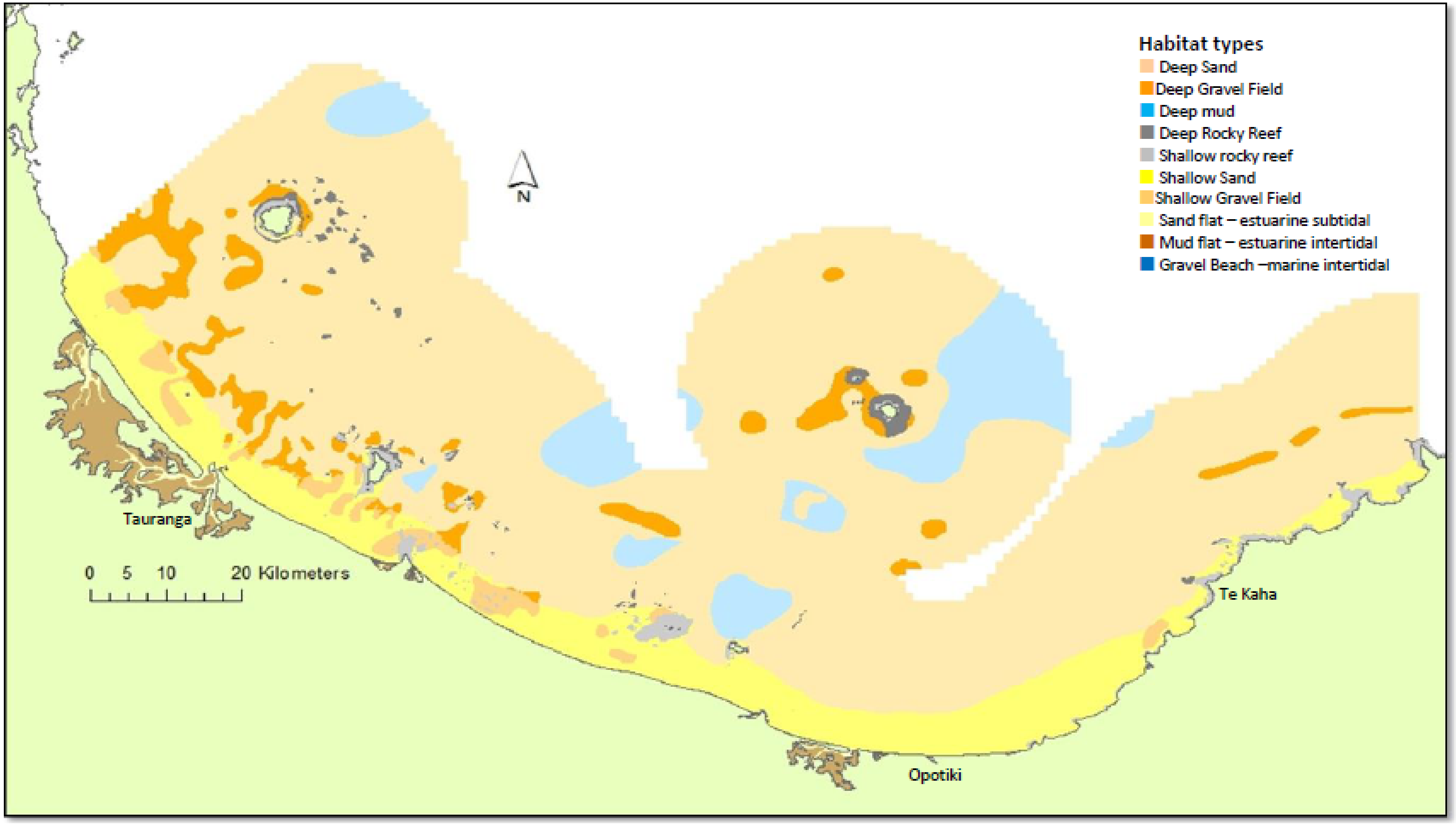


*Figure 3-1 Classification of habitat classes across the Bay of Plenty region, as per the MPA classification protection standard and implementation guidelines (from Haggitt et al 2008).*

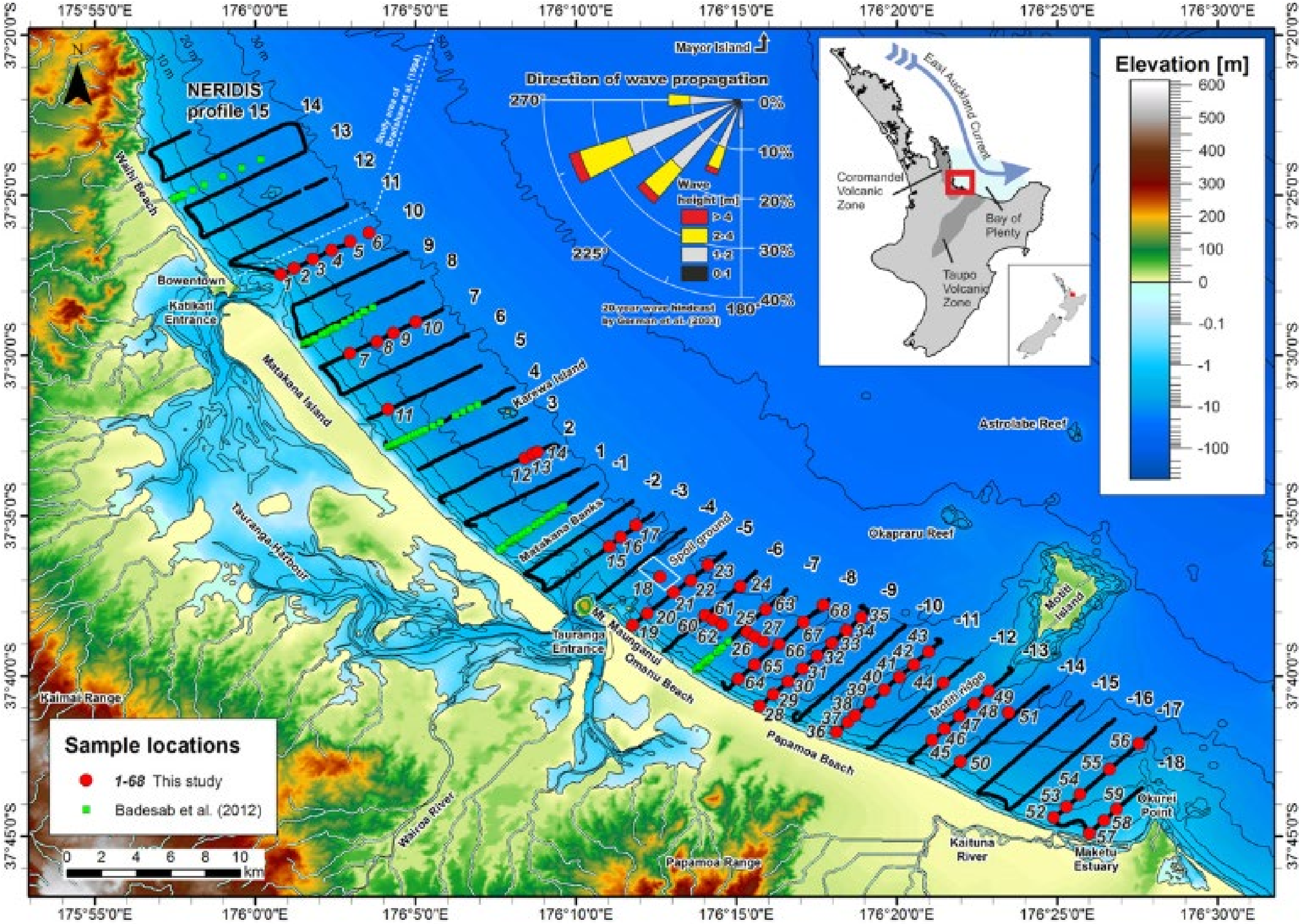


*Figure 3-2 Overview of the Kulgemeyer et al. (2016) study area with sample locations and NERIDIS survey profiles.*

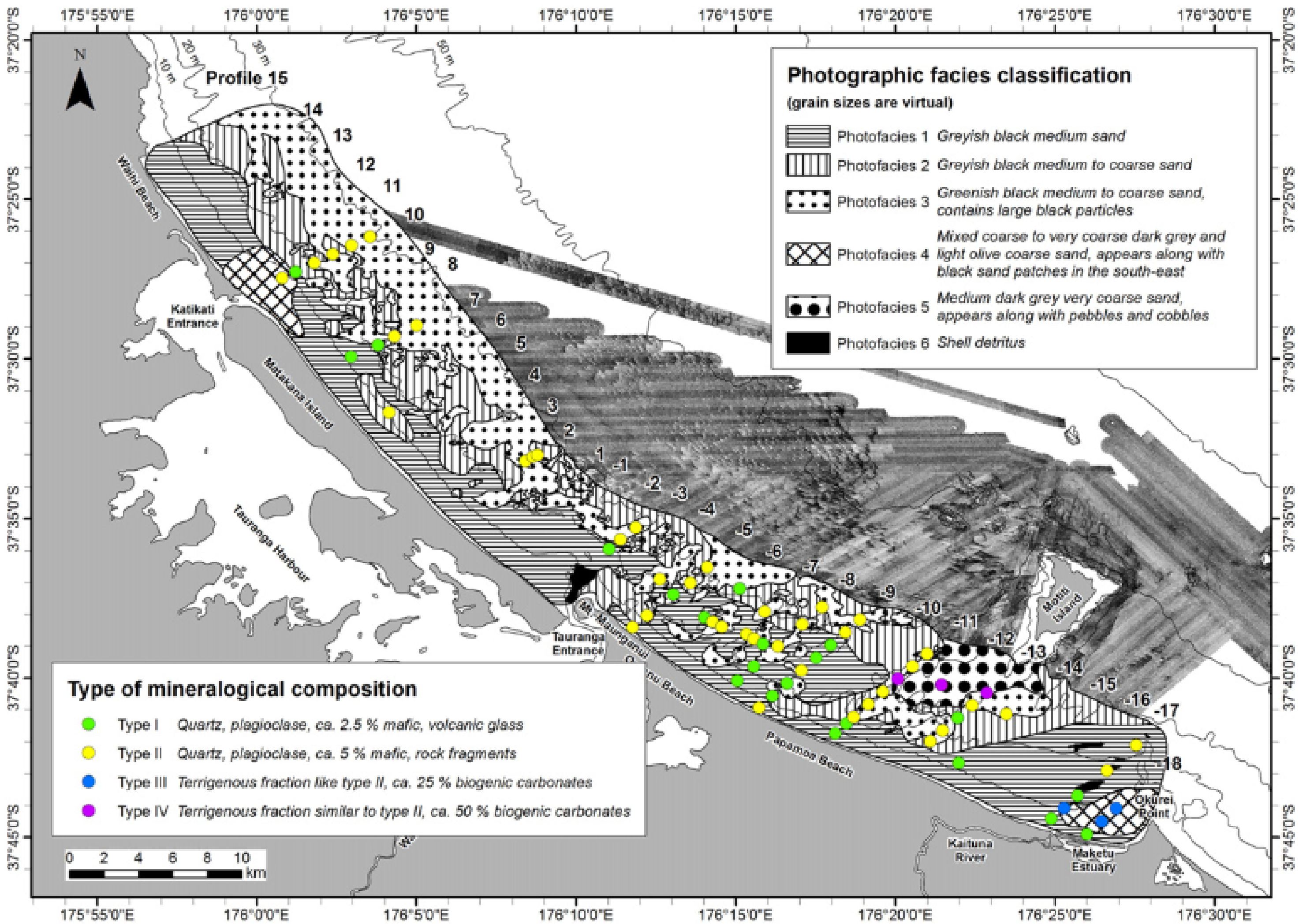


Figure 3-3 Spatial distribution of mineralogical composition derived from samples and photographic facies (from Kulgemeyer et al. 2016).

# 4.0 Motiti Protection Area containing Otaiti, Okarapu Reef, Te Poroiti and Te Papa (Brewis Shoal)

The Motiti Protection Area containing Otaiti, Okarapu, Te Poroiti, Te Papa and other unnamed reefs is the largest of the three management areas designated by the Environment Court. This Motiti Protection Area covers 46.3km$^2$ of the Bay of Plenty (Figure 4-1).

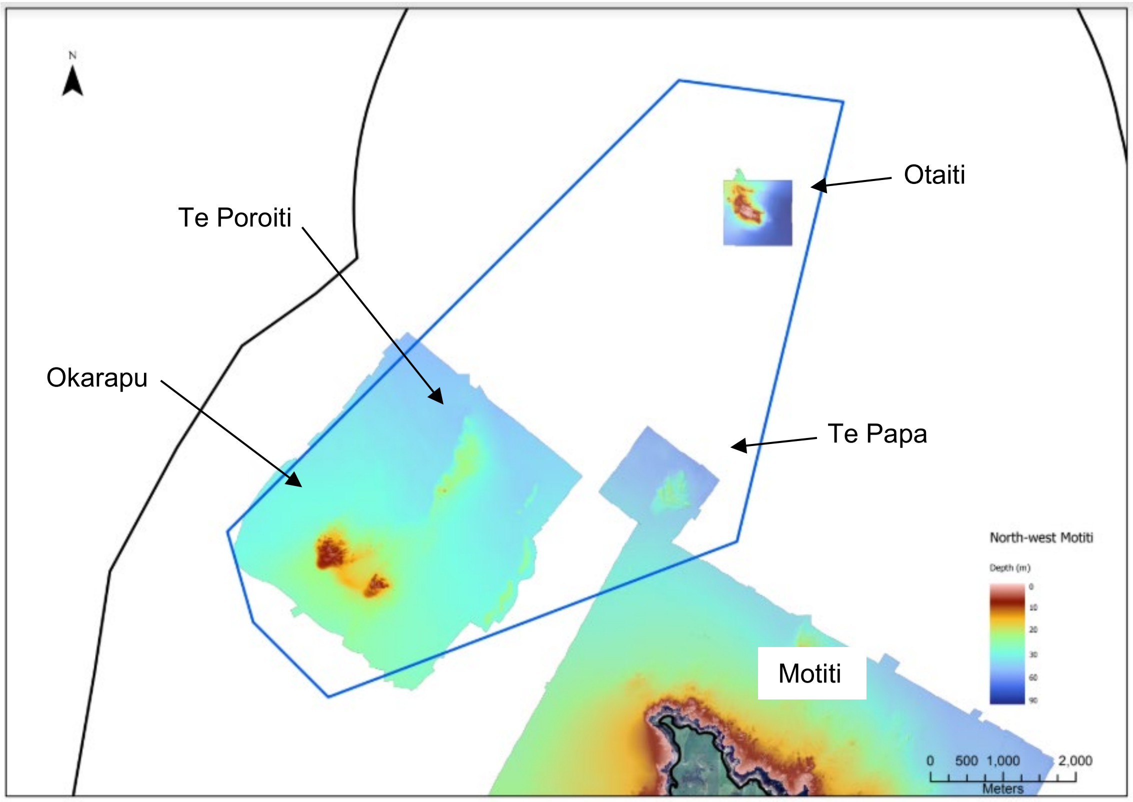


*Figure 4-1 Multibeam Echosounder Bathymetry of reef systems to north-west of Motiti, Otaiti, Okarapu Reef, Te Poroiti and Te Papa (Brewis Shoal).*

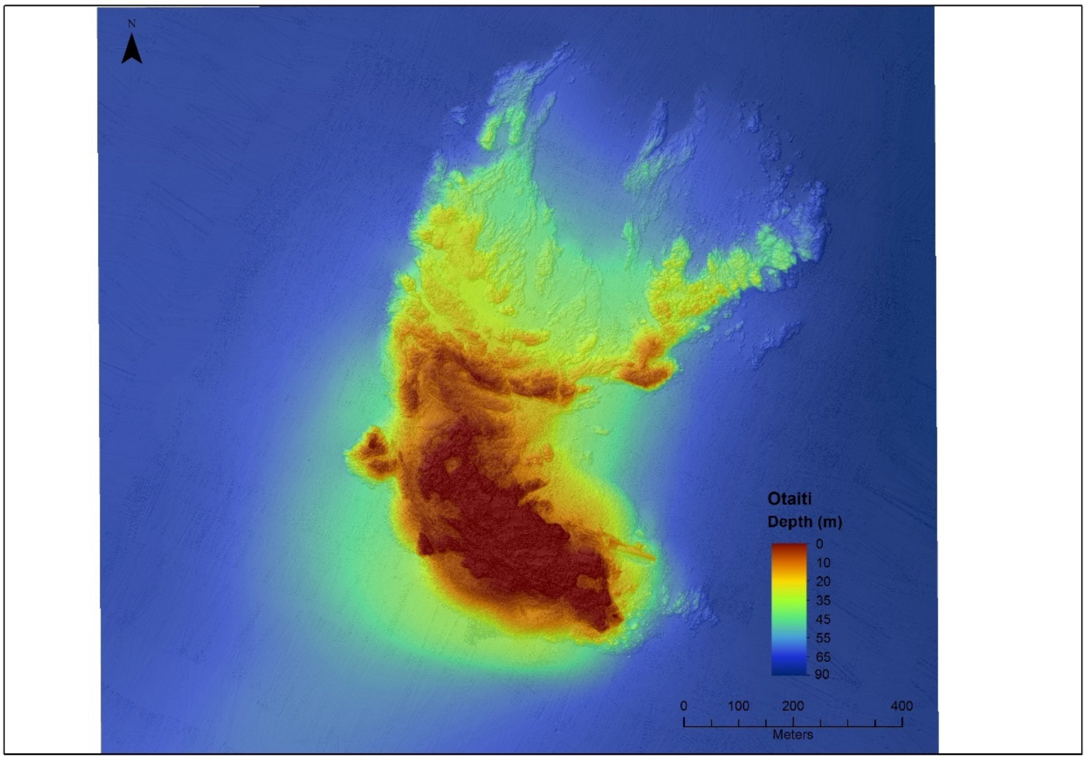


Figure 4-2 *Multibeam Echosounder Bathymetry of Otaiti.*

### 4.1.1 Description

Otaiti rises from a depth of around 70m and breaks the sea surface at mid to low tides. The reef has a base circumference of about 1 km and covers an estimated 461,587m$^2$ of seafloor. At high tide the reef is entirely submerged. Between mid and low tide, a small section of reef, with a surface area somewhere in the range of 15 to 25m$^2$, breaks the water's surface. Otaiti is located approximately 25km northeast of the entrance to Tauranga Harbour (Figure 1-1). Motiti Island is approximately 6.5km to the south and Tuhua (Mayor Island) is 30km to the north.

Otaiti is comparable both in ecology and geology to a number of other Bay of Plenty reefs and islands. These include Okarapu Reef, Brewis Shoal, Motuhaka (Schooner Rocks), Tokoroa Shoal and Motunau (Plate Island) to the south, and Penguin Shoal, Tuhua Reef and Tuhua (Mayor Island) to the north. All of these reefs are pinnacles of rock rising out of depths of between 40 and 100m to either break the surface or come within 12m or less of doing so.

The distribution of biology is highly variable across the Otaiti reef, with the distribution of organisms largely determined by water depth and the characteristics of the reef's surface. The shallower and steeper sections of the reef are largely bedrock. In the deeper and less steep sections of reef, in addition to bedrock, there are boulder fields sitting atop the bedrock and some areas of sand and gravel. Below depths of approximately 40m, towards the base of the reef where the gradient shelves off, the character of the seafloor changes to boulder fields, then cobbles, then gravel then eventually to sand and the Bay of Plenty seafloor. Across these deeper boulder/cobble/gravel sections of reef there are also sections of bedrock reef which protrude from the sea floor. These reefs can be seen on bathymetric charts of Otaiti, particularly to the north and east (Figure 4-2

Figure 4-2).

### 4.1.2 The Rena shipwreck and associated environmental knowledge

As a consequence of the Rena shipwreck, Otaiti is the most extensively studied subtidal reef in the Bay of Plenty. While the bulk of the scientific work has focused on monitoring the distribution and fate of contaminants released from the Rena, a number of ecological studies have also been conducted. The majority of the following information in this section has been sourced (largely verbatim) with permission from the Rena Physical Environment Reference Report prepared as a condition of BOPRC resource consent RC67891 (Ross at al. 2018).

On 5 October 2011, the container ship MV Rena grounded on Otaiti (Astrolabe Reef) approximately 25km northeast of the entrance to Tauranga Harbour causing the discharge of oil and the loss of debris and cargo overboard. Over the following days and months, the vessel condition further deteriorated, broke apart and sank resulting in further significant losses of oil and cargo. The key impacted locations were Otaiti (the site where the Rena ran aground) and nearby Motiti Island, which was heavily affected by oil and debris immediately following the grounding. Salvage and recovery operations, including debris field clearance, were undertaken and ceased on 1 April 2016.

There has been a large amount of scientific data collected at Motiti and Otaiti for the purposes of identifying and quantifying effects of the Rena grounding on marine ecological values and for the assessment of the suitability of organisms for human consumption. Sampling has also been conducted periodically at control/reference locations: Tuhua (Mayor) Island and Rurimu Islands (located approximately 30km to the northwest and 50km to the southeast of Otaiti respectively).

### 4.1.3 Reef habitat

Broad scale habitat mapping has been undertaken to describe the distribution of major ecological habitats across Otaiti based on recognised habitat classification schemes.

The most distinctive habitats at Otaiti and their approximate depth are listed in Table 4-1. Based on the habitat map provided in Figure 3-1, it is possible to calculate the surface area and percentage of each habitat impacted in some way by the wreck. The biological habitats found to be most impacted by the Rena, in terms of affected reef surface area, were as follows: kelp forest (2,741m$^2$); kelp forest with sponge understory (2,843m$^2$); and the kelp-sponge transition zone (3,420m$^2$). When calculated by the proportion of a biological habitat that was impacted by the Rena, the most affected habitats were: shallow mixed algae (14.5%); mixed algae (10.6%); and the kelp forest with sponge understory habitat (10.1%) (Ross, 2016).

*Table 4-1: Spatial extent of reef habitats and the physical impacts of Rena wreckage and debris at Otaiti Reef. Calculations are based on the 2015 bathymetric survey and 2016 predictive habitat map (Ross, 2016). Pre-Rena habitat estimates are derived from the depth distribution of different habitat types and the surface area of reefs available at those depths.*

| Habitat Zone | Depth (m) | Pre-Rena habitat extent (m$^2$) | Area occupied by wreck (m$^2$) | Area impacted but not occupied by wreck (m$^2$) | Total area impacted (m$^2$) | Total habitat area not occupied by wreck (m$^2$) |
|---|---|---|---|---|---|---|
| Shallow mixed algae | 0-5 | 10,259 | 724 | 768 | 1,492 | 9,535 |
| Mixed algae | 5.1-10 | 18,087 | 489 | 1 421 | 1,910 | 17,598 |
| Mixed algae/kelp | 10.1-13 | 12,782 | 287 | 312 | 599 | 12,495 |
| Kelp forest | 13.1-25 | 73,043 | 1,703 | 1038 | 2,741 | 71,340 |
| Kelp forest/ sponge | 25.1-30 | 28,014 | 2,122 | 721 | 2,843 | 25,892 |

| Habitat Zone | Depth (m) | Pre-Rena habitat extent ($m^2$) | Area occupied by wreck ($m^2$) | Area impacted but not occupied by wreck ($m^2$) | Total area impacted ($m^2$) | Total habitat area not occupied by wreck ($m^2$) |
|---|---|---|---|---|---|---|
| Kelp/sponge transition | 30.1-40 | 69,071 | 2,978 | 442 | 3,420 | 66,093 |
| Deep sponge reef boulders | 40.1-55 | 250,331 | 1,254 | 0 | 1,254 | 249,077 |
| Total | | **461,586** | **9,557** | **4 702** | **14,259** | **452,030** |

#### 4.1.3.1 Otaiti reef habitat descriptions (P. M. Ross et al., 2018)

The shallow mixed algae habitat (depth range of 0-5m) is dominated by the macroalgae *Lessonia variegata* and *Carpophyllum flexuosum* and *plumosum*. The subcanopy, which is the area underneath the larger algal species, is fairly dense and is composed of foliose red and brown algae including *Xiphophora chondrophylla*, *Champia laingii*, *Chondracanthus chapmanii*, *Hymenena* sp. *Pterocladia lucida*, *Vidalia colensoi*, *Codium* sp., *Colpomenia peregrine*, *Carpomitra costata*, *Dictyota* sp., *Halopteris* sp., *Microzonaria velutina*, *Zonaria aureomarginata* and a variety of forms of coralline algae (crustose, articulated and pink paint). The shallow mixed algae community is one that thrives in the highest of high energy environments that can be found in the Bay of Plenty. At Otaiti these organisms occur in the shallowest parts of the reef and are able to thrive despite experiencing the huge swells that caused the break-up of the Rena.

The mixed algae habitat (depth range of 5-10m) is dominated by *Carpophyllum flexuosum*. There is some *Lessonia variegata* present. The sub canopy is dense and is composed of the foliose red and brown algal species listed above.

In the mixed algae – kelp transition zone (10-13m), macroalgal stands are a mixture of *Carpophyllum*, *Ecklonia radiata* and some *Lessonia variegata*. The sub-canopy is composed of a moderate to sparse cover of foliose red and brown algae.

The kelp forest habitat (13-25m), is more homogenous than the habitats found at shallower depths and is dominated by stands of large kelp *Ecklonia radiata*. On Otaiti, these plants can attain heights of more than 1.4m. The sub-canopy cover is sparse to moderate and mainly composed of *Zonaria aureomarginata* and crustose coralline algae.

Across the kelp forest depth range, there are also areas of barren rock where canopy-forming macroalgae are absent and there is little in the way of subcanopy. These barren areas are sometimes created and maintained by sea urchins (*Evechinus chloroticus*) grazing down the kelp forest. In other barren areas, the mechanisms by which the reef is kept clear of macroalgae is uncertain as few urchins were observed at some barren areas during survey work. Other grazing gastropods, particularly *Cookia sulcata* were observed at relatively high densities in these barren areas but are unlikely to be responsible for reducing kelp cover. It is possible that these snails could, through their grazing activity, maintain barren areas previously created by sea urchins.

Across a depth range of 25-30m, sponges, including *Eciomenia alata* (formerly *Ancorina alata*), *Tethya* spp., *Polymastia* spp. and *Cliona celata*, appear more frequently in the understory of the *Ecklonia* radiata forest. For the purposes of this report, this habitat has been named as the kelp forest with sponge understory zone.

A kelp-sponge transition zone occurs across depths of 30-40m, where *Ecklonia radiata* becomes sparse and the reef is dominated by sponges of a variety of species, including those listed above.

Beyond 40m, areas of bedrock are dominated by sponges as are boulder fields, mainly composed of small and large boulders (some cobbles) and dominated by encrusting sponges. This habitat is referred to, in this report, as the deep sponge reef–boulder zone. Crustose coralline algae and turfing algae may also be present. *Ecklonia radiata*, although rare, still occur at these depths, an indication of the exceptional water clarity at this location.

Across the entire depth range, canopy forming macroalgae are largely absent from areas of reef that are vertical, near vertical or overhung. The biological communities on these sections of reef are dominated by invertebrates, including sponges, ascidians, bryozoans, anemones, nudibranchs and hydroids.

#### 4.1.3.2 Predictive habitat map development

A reef-wide predictive habitat map was developed in ArcGIS using the bathymetry from a multi-beam survey conducted in 2015. The 2015 data were used as they provide greater coverage of Otaiti Reef than the 2014 survey and a more up to date picture of the distribution of Rena wreckage and debris.

Based on the habitat by depth data and the probability of different habitats occurring at a given depth, each 1m depth band was assigned to a specific habitat type. These habitats were then superimposed on the reef bathymetry to produce a predictive habitat map (Figure 4-3) (Ross, 2016) (P. M. Ross et al., 2018).

On the habitat map, each colour represents the predicted distribution of a biological habitat. Survey transects were then overlaid on this predictive habitat map and the habitat distributions modified where necessary to reflect observations. This ground truthing process increased the accuracy of the map.

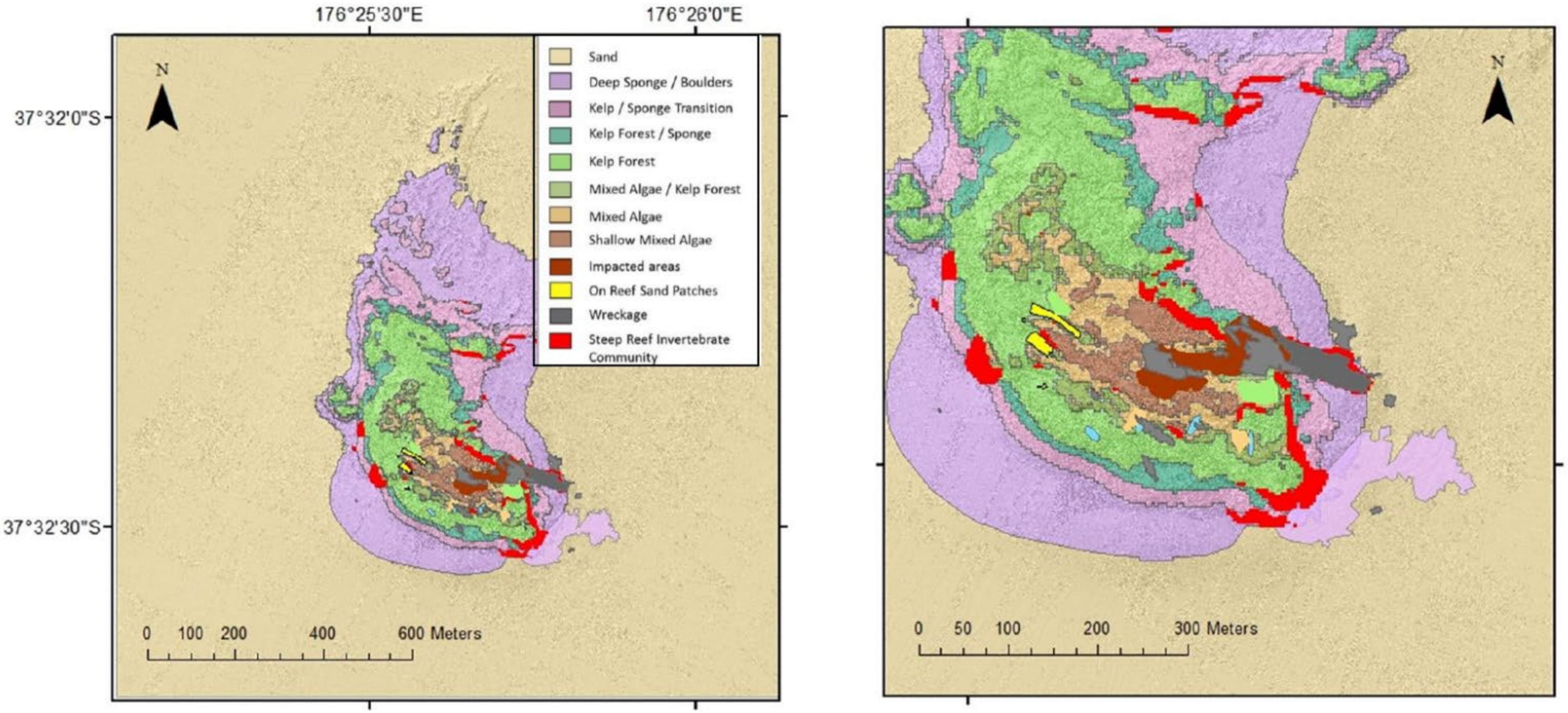


*Figure 4-3: Predictive habitat map of whole Otaiti Reef and habitat around wreckage area (Ross, 2016).*

Rock wall and sloping reef communities

Rock wall and sloping reef communities were surveyed in 2015 (Figure 4-4) (Clark et al., 2016) (Figure 4-4).

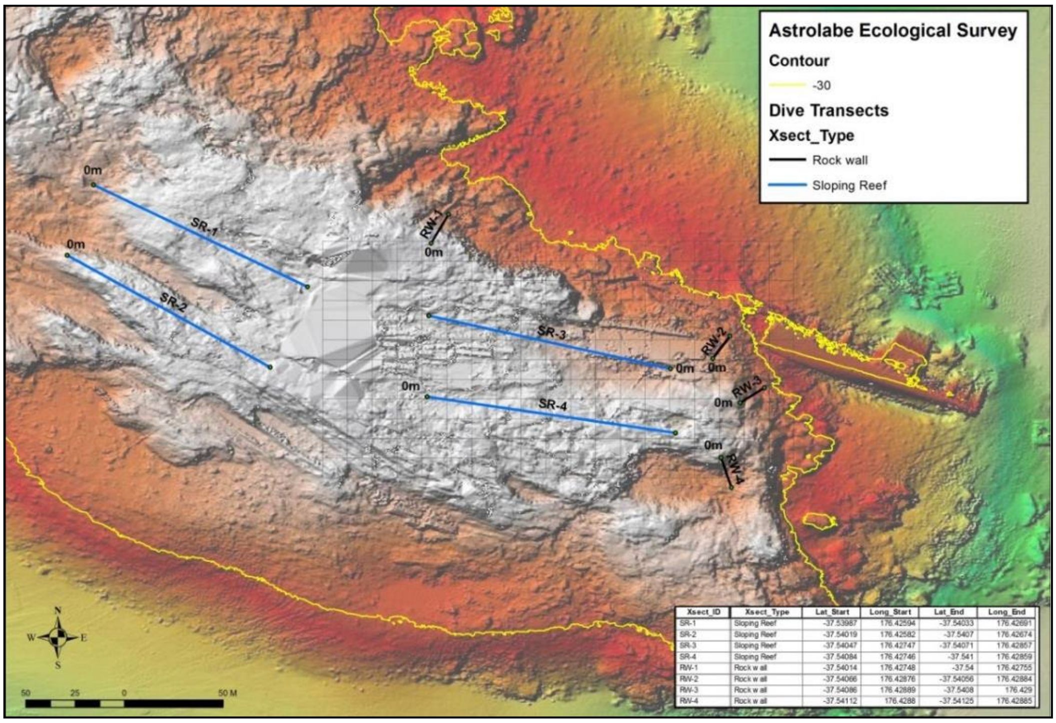


*Figure 4-4: Location of the eight survey transects on Otaiti.*

Rock Wall communities contained more epiphytic brown algae/diatoms, encrusting sponges, encrusting and turfing coralline algae and *Ecklonia radiata*, while the Sloping Reef communities were typified by large brown algae (*C. flexuosum, C. plumosum, X. chondrophylla, L. variegata*), the small brown alga *Zonaria aureomarginata* and the red alga *P. lucida.* Subtidal communities varied with depth: shallower quadrats were characterised by large brown algae and the red alga *P. lucida* and deeper quadrats typified by *E. radiata*, encrusting and turfing coralline algae, filamentous brown and red algae, encrusting sponges, *Hymenena sp*. and epiphytic brown algae/diatoms.

The primary difference noted between the Sloping Reef and Rock Wall transects was the dominance of algal based habitats on the Sloping Reef transects. These included varying mixtures of the dominant macroalgal taxa including *Lessonia variegata, Carpophyllum plumosum, C. flexuosum, Ecklonia radiata* and *Ulva sp*. These large algal species are canopy forming and thus provide a protective understorey for encrusting algae, kina, sponges and grazing gastropods (e.g. turban snail - *Cookia sulcata*) and various small fish like triplefins (*Forsterygion maryannae, Notoclinops segmentatus,* etc.).

In contrast, the more vertical aspect of the rock wall, including overhangs and shade, the less likely the attachment and growth of algal species. Therefore, the steeper habitats of the rock walls can be very diverse: dominated by suspension feeding encrusting organisms, sessile solitary species like sponges, ascidians and anemones and a range of different mobile invertebrates including kina (*Evechinus chloroticus*), crayfish (*Jasus edwardsii*), nudibranchs (e.g. *Jason mirabilis, Ceratosoma* sp.), crabs, whelks (e.g. *Charonia* sp., *Dicathais orbita*), brittlestars, and seastars.

Reef survey

In 2016, surveys of *Ecklonia radiata* kelp forest and mixed algae habitats were undertaken of Eastern Otaiti (Rena wreck affected) and Western Otaiti (non-existent/negligible Rena wreck influence) (P. M. Ross et al., 2018). Replicate 1m$^2$ transects (n=18) were used as the sampling unit at each site. The following parameters were assessed in each quadrat:

a) Substratum type;

b) Percent cover and dominant species of canopy forming algae;

c) Percent cover and dominant species of sub-canopy algae;

d) Canopy height;

e) *Ecklonia radiata* stipe density;

f) Sea urchin (*Evechinus chloroticus*) abundance;

g) Herbivorous snail (*Cookia sulcata*) abundance;

h) Abundance of other mobile species;

i) Percent cover of encrusting sponges.

Within the kelp forest habitat, there was no significant difference between sites in relation to canopy cover, canopy height, stipe density or abundance of *Cookia sulcata*. Sea urchin (*Evechinus chloroticus*) was found in higher abundance at the Western site. Kina barrens were not apparent at the wreck site (Eastern) (P. M. Ross et al., 2018) (Grace, R, 2017). There were no significant differences in parameters measured in the mixed algae habitat between the Western and Eastern sites.

Other species present in the reef habitat include crayfish (*Jasus edwardsii*), paua (*Haliotis iris*), pupu (*Lunella smaragda*), various limpets and predatory gastropods; *Cabestana spengleri*, *Charonia lampas*, *Dicathais orbita* and *Haustrum haustorium* (Ross, 2016; Akuhata, 2016; Paul-Burke, 2016).

### 4.1.4 Surrounding soft sediment habitat

The subtidal soft sediment benthic habitat surrounding Otaiti has not been surveyed for invertebrate community composition (but see Section 4.1.7 below). However, gastropods were collected from subtidal soft sediment habitats south-west of the reef (where higher tributyl-tin concentrations in sediment have been detected) for imposex analysis[2]. Species detected included *Ranella australasia*, *Sassia palmeri*, *Sassia parkinsoni*, *Penion cuvieranus*, *Murexsul octogonus*, and *Austrofusus glans*. Imposex was detected in five of the seven female *A. glans* collected.

[2] Imposex is the development of male genitalia in female snails, resulting in sterile organisms.

### 4.1.5 Contaminant body burden

Tributyl-tin (TBT) (a historically used, environmentally persistent, and highly toxic antifouling paint that was spread around Otaiti when the MV Rena crashed into the reef scraping off the historic and covered tributyl-tin paint) is currently measured annually in the gonad of sea urchins (*E. chloroticus*) and fillet of sea perch (*Helicolenus percoides*). TBT in sea urchin gonad has decreased from a peak in 2014 of 0.006mg/kg to 0.004mg/kg in 2019. TBT concentrations in all urchin samples have remained well below the human health response guideline (0.04mg/kg wet weight).

The concentration of TBT in sea perch flesh has declined since a peak in 2015 of around 0.015 mg/kg to 0.007mg/kg. The concentration remains well below human health response guideline (0.04mg/kg).

### 4.1.6 Water quality

Monitoring was conducted in June 2016 and 2019 to measure the total concentration and bioavailable fraction of copper present in seawater immediately above the sea floor (5-15cm). The water column at three sites within G18/G19 (due to copper clove[3] being detected in highest quantities at grid reference G18/G19), at increasing distance from G18/G19 to the SW and NW (Figure 4-5).

The 2016 and 2019 data indicated elevated copper concentration in water at G18/19, which is expected, as it is beneath the wreck at G18/19 where the remaining copper clove is likely to be located and is dissolving over time. The mean concentration of copper has been recorded between the ANZECC (ANZECC, 2000) 90% and 95% water quality guideline trigger values Sites to the SW and NW had very low copper concentrations, better than the ANZECC 99% water quality guideline trigger value in both 2016 and 2019.

Copper concentrations are likely to be elevated in the water column localised above G18/19 for the foreseeable future, as the copper clove buried by the wreck oxidises and releases copper ions to the water column.

[3] Copper wiring cut into 1-3mm lengths, sourced from building demolished in the Christchurch earthquakes.

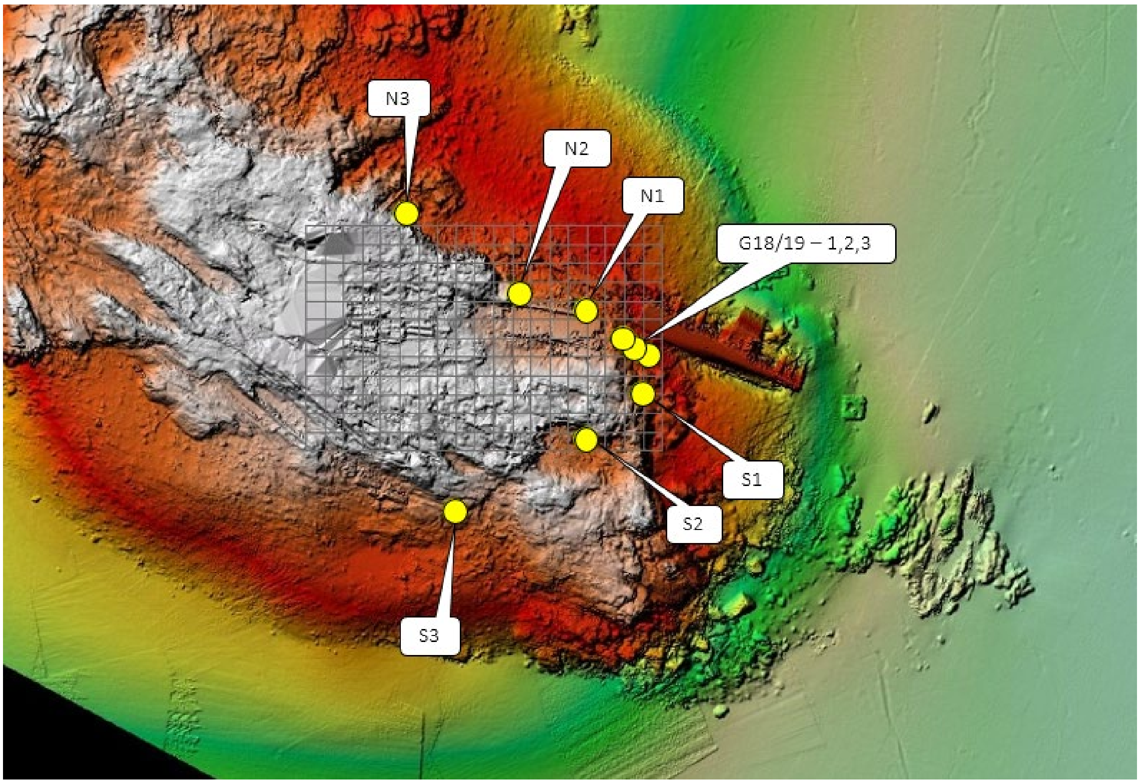


*Figure 4-5: Water quality and Diffuse Gradient Thin Film survey locations on Otaiti.*

### 4.1.7 Sediment quality

Sediment chemistry samples have been collected within the former Rena debris field, the wider on-reef areas and off-reef areas (Figure 4-6 and Figure 4-7). The contaminants that have been detected in elevated concentrations in Otaiti sediments relative to reference sites included tributyl-tin (and derivatives), copper, PAHs, zinc, diuron, fluoride, nickel, and tin. Of these, contaminants exceeding ANZECC Interim Sediment Quality Guideline (ISQG) concentrations at Otāiti were PAHs, copper, and TBT.

Currently, TBT, DBT, MBT and copper are surveyed in sediments in the former debris field, on-reef areas and off-reef areas. Mean contaminant concentrations generally show a downward trend, but there remains high variability within and between sites, indicating the patchy nature of contaminants within sediment (P. Ross, 2020)

Ongoing sediment sampling will continue to define and delineate the fate, concentration and location of contaminants. A recommendation in the recent survey report (Ross, 2020) is that sediment surveys are to continue annually in the outer reef and former debris field. There are adaptive management provisions in the conditions of consent that allow for annual recommendations to the contents and frequency of each monitoring item.

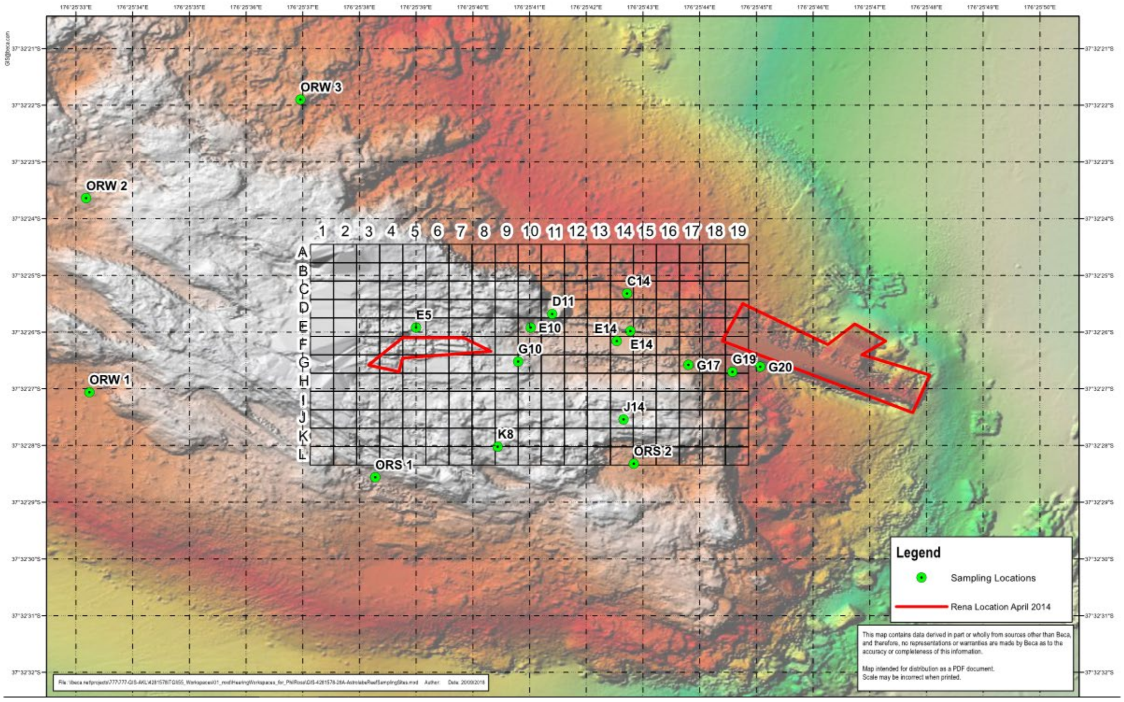


*Figure 4-6: Location of sediment chemistry survey sites on-reef at Otaiti (with main wreck parts marked in red outline).*

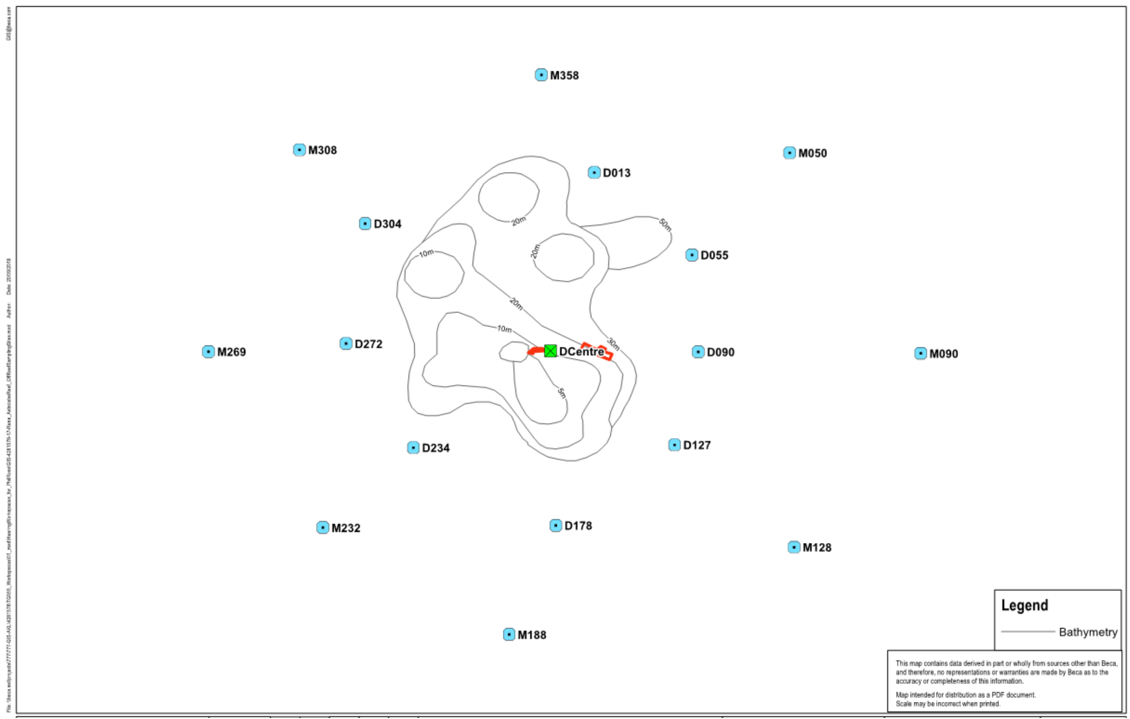


*Figure 4-7: Location of sediment chemistry survey sites off-reef of Otaiti.*

### 4.1.8 Observations / Anecdotal Information

Species of fish that have been identified as present on/adjacent to Otaiti include tarakihi (*Dactylosparus macropterus*), hapuku (*Polyprion oxygeneios*)[4], bass groper (*Polyprion moeone*), kahawai (*Arripis trutta*), trevally (Araara, *Pseudocaranx dentex*), kōheru/Jack Mackeral (*Trachurus novaezelandiae*), scorpion fish (Matua whaapuku, *Scorpaena papillosa*), sea perch (pūaihakarua, *Helocolenus percoides*), banded wrasse (*Notolabrus fuicola*), blue cod (Rāwaru/Pakirikiri/ Patutuki, *Parapercis colias*), butterfish (Koaea/Mararā/Tarao, *Odax pullus*), demoisilles (*Chromis dispilus*), sweep (hiwihiwi, *Scorpis lineolatus*), red and blue moki (Nanua, *Cheilodactylus spectabilis* and Moki, *Latridopsis ciliarus* respectively), pigfish (*Congiopodus leucopaecilus*), black angel fish (*Parma alboscapularis*), porcupine fish (*Tragulichthys jaculiferus*), snapper (Karati/tāmure, *Pagrus auratus*), blue maomao (Maomao, *Scorpis violacea*), oblique-swimming triplefin (*Obliquichthys maryannae*), spotty (*Notolabrus celidotus*), marblefish (*Aplodactylus etheridgii*), kelpfish (*Parma alboscapularis*), leatherjacket (*Parika scaber*), kingfish (*Seriola lalandi*) and shark (species not identified) (Walters, 2016; Wilkinson, A.G., 2016; Boyd, 2016; Ross, 2016; Kahotea, 2016; Paul-Burke, 2016; Grace, 2017).

Other species observed include sting ray (Whai, *Bathytoshia brevicaudata*), eagle ray (Whai keo, *Myliobatis tenuicaudatus*) and octopus (Wheke, *Macroctopus maorum*). Fur seal (Kekeno, *Arctocephalus forsteri*) also haul out on the rocks that are exposed above the water. In addition, common dolphin (*Delphinus delphis/capensis*) have been detected around the reef at times (Stirnemann, 2017).

After the Rena grounding, there was an exclusion zone in place for 4.5 years, which resulted in decreased fishing pressure on crayfish, hapuku and snapper. With the lifting of the exclusion zone, the abundance of those species declined again (Ross, 2018).

[4] Hapuku species have been depleted over decades and are now mainly harvested in >300m deep water (Boyd, 2016)

## 4.2 Okarapu Reef

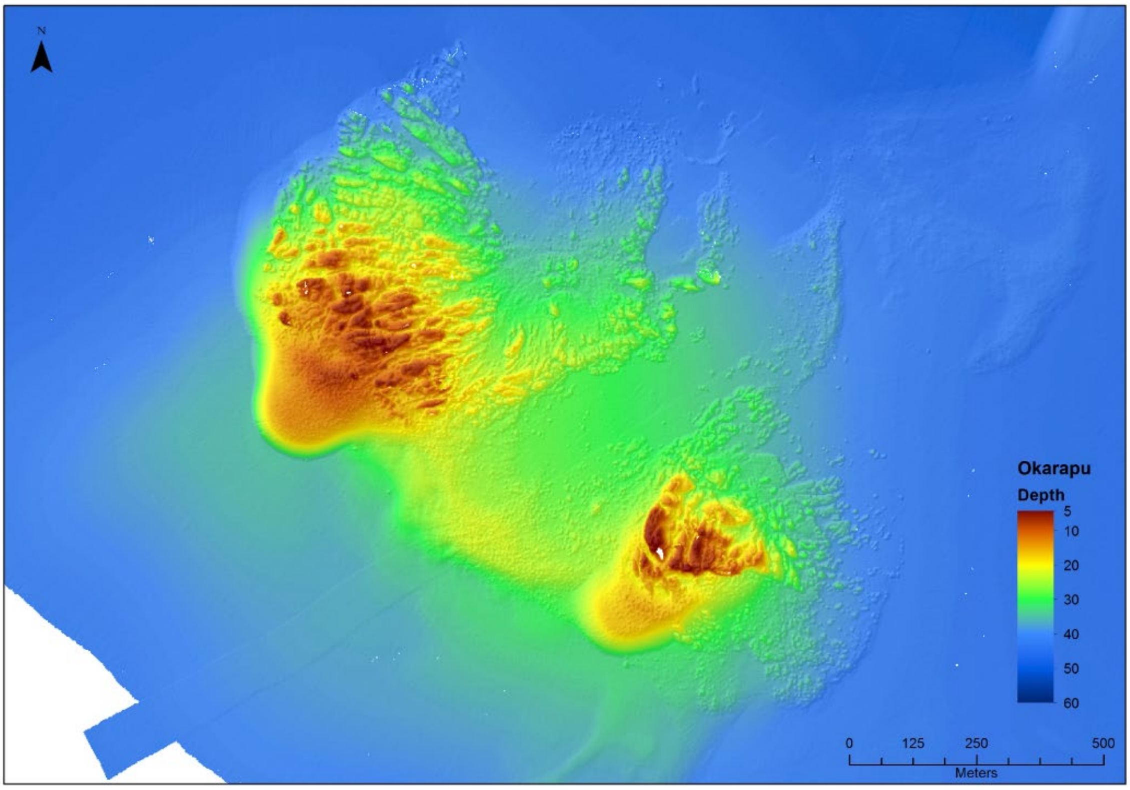


Figure 4-8 Multibeam Echosounder Bathymetry Okarapu.

### 4.2.1 Description

Okarapu consists of two reefs, joined at their base, which rise from a depth of 46m to shallow points of approximately 5m and 6m beneath the ocean surface at low tide (Figure 4-8). The average depth of the reef is 26m. The reef system is approximately 1.4km long (running NW to SE) and 800m wide and covers an estimated 779,687m$^2$ of seafloor. Okarapu is located approximately 17km northeast of the entrance to Tauranga Harbour (Figure 1-1). Motiti Island is approximately 10km to the south and Tuhua (Mayor Island) is 31km to the north.

### 4.2.2 Reef Habitat

The ecology and geology of Okarapu is comparable to that of Otaiti (described above) and a number of other Bay of Plenty reefs and islands.

The only known published ecological data for Okarapu is from Gregor and Young (2013) who conducted three ecological surveys (October 2011, July/August 2012 and December/January 2012/2013) at Okarapu, Motunau, Tuhua, Karewa and Motiti as part of the response to the Rena oil spill (Figure 4-9). The abundance and size of sea urchins (*E. chloroticus*); coverage, density and canopy height of kelp (*E. radiata*) and coverage of other brown algae were recorded in 1m$^2$ quadrats at each survey site. They found no clear response to the oil spill but noted that urchin populations were relatively stable compared with algal coverage which varied between sites and across the three sampling events.

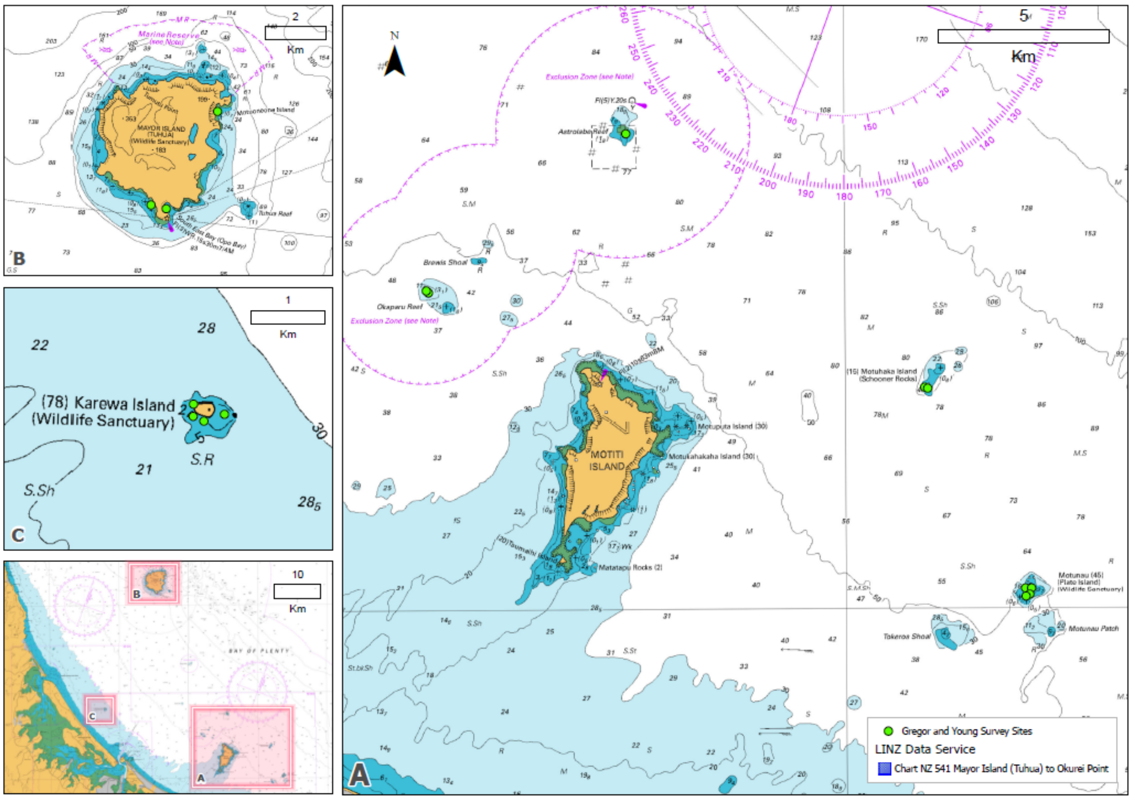


*Figure 4-9 Location map from Gregor and Young (2013) indicating their sampling locations.* Bottom left panel shows western Bay of Plenty from Motiti in the south to Tuhua in the North. Chart segments highlighted in red refer to panels showing sampling locations at (A) Okarapu, Motunau. Motuhaku and Otaiti; (B) Tuhua; and (C) Karewa Island.

Photographs of each quadrat and video transects running from deep to shallow were also recorded at each site to provide additional ecological information (Figure 4-10). Video transects and quadrat photographs were not analysed, but could be utilised in future as part of an ecological baseline against which to assess ecological change.

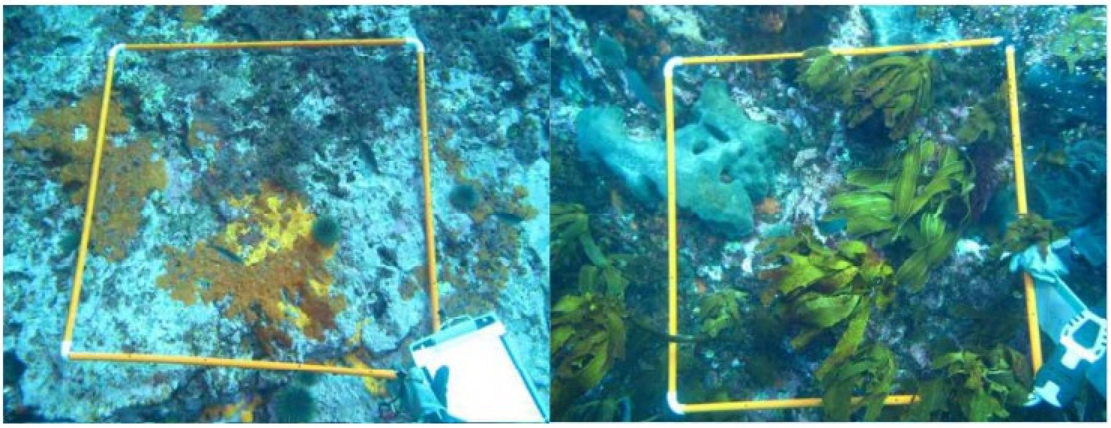

*Figure 4-10 Examples of quadrat photos collected by Gregor and Young (2013).*

### 4.2.3 Water quality

Copper in seawater was detected at very low concentration at Okarapu Reef (as a control site) in 2016, at/just above the ANZECC 99% water quality guideline, as part of assessing the effects of the copper clove contained within the Rena wreck.

## 4.3 Te Poroiti

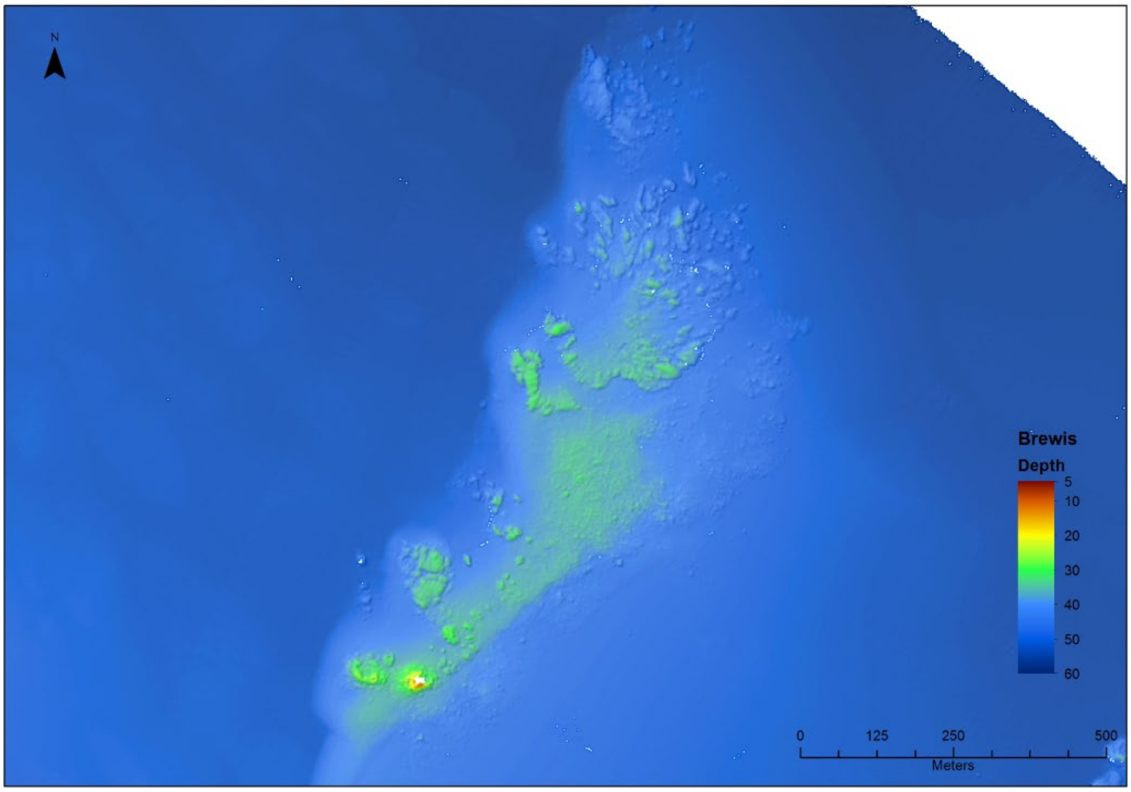


*Figure 4-11: Multibeam Echosounder Bathymetry Te Poroiti.*

### 4.3.1 Description

Te Poroiti is a subtidal reef situated approximately 2km north-east of Okarapu and 4.5km north-west of Motiti (Figure 1-1, Figure 4-11). Te Poroiti consists a large area of deep reef covering an estimated 316,056m$^2$ of seafloor with a maximum depth of about 42m. The reef is characterised by a series of reef pinnacles, the tallest of which are located at the southern end of the reef and rise to depths 18 and 6m.

There are no known scientific publications documenting the ecology of Te Poroiti.

### 4.3.2 Observation/Anecdotal Information

Anecdotal observations of Te Poroiti ecology include sighting and capture of hapuku, terakihi, kingfish, crayfish and sponges (Wilkinson, B.W., 2016 and anecdotal observations of Dr Phil Ross).

## 4.4 Te Papa (Brewis Shoal)

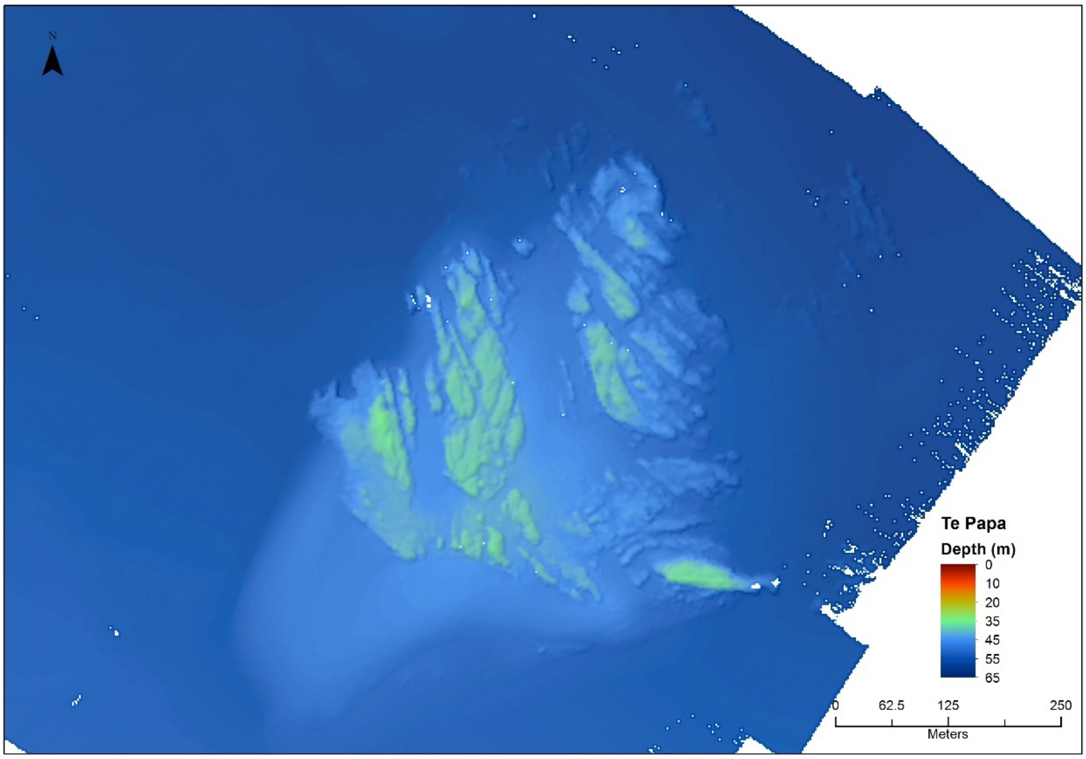


*Figure 4-12:* Multibeam Echosounder Bathymetry at Te Papa.

### 4.4.1 Description

Te Papa is a subtidal reef situated approximately 3km north of Motiti (Figure 1-1). Te Papa covers an estimated 126,550m$^2$ of seafloor and the shallowest point on the reef has a depth of 33m and the deepest is 59m.

There are no known scientific publications documenting the ecology of Te Papa.

# 5.0 Motiti Protection Area containing Motuhaku Island

The Motuhaku Motiti Protection Area is the smallest of the three management areas covering an area of 13.7km$^2$.

## 5.1 Motuhaku Island (Schooner Rocks)

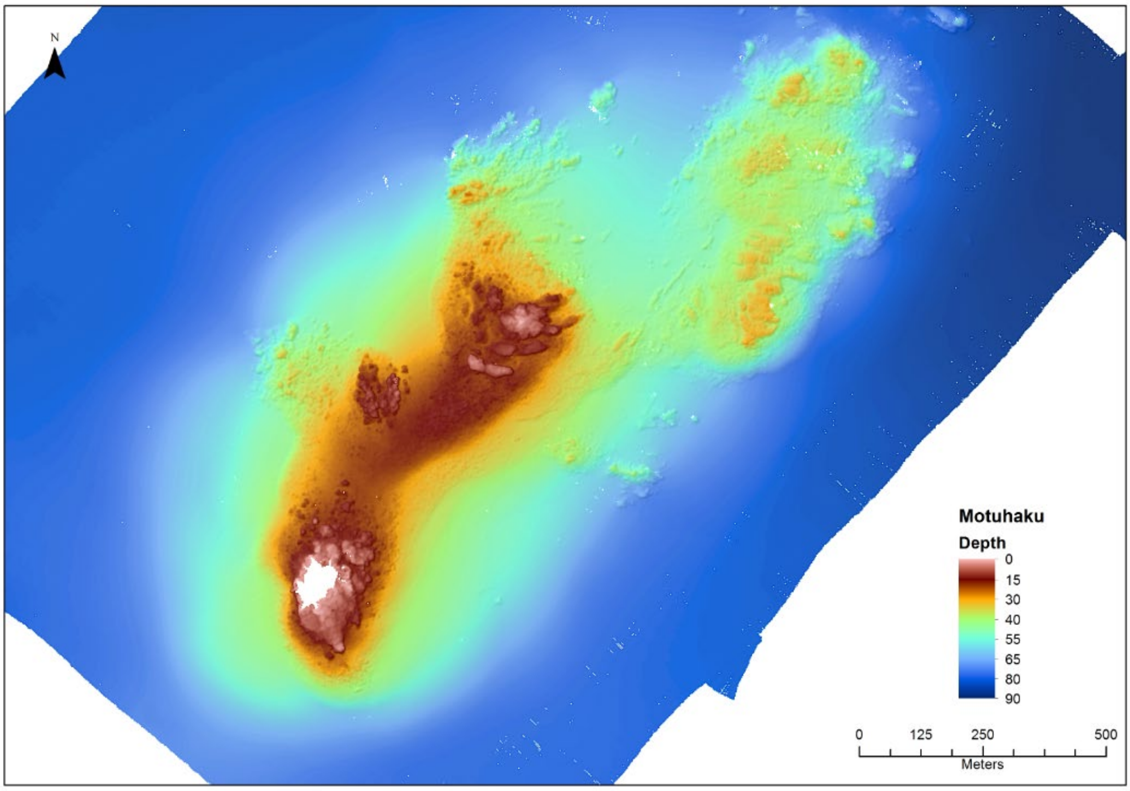


*Figure 5-1 Multibeam Echosounder Bathymetry of Motuhaku*

### 5.1.1 Description

The Motuhaku reef system covers approximately 115,113m$^2$ of seafloor (Figure 5-1). The maximum depth of the reef is approximately 77m and the average depth is 35m. The reef system emerges from the ocean at its southern end.

### 5.1.2 Reef habitat

The subtidal ecology and geology of Motuhaku is comparable to that of Otaiti (described in section 4.0) and as was reported for some of the other reefs and islands in the Bay of Plenty. A mixture of algal species (*Carpophyllum, Cystophora, Lessonia, Xiphophora*) in shallow waters (0 – 13 m), kelp (*Ecklonia*) forest below 10 m, sponge encrusted reef and boulders below 25 m and diverse invertebrate communities in caves and on vertical or shaded reef surfaces.

Gregor and Young (2013) conducted three ecological surveys (October 2011, July/August 2012 and December/January 2012/2013) at Okarapu, Otaiti, Tuhua, Karewa and Motiti as part of the response to the Rena oil spill (Figure 4-9). The abundance and size of sea urchins (*E. chloroticus*); coverage, density and canopy height of kelp (*E. radiata*) and coverage of other brown algae were recorded in $1m^2$ quadrats at each survey site. They found no clear response to the oil spill but noted that urchin populations were relatively stable compared with algal coverage which varied between sites and across the three sampling events. Photos were taken of each quadrat and video transects running from deep to shallow were also recorded at each site to provide additional ecological information. It appears that video transects or quadrat photographs were not analysed, but could be utilised in future as part of an ecological baseline against which to assess ecological change.

In 2016, surveys of *Ecklonia radiata* kelp forest and mixed algae habitats were undertaken at Motuhaku Island (Ross et al., 2018) and comparisons made to similar habitat types on Otaiti. Replicate 1 $m^2$ transects (n=18) were used as the sampling unit at each site. The following parameters were assessed in each quadrat: substratum type; percent cover of canopy forming algae; percent cover of sub-canopy algae; canopy height; kelp stipe density; sea urchin (*Evechinus chloroticus*) density; herbivorous snail (*Cookia sulcata*) density; density of other mobile species; and percent cover of encrusting sponges.

Within the kelp forest habitat, there was no significant difference between sites in relation to canopy cover, canopy height, stipe density or abundance of *Cookia sulcata*. Sea urchin (*Evechinus chloroticus*) abundance at Motuhaku was found to be similar to the Eastern Otaiti site, but lower than the Western Otaiti site. Subcanopy cover was significantly higher at Motuhaku Island compared the Otaiti sites.

Within the mixed algae habitat, the abundance of *E. chloroticus* was significantly lower than at Otāiti sites.

### 5.1.3 Observation/Anecdotal Information

Hapuku, tarakihi, blue nose and other moeone species are present (Wilkinson, B.W.,2016).

# 6.0 Motiti Protection Area containing Motunau (Plate Island), Muatai and Tokoroa Shoal

This is the second largest of the three Motiti Protection Areas. It covers an area of 24.7km$^2$. This Motiti Protection Area contains three major reef systems; Motunau, Muatai and Tokoroa Shoal.

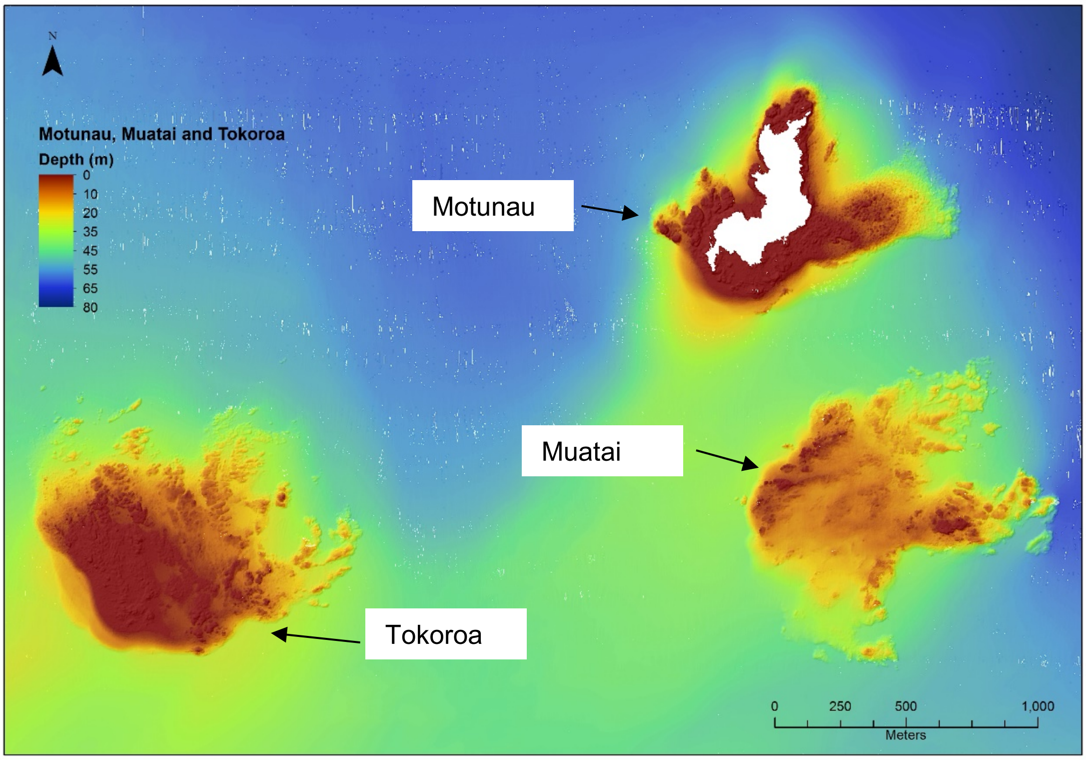


*Figure 6-1: Multibeam Echosounder bathymetry of the Motiti Protection Area containing Motunau, Muatai and Tokoroa Shoal.*

## 6.1 Motunau

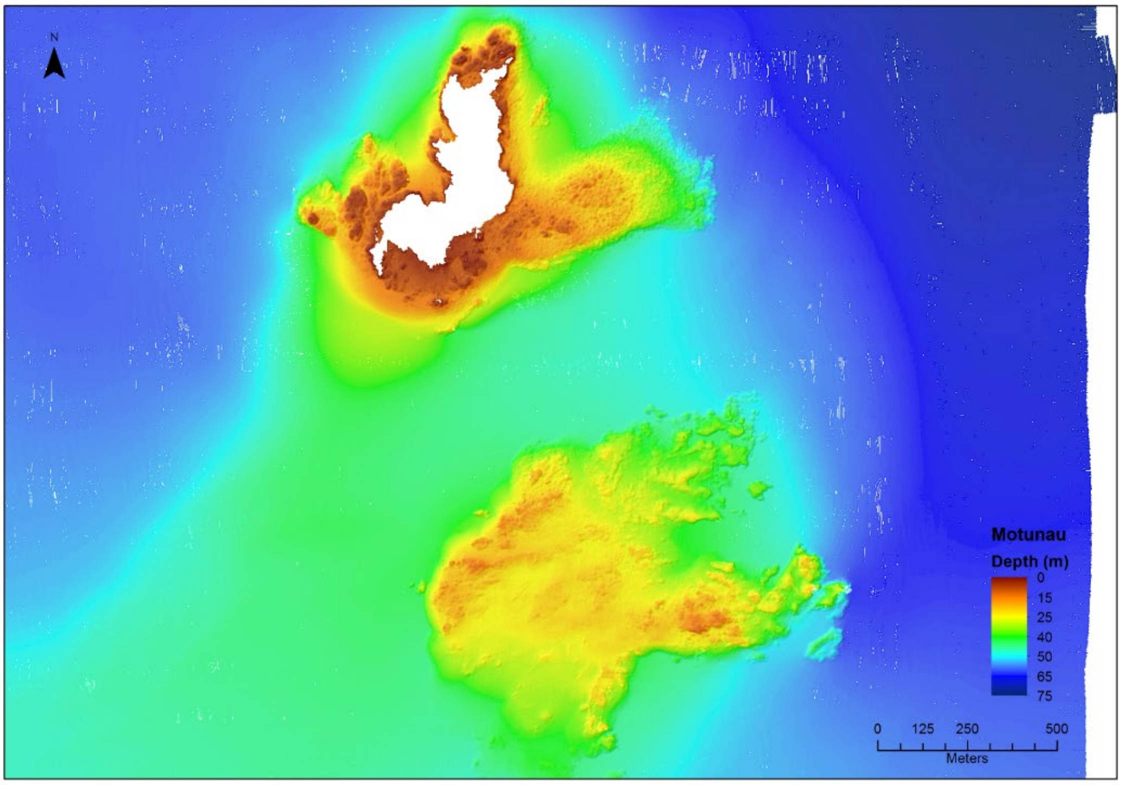


*Figure 6-2 Multibeam Echosounder bathymetry of Motunau (north) and Muatai (south).*

### 6.1.1 Description

The reef system is made up of two main reefs separated at their base by about 500m. Motunau, the northern reef, occupies approximately 434,625m$^2$ of seafloor and has a maximum depth of 58m (Figure 1). Muatai, the southern reef, occupies 695,856m$^2$ of seafloor, has a maximum depth of 50m and a shallowest point that is 10m below the ocean surface.

The island at Motunau is itself nationally significant and protected by Department of Conservation as a Wildlife Sanctuary and was designated in 1969. The island is habitat to a range of At Risk or Threatened avifauna, including Reef heron (Motuku moana, *Egretta sacra*) (Threatened, Nationally Vulnerable), Pied shag (Kāruhiruhi, *Phalacrocorax varius*) (Threatened, Nationally Vulnerable), Red-billed gulls (Tarāpunga, *Larus novaehollandiae*) (Threatened, Nationally Vulnerable), Northern little blue penguin (Kororā, *Eudyptula minor*) (At Risk, Declining), White-fronted tern (Tara, *Sterna striata*) (At Risk, declining), Fluttering shearwater (Pakahā, *Puffinus gavia*) (At Risk, Relict), New Zealand white-faced storm petrel (Takahikare-marina, *Pelagodroma marina*) (At Risk, Relict), Northern diving petrel (Kuaka, *Pelecanoides urinatrix*) (At Risk Relict). Fluttering shearwater and White-fronted tern (both considered *At Risk*) are associated with schooling trevally, kahawai and blue maomao[5]. DOC do not specifically monitor for birds within

[5] IBDA A77 and IDBA A78 descriptions in Schedule 2 to the Regional Coastal Environment Plan (Indigenous Biological Diversity Areas in the Coastal Environment).

the Motiti Natural Environment Management Area. Some data have been collected by DOC in the past. However, the only official seabird monitoring is around Mauao and Motuotau.

Gregor and Young (2013) who conducted three ecological surveys (October 2011, July/August 2012 and December/January 2012/2013) at Motunau, as well as at Okarapu, Tuhua, Karewa and Motiti as part of the response to the Rena oil spill (Figure 4-9). The abundance and size of sea urchins (*E. chloroticus*); coverage, density and canopy height of kelp (*E. radiata*) and coverage of other brown algae were recorded in $1m^2$ quadrats at each survey site. Photos were taken of each quadrat and video transects running from deep to shallow were also recorded at each site to provide additional ecological information. Again, video transects and quadrat photographs were not analysed but could be utilised in future as part of an ecological baseline against which to assess ecological change.

### 6.1.2 Observation/Anecdotal Information

The island contains a rift in the middle which contains deep water species in shallow water (cup sponges, hydroids and bryozoans)[5].

Hapuku, tarakihi, blue maomao, reef snapper (Paheha) and schooling snapper (Tamure) and kina are also present (Wilkinson, B.W., 2016; Kahotea, 2016; Wilkinson, A.G., 2016).

There is an annual cultural harvest of muttonbird (sooty shearwater, *Puffinus grisea*)[6].

[6] Threat status – Near Threatened – population declining.

## 6.2 Tokoroa Shoal

Tokoroa is a roughly circular reef system with width of approximately 1km. It occupies approximately 727,518m$^2$ of seafloor with an average depth of 25m, a maximum depth of 51m and a minimum depth of 4m (Figure 6-3).

There are no known scientific publications documenting the ecology of Tokoroa Shoal.

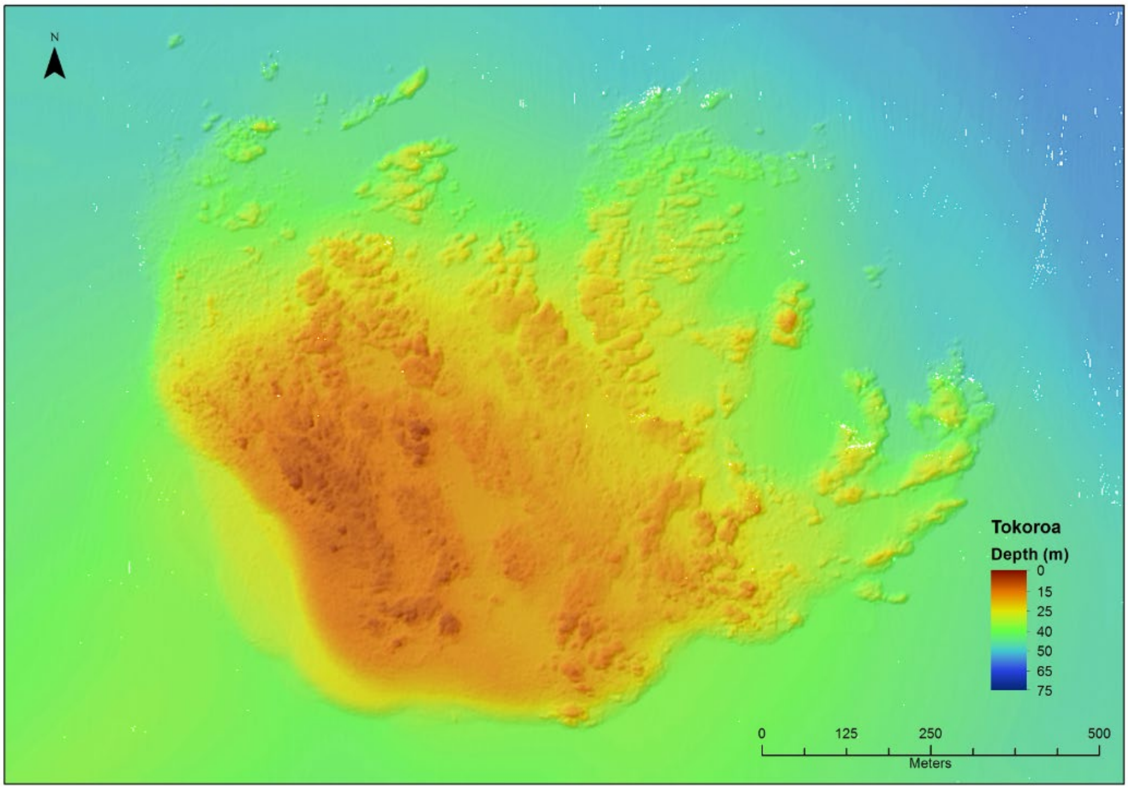


*Figure 6-3 Multibeam Echosounder bathymetry of Tokoroa Shoal.*

# 7.0 Wider Motiti Natural Environment Management Area

This section of the report summaries scientific knowledge of marine ecological values and species that are within the Motiti Natural Environment Management Area but outside the Motiti Protection Areas (this includes Motiti Island). These areas include the coastal reefs and waters around Motiti Island itself, and reef and soft sediment habitats situated throughout the Motiti Natural Environment Management Area (Figure 1-1). The Motiti Natural Environment Area (Figure 1-1) is listed in the Regional Coastal Environment Plan as an area of significant conservation value (ASCV 25), yet relatively little is known about the ecology of the area, outside of what is described in the above sections of this report.

The Environment Court did not implement any protections over the parts of the Motiti Natural Environment Management Area not falling within the three Motiti Protection Areas. However, the court did conclude that there should be further ecological investigations conducted within the Motiti Natural Environment Management Area and this could lead to the imposition of controls in the future. The level of natural character has not been assessed as an integrated whole and is part of the ongoing monitoring and investigation prescribed by the Environment Court.

Method 29[7] identifies the mechanisms by which investigations and monitoring will occur, including the formation of a Technical Advisory Group which will make recommendations on:

- Investigations and monitoring as considered necessary to establish the state of the Motiti Natural Environment Management Area marine environment and biodiversity;
- Measures necessary to enhance existing values and attributes; and
- A monitoring programme to be conducted in order to assess the existing, new or revised values and attributes.

[7] Bay of Plenty Regional Council Regional Coastal Environment Plan

## 7.1 Motiti Island

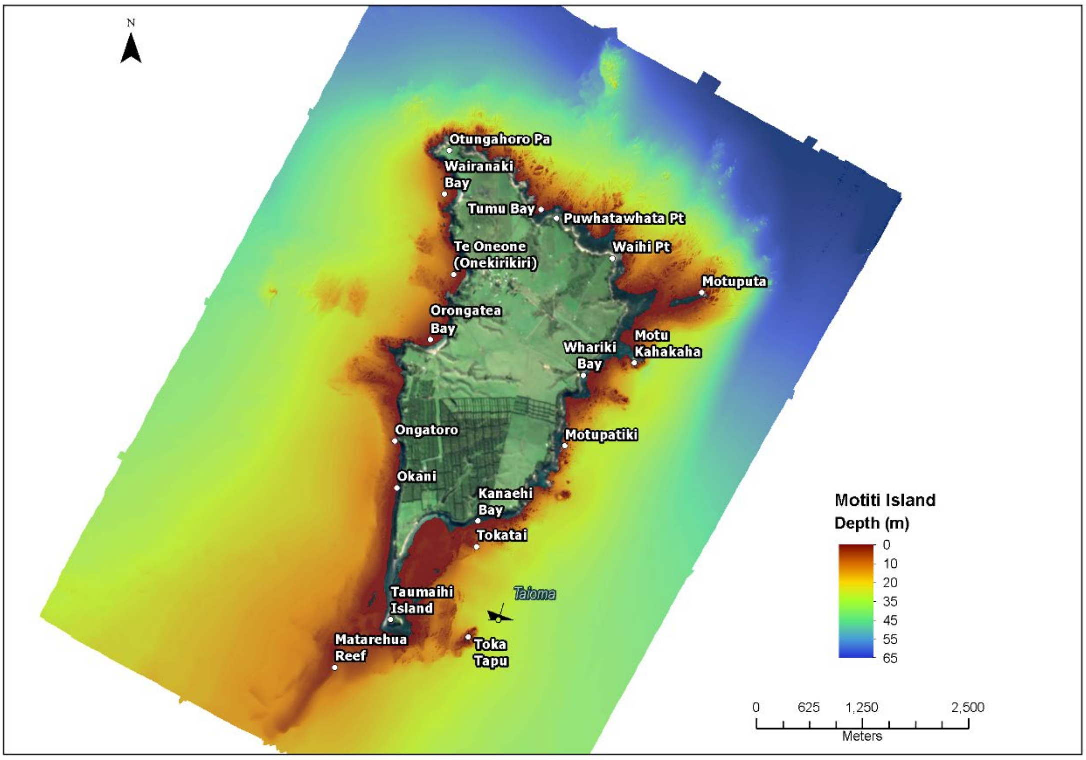


*Figure 7-1 Multibeam Echosounder Bathymetry and sites referred to on Motiti Island.*

Motiti Island is the only permanently inhabited offshore island along the Bay of Plenty Coastline. Motiti is less intact than the other features within the grouping and less natural. Its' coastline is considered to have high natural character and is included in the feature. The landward boundary of the Outstanding Natural Features and Landscape (ONFL) on Motiti Island is similar to the high natural character area identified in Schedule 3 to the Regional Coastal Environment Plan. The small islands immediately surrounding Motiti are also included. The offshore islands of Motuhaku and Motunau are relatively small rocky islands with some coastal vegetation located upon the upper plateau of the islands. Other reefs and shoals exist around this wide grouping of islands including the Astrolabe Reef, Brewis Shoal and Okarapu Reef which form part of a wider complex of island features in the area and are included in the Outstanding Natural Features and Landscapes (Schedule 3, Regional Coastal Environment Plan).

### 7.1.1 Benthic and Pelagic Habitat

There is a high abundance and diversity of biological life in the seabed and ocean surrounding reefs within the Motiti Natural Environment Management Area. Reefs around island include exposed, semi-exposed and sheltered. Sandy beaches at Wairanaki Bay, Te Oneone Bay, Orongatea Bay. The remainder of coastline is a mix of hard rock platforms, large boulder to small boulder reefs. Near-shore reefs are relatively shallow and drop off to the reef fringe between 8-20m (Sayers, 2017).

Species noted in Schedule 3 of the Regional Coastal Environment Plan as present within the Motiti Natural Environment Management Area include snapper, kahawai, blue maomao, tarahiki, moki, araara (trevally), parore (*Girella tricuspidata*), haku (kingfish), mango (sharks), aturere (tuna), kuparu (John Dory, *Zeus faber*), kumukumu (guarnard, *Chelidonichthys cuculus*), hapuku, blue nose, patikiori (sole, *Peltorhampus novaezeelandae*), wheke (octopus), koura (crayfish), paua (abalone), kuku (mussels, *Perna canaliculus*), tipa (scallops, *Pecten novaezelandiae*), tio (oysters, *Crassostrea gigas* (Pacific) and *Saccostrea glomerata* (rock)), kina (urchins), rori (sea cucumber, *Stichopus mollis*), karengo (seaweeds).

In addition, fur seals haul out around Motiti (Stirnemann, 2017).

Avifauna detected in the general Motiti Island area (from the Ornithological Society of New Zealand) (over two squares[8], with a single square measuring 10km x 10km) include the following (Table 7-1):

*Table 7-1: Coastal and seabird avifauna species detected in 200km$^2$ over and around Motiti Island.*

| **SPECIES - Robertson et al. 2012** | | **CONSERVATION STATUS - Robertson et al. 2017** | | | Farmland / open country | Freshwater / wetlands | Coastal / Estuary | Oceanic | Urban/Residential |
|---|---|---|---|---|---|---|---|---|---|
| Fluttering shearwater | *Puffinus gavia* | Endemic | At Risk | Relict | | | | | |
| Common diving petrel | *Pelecanoides urinatrix urinatrix* | Native | At Risk | Relict | | | | | |
| Little blue penguins | *Eudyptula minor* | Native | At Risk | Declining | | | | | |
| Black-backed gull | *Larus d. dominicanus* | Native | Not Threatened | Not Threatened | | | | | |
| Red-billed gull | *Larus novaehollandiae scopulinus* | Native | At Risk | Declining | | | | | |
| Reef heron | *Egretta sacra sacra* | Native | Threatened | Nationally Endangered | | | | | |
| Variable oystercatcher | *Haematopus unicolor* | Endemic | At Risk | Recovering | | | | | |
| Caspian tern | *Hydroprogne caspia* | Native | Threatened | Nationally Vulnerable | | | | | |
| Grey-faced petrel | *Pterodroma macroptera gouldi* | Native | Not Threatened | Not Threatened | | | | | |
| Pied shag | *Phalacrocorax varius varius* | Endemic | At Risk | Recovering | | | | | |

Gregor and Young (2013) conducted three ecological surveys (October 2011, July/August 2012 and December/January 2012/2013) at Motiti as well as at Okarapu, Motunau, Tuhua, and Karewa as part of the response to the Rena oil spill (Figure 4-9). The abundance and size of sea urchins (*E. chloroticus*); coverage, density and canopy height of kelp (*E. radiata*) and coverage of other brown algae were recorded in 1m$^2$ quadrats at each survey site. The sites at Motiti surveyed by Gregor and Young (2013) were all on the northern half of the island. The coordinates of sampling were withheld from the published report due to cultural sensitivities but may be available on request. Photos were taken of each quadrat and video transects running from deep to shallow were also recorded at each site to provide additional ecological information. Again, video

[8] Robertson et al. (2007). OSNZ squares 638, 281 and 639, 281 (data collected 1999-2004)

transects and photo quadrats were not analysed but could be utilised in future as part of an ecological baseline against which to assess ecological change.

**<u>West Motiti</u>**

### 7.1.2 Te Oneone Bay (Motiti Island)

Te Oneone Bay is sheltered by with platform reef on north side extending c. 80m from the shore. Seaward from the shore, the reef has a 2-3m wide band of mixed brown algae, then kina barrens to 4m water depth, followed by *Ecklonia* forest, then reef edge and sand. Kina barrens occupy approximately 40% of the reef. Fish present include sweep, red moki, kelp fish, spotty, black angelfish, blue maomao, butterfish, kahawai and leather jacket. Paua are also present (Sayers, 2017).

### 7.1.3 Ongatoro

Ongatoro is a rocky point and reef that projects approximately 90m seaward from coast.

The northern side of the reef has predominantly medium boulders (5-10m diameter). The reef comprises mixed macroalgae in shallows, with 10-20m diameter patches of kina barrens. The reef then continues seaward with even gradient with large *Ecklonia* and *Carpophyllum* species. Fish present include sweep, red moki, kelp fish, spotty, black angelfish, blue maomao, and butterfish. Paua are also present (Sayers, 2017).

**<u>South Motiti</u>**

### 7.1.4 SS Taioma

The Taioma (decommissioned tug boat) was scuttled in 2001 (Figure 6-1 and Figure 7-2: Multibeam echosounder image of SS Taioma (sourced from Immenga, 2011)). With 17m as the vessel's highest point, the Taioma provides complex habitat for marine organisms.

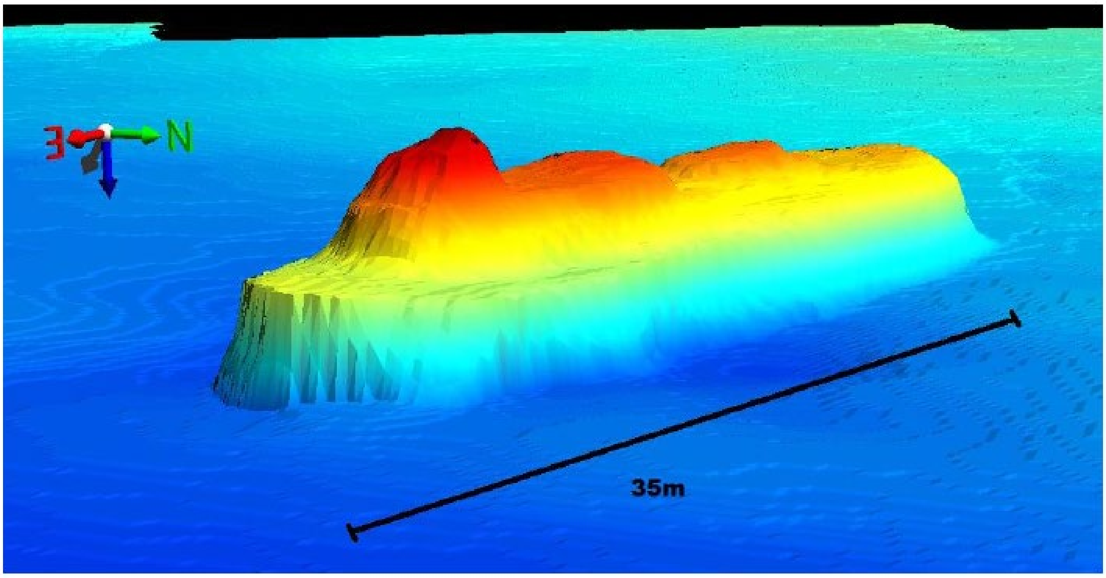


*Figure 7-2: Multibeam echosounder image of SS Taioma (sourced from Immenga, 2011).*

Surveys undertaken in 2012 (Robertson, 2012) indicated that oblique swimming triplefin (*Obliquichthys maryanne*) was the most abundant fish detected (0.38/$m^2$), with snapper (*Pagrus auratus*), jack mackerel *(Trachurus novaezealandiae*), goat fish (*Upeneichthys lineatus*), tarakihi (*Nemadactylus macropterus*), and leatherjacket (*Parika scaber*) being present at less than 0.1/$m^2$.

### 7.1.5 Matarehu (Matarehua) Reef

Matarehua is a large complex reef that surrounds Taumaihi Island on southern end of Motiti Island. The reef extends 2.5km from southwest to northeast and 1km northwest to southeast, with parts breaching the surface (platform rock with some boulders). At 0.5m water depth the central eastern side of the island has encrusting algae and Neptune's necklace, then after several meters water depth there is mixed macroalgae, transitioning to kina barrens to 12m depth, after which *Ecklonia* forest dominated. Fish present include mackerel, sweep, red moki, kelp fish, spotty, black angelfish, blue maomao, leather jacket, snapper and banded wrasse. Paua are also present (Sayers, 2017).

### 7.1.6 Kanaehi Bay

The reef within Kanaehi Bay (Kanae is mullet in Te Reo) extends 80m to 12m water depth. The shallow part of reef has encrusting algae and Neptune's necklace, kina barrens dominate at 2-10m water depth with sparsely distributed *Carpophyllum fleximosa*, seaward of 10m water depth the habitat transitions to sand. Fish present include mackerel, red moki, spotty, black angel, trevally, goat fish, leather jacket, terakihi, snapper (including juvenile) and kahawai. Paua present in low abundance (Sayers, 2017).

**East Motiti**

### 7.1.7 Motu Patiki

Behind Motu Patiki Island is a sheltered reef system with average water depth of 8m, but shallower close to shore. The island supports a variety of nesting seabirds (Sayers, 2017).

### 7.1.8 Motu Kahakaha Island

Motu Karakaha Island is located off the reef from Whariki Bay. The island sits at a drop off (Sayers, 2017).

**North Motiti**

### 7.1.9 Te Tumu Bay

Te Tumu Bay contains a reef comprising hard rock with large to medium boulders. Mixed algae are present near the shore, which transitions to extensive kina barrens at 3m water depth, extending to 10m depth. Urchin barrens are also present between Puwhatawhata and Motutara Point. Kina are abundant. *Ecklonia* is lusher at Te Tumu Bay compared to Otaiti. Commercial craypots are present on inshore reefs at northern end of the island. The reef is broken by small areas of sand. Crayfish and paua present. Fish included mackerel, sweep, red moki, kelp fish, spotty, black angel, blue maomao, butterfish, leather jacket and trevally. Small snapper are also present. Overall, there are lower numbers of fish than Otaiti (Sayers, 2017).

### 7.1.10 Observation/Anecdotal Information

Hapuku, tarakihi, groper, blue nose (Matiri, *Hyperoglyphe antarctica),* bass, and stingray have been noted as present (Wilkinson, B.W., 2016; Ranapia, 2017).

Commercial fishing in the wider Bay of Plenty target jack mackerel, English/blue mackerel, skipjack tuna, snapper and terakihi. In addition, rock lobster are a commercially targeted species and kina are harvested from Otaiti every four years (Hill, 2017).

## 7.2 Other areas within the Motiti Natural Environment Management Area

### 7.2.1 Reefs

There is very little information available on the reef systems of the Motiti Natural Environment Management Area that do not fall within the Motiti Protection Area. The majority are deep (>25 m), have not been mapped, and have not been the subject of scientific investigation. It is likely that the ecology of these reefs is similar to that described for Otaiti. However, the beyond approximately 30m depth (the limits of occupational scientific diving) there is very little information available on the biodiversity of the Motiti Natural Environment Management Area reef systems. If efforts were made to examine the biodiversity of these deep reefs it is highly likely that new and undescribed species would be found. It is unknown whether these new species would be unique to particular reefs or the Bay of Plenty region. Remote operated vehicles and drop cameras could be used to begin investigations in these areas.

### 7.2.2 Soft sediment

Almost nothing is known about the biodiversity of soft sediment and gravel subtidal habitats or the distribution biogenic reef habitats in the Bay of Plenty and Motiti Natural Environment Management Area. Further analysis of the Kulgemeyer et al. (2016) photographic dataset will provide information about epifauna and biogenic reefs between the coast and the southern edge of the Motiti Natural Environment Management Area (Figure 3-3).

## 7.3 Fauna

There is currently no quantitative information on fish, crayfish or other invertebrates. However, there are some kina data at some sites.

# 8.0 Commercial Fishing Data from MPI

Commercial fishing in the Bay of Plenty is described in the Environment Court evidence of Andrew Hill (Hill, 2017):

1. The largest fishery fleet by catch volume in the Bay of Plenty is purse seine. This fleet (currently approx. 4 vessels) primarily targets jack mackerel and reports large volumes of jack mackerel, English/blue mackerel and skipjack tuna. Kahawai is also taken in significant volumes in this fishery. Total purse seine catches vary significantly year to year but remain higher than any other method.
2. Snapper is an iconic species in the Bay of Plenty (and other areas of Northern New Zealand) and is taken commercially using a variety of fishing methods. Largest volumes are taken by bottom trawl. There are currently about 18 bottom trawlers reporting catch in the Bay of Plenty. Other key species taken by bottom trawl are tarakihi and trevally although many others are also taken. Significant volumes of snapper are also caught by a small fleet of Danish seine (approx. 4 vessels) and bottom longliners (14 vessels; bluenose and ling are other key species for this method).
3. There are a number of smaller, niche fishing methods operating in the Bay of Plenty region including rock lobster potting, set netting, diving and surface long lining. Large volumes of sea lettuce are also harvested from Tauranga Harbour. The Coromandel scallop fishery extends into the region but this area has not been fished significantly in recent years.
4. Appendix B of Mr Hill’s evidence set out the top 10 species commercially targeted in statistical areas 009, 009H, and 010 (which cover the majority of the Bay of Plenty area, including Motiti Island), the total commercial catch for the top 20 species caught, the number of commercial vessels operating and their incidence of bycatch of protected species.
5. Reporting requirements have evolved over time with many methods (including trawling, purse seining, Danish seining and long lining) currently required to report their fishing

locations to the nearest minute of latitude and longitude. Further discussion is underway as part of the Future of our Fisheries programme regarding how to utilise technology to support and improve gathering of fine scale data.

6. Appendix C of Mr Hill's evidence provides various representations of the commercial fisheries take in statistical areas 009, 009H and 010 including by method. These maps show a low to moderate commercial take in and around Motiti Island and Otaiti. Around Otaiti in the April 2016 to March 2017 year there are more event start points for larger non-bottom contact methods (e.g., purse seining, long lining and set-netting) than there are for their equivalent bottom contact methods (e.g., bottom trawl and Danish seine). To the west of Motiti Island, there are roughly the same number of start points for larger non-bottom contact methods than the equivalent contact methods, and the trawling is by midsize trawlers not required to report their trawl lines. To the east of Motiti Island, there is more Danish seining and trawling start points than there are non-bottom contact methods, but again they are midsize trawlers.
7. Commercial dredging has occurred near Motiti Island in the past (outside of the 1 nautical mile (nm) prohibition around the island), but not in recent years due to the low density of scallops. While fine scale information is not available for rock lobster and kina, there are two rock lobster vessels operating around the island and commercial kina fishers target Otaiti on a four-yearly rotational harvest.

Commercial fisheries data for the Motiti Natural Environment Management Area was requested from MPI for the purposes of preparing this report. However, due to there being a small number of commercial fishers that have quota for species within the wider Motiti Natural Environment Management Area, MPI have only been able to provide aggregated data (described below) indicating high to low fishing effort for both bottom contact methods and non-bottom contact methods (Figure 8-1, Figure 8-2).

Bottom contact (trawling, dredging and seining) fishing effort for the 2007-2018 period was moderate to high throughout the Motiti Natural Environment Management Area. The exception to this is the areas around Otaiti, Okarapu and Te Poroiti where recorded fishing effort was low (Figure 8-1). Highest bottom contact fishing effort within the Motiti Natural Environment Management Area was in the areas to the south east and north-east-east of Motiti Island.

Non-bottom contact fishing (lining, passive netting and potting) effort was highest to the south of Motiti and between the Motiti Natural Environment Management Area and the main Mount Maunganui/Papamoa coast (Figure 8-1). Lowest fishing effort was recorded at northern, eastern and south eastern boundaries of the Motiti Natural Environment Management Area (Figure 8-2).

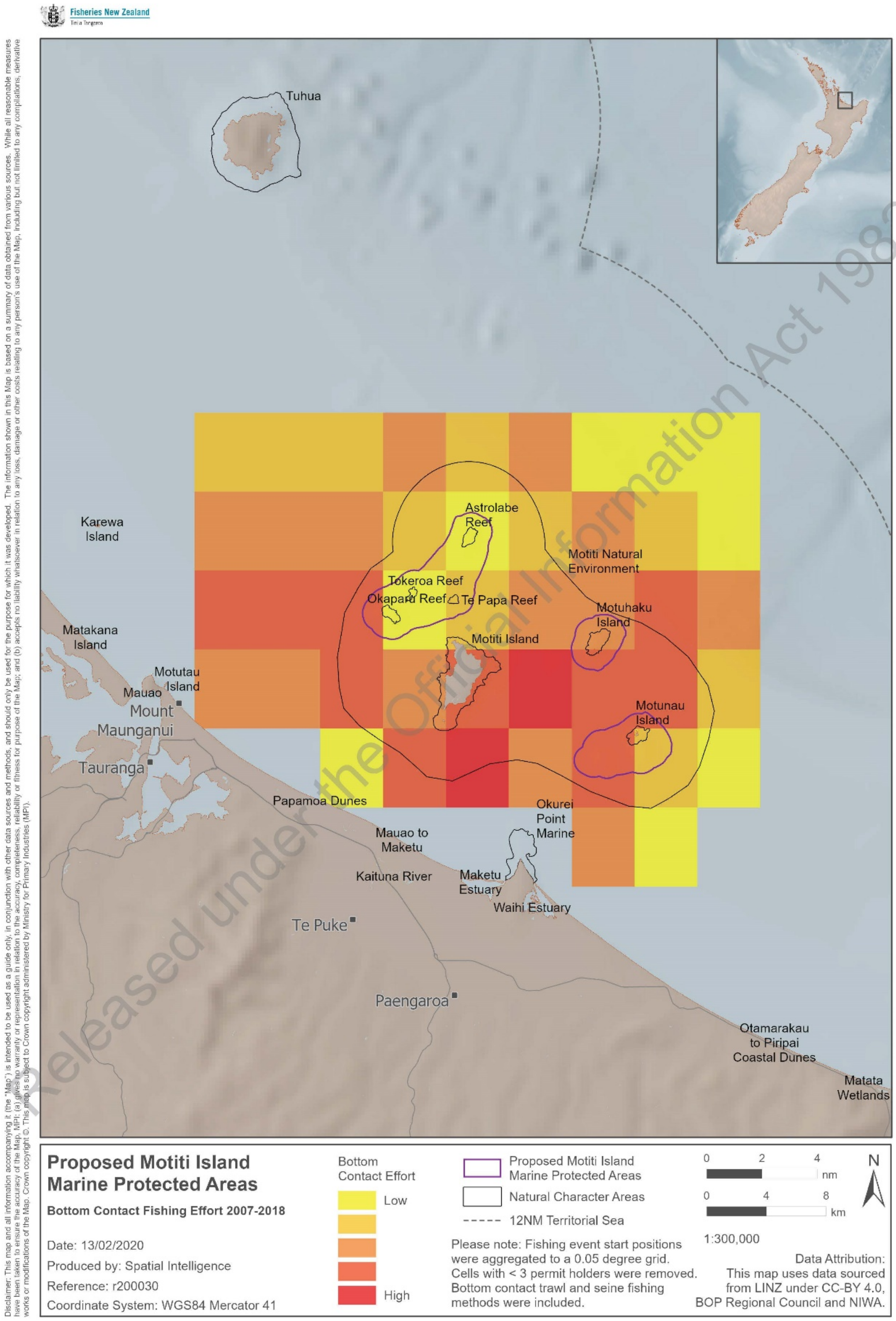


*Figure 8-1: Bottom contact fishing effort 2007-2018 (data from MPI). Te Poroiti is incorrectly identified as Tokoroa.*

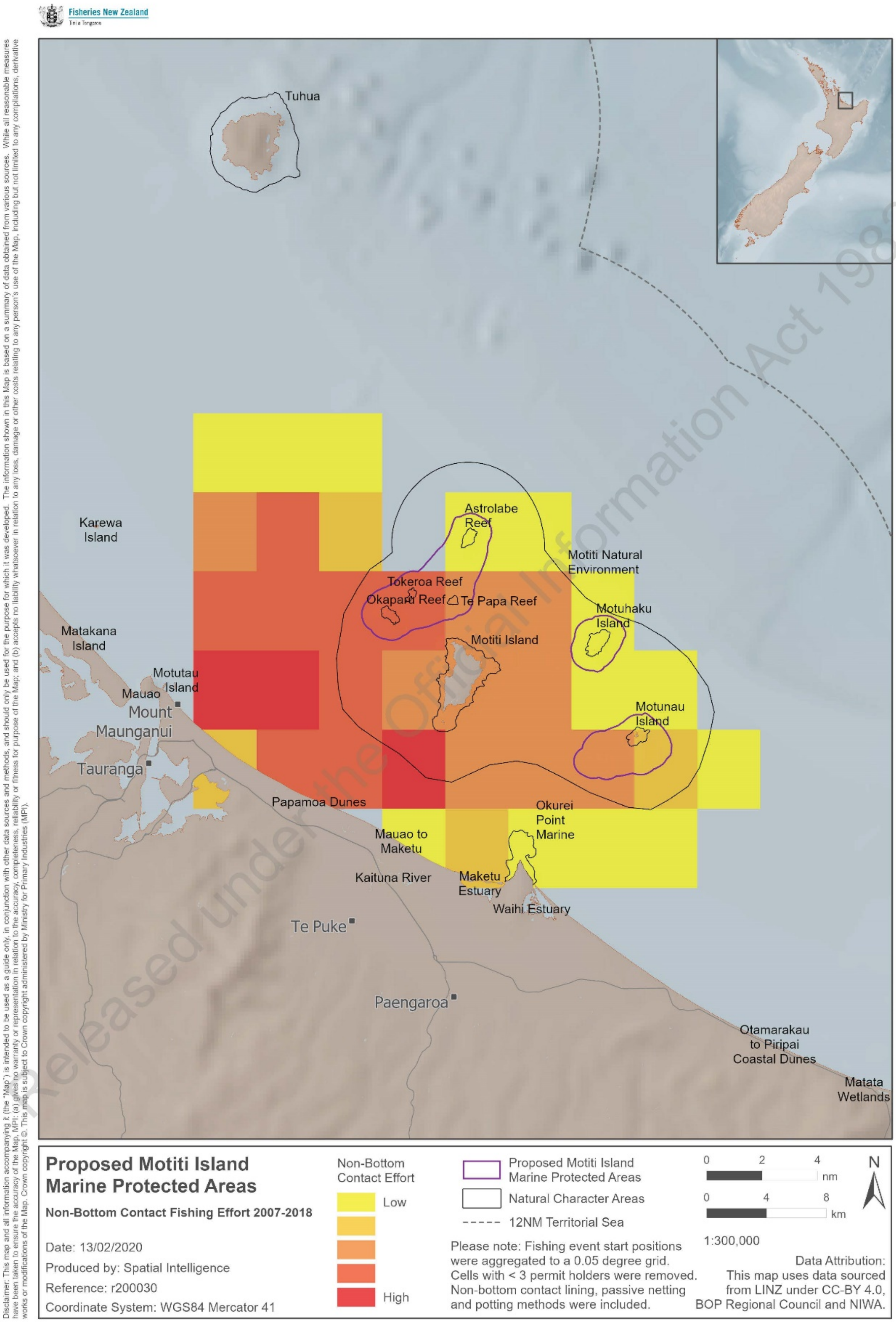


*Figure 8-2: Non-bottom contact fishing effort 2007-2018 (data sourced from MPI). (Note: Te Poroiti is incorrectly identified as Tokoroa).*

# 9.0 Recreational Fish Data

Recreational fishing in the Bay of Plenty is described in the Environment Court evidence of Andrew Hill (Hill, 2017):

1. Recreational catch is not reported under the Fisheries Act, but MPI commissions periodic National Panel Surveys to estimate the recreational catch from each fish stock nationwide. Under these surveys, snapper is by far the most common recreationally harvested fin fish in the Bay of Plenty, followed by kahawai, gurnard, tarakihi, trevally and kingfish. Kina and crayfish are also harvested in the region, while marlin and other gamefish are commonly targeted over the summer months.

2. In 2011-2012, overflight surveys of recreational fishing numbers were conducted alongside the National Panel Survey and these allow representations like Figure 9-1 below to show indicative levels of recreational fishing interest in the Motiti Island surrounds. However, because of the timing of the surveys (during the exclusion following the Rena grounding), Figure 9-1 does not give an accurate indication of the level of recreational fishing interest around Otaiti in particular. Figure 9-2, shows a similar representation based on overflight surveys conducted in 2004-2005.

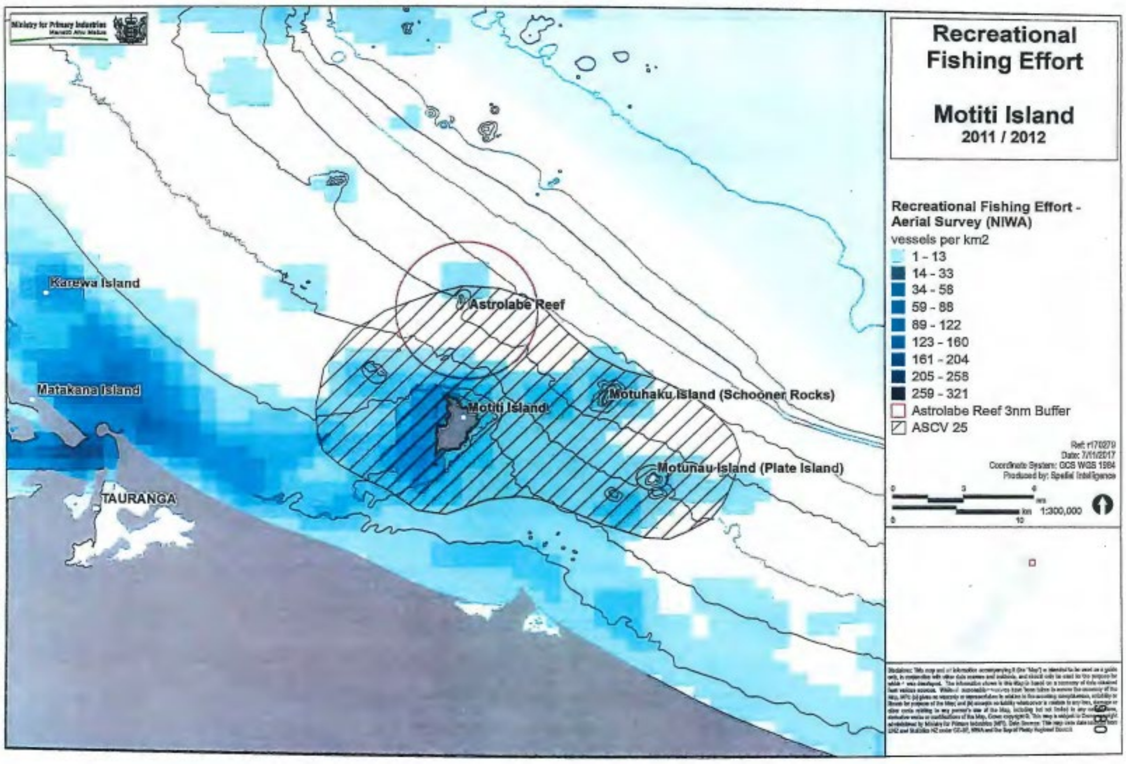


*Figure 9-1 Recreational Fishing Effort around Motiti Island 2011 – 2012. This figure shows the total number of recreational vessels identified (per square km) in the area surrounding Motiti, over the course of 30 overflight surveys conducted between October 2011 and September 2012 (during the MV Rena exclusion zone).*

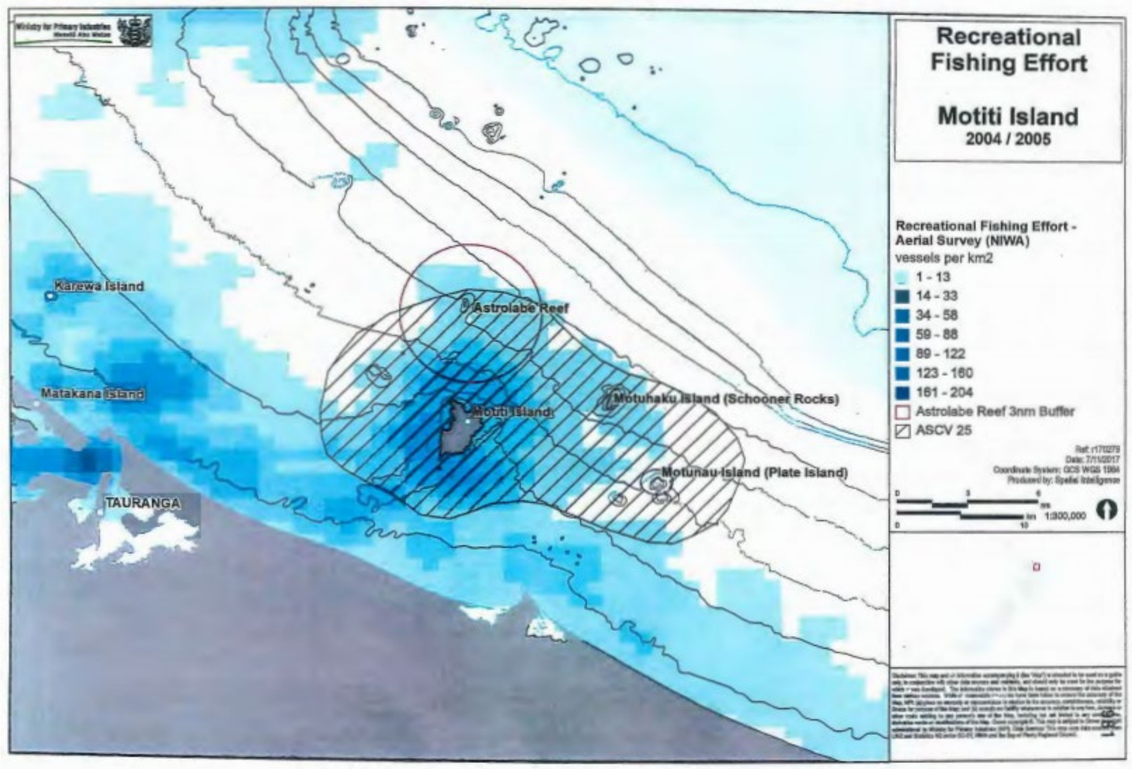


*Figure 9-2 Recreational Fishing Effort around Motiti Island 2004 – 2005. This figure shows the total number of recreational vessels identified (per square km) in the area surrounding Motiti, over the course of 40 overflight surveys conducted between December 2004 and November 2005.*

MPI were not able to provide recreational fisheries data for the Motiti Natural Environment Management Area for the purposes of preparing this report. However, national aggregated data is available (Figure 9-3). One of the primarily reasons put forward for lower harvests in 2017-2018 compared to 2011-2012 is fewer fishing trips in 2017-2018. Harvests were lower in 2017-2018 for 43 finfish species and higher in 2017-2018 for 18 finfish species. The highest drop between the two surveys was in snapper, with the harvest in 2017-2018 compared to 2011-2012 was over one million less fish.

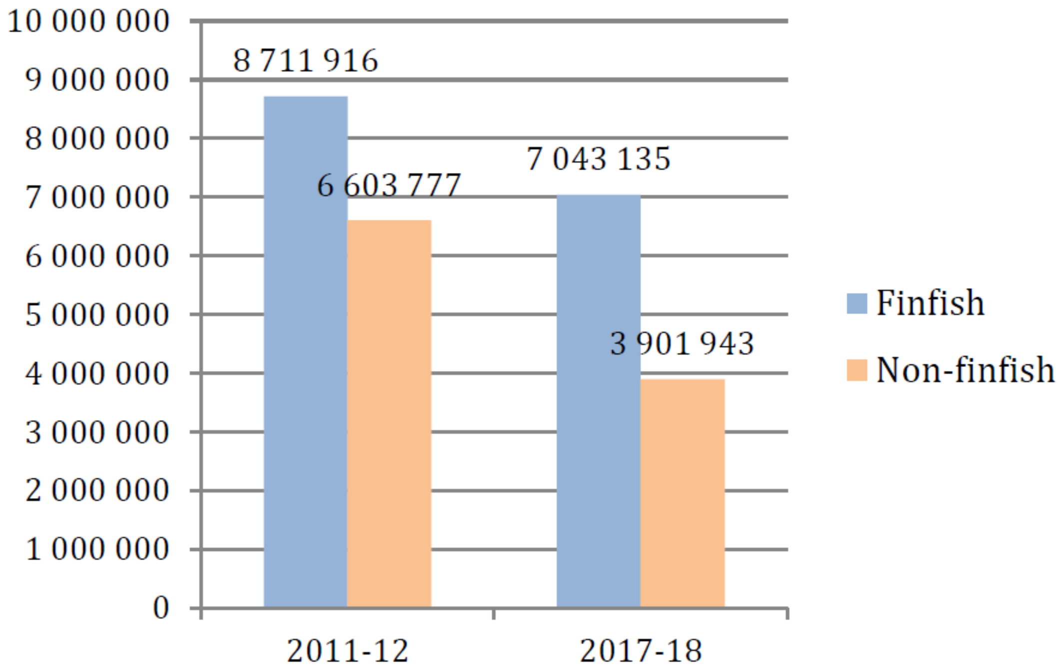


*Figure 9-3: Recreational harvest of finfish and non-finfish 2011-12 and 2017-18 nationally (from Wynne-Jones et al., 2019).*

# 10.0 GAP Analysis, Recommendations and Conclusions

There is a considerable body of ecological knowledge available for the Motiti Natural Environment Management Area. However, the majority relates specifically to the Rena shipwreck and Otaiti and has not been replicated at other reef systems. A summary of the identified research and monitoring gaps are shown in Table 10-1 (and discussed below) alongside steps that could be taken to fill these gaps and generate knowledge to inform future management solutions.

In terms of information available to act as a baseline for future monitoring programmes, a detailed habitat map was generated for Otaiti in 2016 and is already proving useful in identifying ecological changes that have occurred since (P.Ross *pers comm.*). Equivalent habitats maps for the Motiti Protection Areas and other key sites within the Motiti Natural Environment Management Area would be useful and could be generated using the model of depth stratified habitat distribution generated for Otaiti. Verification of any new habitat maps would be required and could be conducted using a combination of drone, diver and drop camera surveys.

Bathymetry is available for much of the Motiti Natural Environment Management Area and Motiti Protection Areas. The areas that have not been mapped can be viewed in Figure 10-1 and include deep reefs lying between Motiti Island and the Motiti Protection Areas. Information about the biodiversity of these reefs may be important in determining future management options for the Motiti Natural Environment Management Area. Generating bathymetry data for these reefs would be a good starting point. Given that there is local knowledge of the whereabouts of some of these reefs and low resolution data on existing maritime charts, a targeted approach to future multibeam surveys may be possible rather than a necessity to survey all remaining parts of the Motiti Natural Environment Management Area.

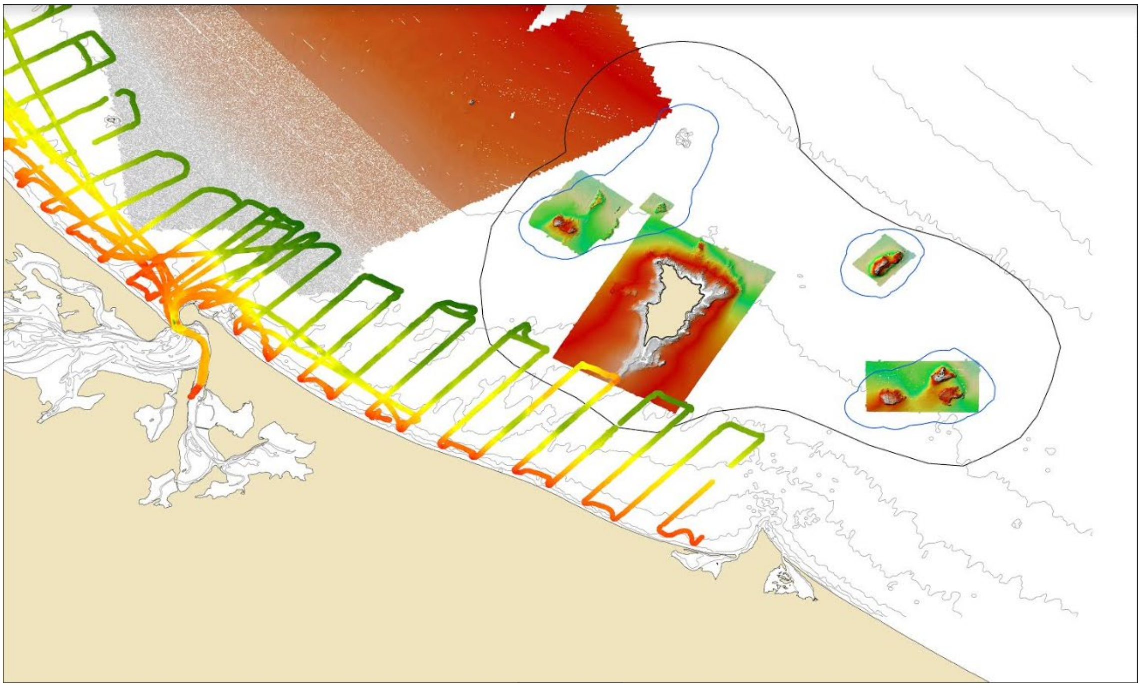

*Figure 10-1: Current multibeam survey coverage for the Motiti Natural Environment Management Area and surrounding areas.*

Survey work conducted at Otaiti provides an excellent picture of the biodiversity present on this reef. It is likely that many of the species present on Otaiti are also found on reefs throughout the Motiti Natural Environment Management Area. It is also possible that there are differences in biodiversity between reefs and there may even be species that are unique to certain reefs within the Motiti Natural Environment Management Area. A bioblitz type survey similar to that conducted at Otaiti could be used to generate biodiversity registers for each reef within the Motiti Natural Environment Management Area.

Benthic ecology data will be key to determining the ecological changes that occur within the Motiti Protection Areas following their implementation. Habitat mapping and monitoring will identify changes that occur and the monitoring of benthic ecology (flora and fauna on the reef) will help to explain the mechanisms driving changes in the distribution of habitats and associated biodiversity. Some benthic ecology data is available for Otaiti, Okarapu, Motunau and Motuhaku dating back to 2011 but has not be collected with any temporal consistency since. Video transects and photo quadrats collected in 2011 and 2012 at Okarapu, Motunau and Motuhaku may prove particularly useful. This data should be assessed and used as a baseline for future monitoring where possible and appropriate.

*Table 10-1 Key knowledge gaps identified for the Motiti Natural Environment Management Area (MNEMA) and work that could be undertaken to address these unknowns.*

| Knowledge type | Where available | Where unavailable | Work required to fill knowledge gap |
|---|---|---|---|
| **Habitat and biodiversity data** | | | |
| Maps showing distribution of different marine habitats | Otaiti (Fig. 4-3) | Elsewhere in MNEMA | Bathymetry is available for most of the reefs that fall within the Motiti Protection Areas. Habitat maps could be generated by applying the depth stratified habitat distribution model generated for Otaiti in 2016 (Table 4-1). Any new habitat maps should be verified through combination of drone photogrammetry and diver and drop camera surveys. |
| Bathymetry | Motiti Protection Areas and Motiti Island (Fig. 10-3) | Deeper reefs within the MNEMA | Targeted MBES to characterise deep reefs that have been identified from existing charts or local knowledge |
| Biodiversity scan / species list | Otaiti | Elsewhere in MNEMA | Conduct surveys similar to those conducted at Otaiti (Section 4.1.3.1; Fig 4-4) at locations throughout MNEMA. |
| Benthic ecology data | Otaiti (2016 and 2019), Motuhaku (2011, 2012, 2016), Motunau, Okarapu (2011, 2012) | Elsewhere in MNEMA | Establish permanent monitoring sites at reefs across MNEMA to be routinely monitored over time. This will provide information about ecological responses to protections. For example, what happens to urchin barrens habitat once protection are put in place. When establishing new monitoring sites, look to utilise sites surveyed by Gregor and Young (2013) in 2011 and 2012 as this will provides an earlier baseline data set.<br><br>Access and analyse video transects (Motuhaku, Motunau, Okarapu) from Gregor and Young 2013. Consider repeating video transect for future surveys if data looks useful. |
| **Abundance and population structure data for key biota** | | | |
| Rock lobster | No data available | MNEMA and MPAs | Potting surveys<br><br>Diver surveys |
| Finfish | No data available | MNEMA and MPAs | Baited underwater video surveys<br><br>Diver surveys |
| Seabirds | No data available | MNEMA and MPAs | Work with DOC to determine what data is available and identify opportunities for generating additional data |
| Sea urchins (kina) | Otaiti (2016 and 2019), Motuhaku (2011, 2012, 2016), Motunau, Okarapu (2011, 2012) | Motiti | Diver surveys |
| **Fisheries data** | | | |
| Commercial fisheries data | None presently available at appropriate spatial scale | MNEMA and MPAs | Work with MPI to generate information from existing data sets at an appropriate scale for the MNEMA and determine whether future data collections can be reported at appropriate scales. |
| Recreational fisheries data at appropriate scale | None presently available at appropriate spatial scale | MNEMA and MPAs | Work with MPI to generate information from existing data sets at an appropriate scale for the MNEMA and determine whether future data collections can be reported at appropriate scales. |

Although these protected areas have not been designated for the purposes of fisheries management, future changes in the abundance of species targeted by recreational and commercial fishers may have direct or indirect consequences for indigenous biodiversity within the Motiti Natural Environment Management Area and Motiti Protection Areas. Without having some knowledge of populations of these key species it will be difficult to assign causation to ecological changes recorded in future monitoring. There is presently no data available regarding the size and abundance of rock lobster or finfish within the Motiti Natural Environment Management Area, and there is only limited information for sea urchin populations. Potting, diver and baited underwater video surveys could be used to fill these knowledge gaps. Seabirds were identified in the Environment Court decision as warranting some protection and possibly benefiting from the Motiti Protection Areas. Sea bird surveys have not previously been conducted in the Motiti Natural Environment Management Area, but may be necessary if the Regional Council is to gain an understanding of benefits these bird species accrue from the implementation of the Motiti Protection Areas.

Accessing commercial and recreational fisheries data at a scale that would be useful for understanding possible fishing impacts and the distribution of fishing pressure has been problematic. It is likely that this data is available but cannot be released by MPI as it is commercially sensitive. Similarly, surveys recording the spatial distribution of recreational fishing effort have been conducted but have not been made available in a format or scale that is useful for examining pressure and impacts in the Motiti Natural Environment Management Area. It may be possible to work with MPI to generate information, from the existing fisheries data sets, at an appropriate scale for the Motiti Natural Environment Management Area and to determine whether future data collections can be reported at appropriate scales and shared with the Regional Council.

A considerable amount of time and resources would be required to address all of the knowledge gaps identified above (Table 10-1). The priority or urgency for filling each particular gap will depend on the data that the Regional Council will require for informing their environmental management decision making processes. For example, if a priority is to determine success of the Motiti Protection Areas in protecting and restoring indigenous marine biodiversity then habitat maps showing the distribution of kelp forest and urchin barrens habitat would be useful. There is an expectation, based on what has happened in other north-east New Zealand marine protected areas that the coverage of kelp forest will increase as the size and abundance of urchin predators increases. Kelp forest supports greater biodiversity than urchin barrens and thus habitat maps will provide a baseline against which to assess whether these protections have restored kelp forest biodiversity. Quantitative data on the abundance of sea urchins, crayfish and fish that eat sea urchins will also be useful in explaining changes in kelp forest coverage and a benthic habitat survey with sufficient taxonomic resolution will be useful in describing and quantifying what kelp forest biodiversity looks like in the Bay of Plenty.

Alternatively, if there is interest in identifying additional areas with ecologically significant biodiversity that may require management, then research priorities may be filling in the remaining gaps in the multibeam survey map (Figure. 10-1) and exploratory investigations of deeper reef systems in the Motiti Natural Environment Management Area and beyond. With better information on the distribution of habitats and indigenous biodiversity within the Motiti Natural Environment Management Area and Bay of Plenty, environmental managers will be in a better position to understand what biodiversity is currently being managed and where there is a need to implement additional management tools. A prioritisation of these potential monitoring methods/gaps could be explored by BOPRC.

# 11.0 References

Akuhata, P., 2016. Primary statement of evidence of Paku Akuhata on behalf of the iwi appellants in the matter of two appeals under s 120 of the Resource Management Act [Rena Hearing], Environment Court (ENV-2016-AKL-42, 43 and 45), 23 December 2016.

ANZECC, 2000. Australian and New Zealand guidelines for fresh and marine water quality, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

Boyd, R.O., 2016. Statement of Evidence on behalf of the Applicant by Richard Owen Boyd in the matter of an appeal under section 120 of the Resource Management Act [Rena Hearing], Environment Court (ENV-2016-AKL-42, 43 and 45), 28 October 2016.

Clark, D., Dunmore, R., Barter, P., 2016. Astrolabe Reef ecological survey 2015: data analysis. Prepared for Beca. (Cawthron Report No. 2911).

Edgar, G.J., Stuart-Smith, R.D.,. Systematic global assessment of reef fish communities by the Reef Life Survey program. *Scientific Data*. 2014;1:140007:1–8. pmid:25977765

Edgar, G.J., Stuart-Smith, R.D., Thomson, R.J., Freeman, D.J., 2017. Consistent multi-level trophic effects of marine reserve protection across northern New Zealand. PLOS One, https://doi.org/10.1371/journal.pone.0177216.

Grace, R., 2017. Statement of evidence of Dr Roger Grace on behalf of Motiti Rohe Moana Trust in the matter of an appeal under clause 14 of the first schedule of the Resource Management Act [Bay of Plenty Regional Coastal Plan Hearing], Environment Court, Auckland Registry (ENV 2015 AKL 0000134), 25 October 2017.

Gregor, K., Young, K., 2013. Subtidal rocky reef monitoring for contamination from MV Rena. In: Rena Environmental Recovery Monitoring Programme 2011-2013, Waikato University, Hamilton.

Haggitt, T., Mead, S., Green., 2008. Classification of the Bay of Plenty Marine Environment into MPA Habitat Classes. Report prepared for the Department of Conservation.

Hill, A.F., 2017. Brief of evidence of Andrew Francis Hill in the matter of an appeal under clause 14 of the first schedule of the Resource Management Act and an application under section 311 of the Act [Bay of Plenty Regional Coastal Plan Hearing], Environment Court, Auckland Registry (ENV-2015-134), November 2017.

Immenga, D., 2011. Multibeam Images of SS Taupo and SS Taioma. Bay of Plenty: University of Waikato. Department of Earth and Ocean Sciences.

Kahotea, D.T., 2016. Statement of Evidence on behalf of the Applicant by Desmond Tatana Kahotea in the matter of an appeal under section 120 of the Resource Management Act [Rena Hearing], Environment Court (ENV-2016-AKL-42, 43 and 45), 28 October 2016.

Kulgemeyer, T., von Dobeneck, T., Müller, H., Bryan, K.R., de Lange, W.P., Battershill, C.N., 2016. Lithofacies distribution and sediment dynamics on a storm-dominated shelf from combined photographic, acoustic and sedimentological profiling methods (Bay of Plenty, New Zealand). Marine Geology, 376, 158-174.

Morrison, A.E., Gregor, K.E., 2012 Snapper (*Pagrus auratus*) abundance and size at Tūhua Marine Reserve as determined by baited underwater video (BUV) survey. *Technical Report Series 6*. East Coast Bay of Plenty Conservancy, Department of Conservation, Rotorua.

Paul-Burke, P., 2016. Statement of Evidence by Kura Paul-Burke on behalf of the Korowai Kāhui o nga Pakeke o te Patuwai (The Korowai), in the matter of an appeal under section 120 of the Resource Management Act [Rena Hearing], Environment Court (ENV-2016-AKL-42, 43 and 45), 22 December 2016.

Ranapia, N., 2017. Statement of evidence of Nepia Ranapia on behalf of Motiti Rohe Moana Trust in the matter of an appeal under clause 14 of the first schedule of the Resource Management Act [Bay of Plenty Regional Coastal Plan Hearing], Environment Court, Auckland Registry (ENV 2015 AKL 0000134), 25 October 2017.

Robertson, C.J.R., Hyvönen, P., Fraser, M.J., Pickard, D.R., 2007. Atlas of Bird Distribution in New Zealand 1999-2004. Ornithological Society of New Zealand Inc, Wellington.

Robertson, S., 2012. SS Taioma and SS Taupo. Unpublished University of Waikato report.

Ross, P., 2020. Physical Environment Monitoring Report 2019.

Ross, P., 2016. Statement of evidence on behalf of the Applicant by Philip Maxwell Ross in the matter of appeals under section 120 of the Resource Management Act [Rena Hearing], Environment Court (ENV-2016-AKL-42, 43 and 45), 28 October 2016.

Ross, P., Tremblay, L., Champeau, O., Kelly, F., 2018. Physical Environment Reference Report.

Sayers, T., 2017. Statement of evidence of Te Atarangi Sayers in reply on behalf of Motiti Rohe Moana Trust in the matter of an appeal under clause 14 of the first schedule of the Resource Management Act [Bay of Plenty Regional Coastal Plan Hearing], Environment Court, Auckland Registry (ENV 2015 AKL 0000134), 20 November 2017.

Shears, N.T., Babcock, R.C., 2007. Quantitative description of mainland New Zealand's shallow subtidal reef communities. *Science for Conservation 280*. Department of Conservation, Wellington.

Shears, N.T., Babcock, R.C., Salomon, A.K., 2008. Context-dependent effects of fishing: variation in trophic cascades across environmental gradients. *Ecological Applications.* 18: 1860-1873.

Stirnemann, L.V., 2017. Statement of evidence of Rebecca Liv Stirnemann on behalf of The Royal Forest and Bird Protection Society of New Zealand Inc in the matter of an appeal under clause 14 of the first schedule of the Resource Management Act [Bay of Plenty Regional Coastal Plan Hearing], Environment Court, Auckland Registry (ENV 2015 AKL 0000134), 24th October 2017.

Walters, T.N.N., 2016. Affidavit of Te Wano Ngahana Ngatipeehi Walters for Te Rūnanga o Ngāti Whakaue Ki Maketū Inc. and Te Arawa Takitai Moana Kaumatua Forum in the matter of three appeals under s 120 of the Resource Management Act [Rena Hearing], Environment Court (ENV-2016-AKL-42 and 45), 23 December 2016.

Wilkinson, A.G., 2016. Primary statement of evidence of Aroha Gwenvillan Wilkinson for Te Rūnanga o Ngāti Whakaue Ki Maketū Inc. and Te Arawa Takitai Moana Kaumatua Forum in the matter of two appeals under s 120 of the Resource Management Act [Rena Hearing], Environment Court (ENV-2016-AKL-42 and 45), 22 December 2016.

Wilkinson, B.W., 2016. Primary statement of evidence of Barrie William Wilkinson for Te Rūnanga o Ngāti Whakaue Ki Maketū Inc. and Te Arawa Takitai Moana Kaumatua Forum in the matter of two appeals under s 120 of the Resource Management Act [Rena Hearing], Environment Court (ENV-2016-AKL-42 and 45), 22 December 2016.

Wynne-Jones, J., Gray, A., Heinemann, A., Hill, L., & Walton, L., 2019. National Panel Survey of Marine Recreational Fishers 2017-18 (New Zealand Fisheries Assessment Report 2019/24). Ministry for Primary Industries.

Young, K., Ferreira, S., Jones, A., Gregor, K.E., 2006. Recovery of targeted reef fish at Tuhua Marine Reserve-monitoring and constraints. *DOC Research and Development Series 251.* Department of Conservation, Wellington.