

**REFINING NZ
CRUDE FREIGHT PROJECT**

**A REVIEW OF LITERATURE ON THE
MARINE NATURAL ENVIRONMENT OF
WHANGAREI HEADS, BREAM BAY AND ITS
ADJACENT COASTLINE**

**PREPARED FOR CHANCERY GREEN ON BEHALF
OF REFINING NZ**



Consulting Biologists - Established 1972
P.O. Box 2828, Auckland 1140, New Zealand
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Crude Freight Project**

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Marine Natural Environment Of
Whangarei Heads, Bream Bay And Its
Adjacent Coastline**

December 2015

For : Chancery Green On Behalf Of Refining NZ
Report By : S A West, M.Sc (Hons)
G L Don, M.Sc (Hons)

Refining NZ

A Review of Literature on the Marine Natural Environment of Whangarei Heads, Bream Bay and Its Adjacent Coastline

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1 INTRODUCTION AND SCOPE

The following report summarises current published and some unpublished information on the natural marine environment of the Whangarei Harbour mouth, Bream Bay, and its peripheral shoreline.

The report forms one part of a feasibility study commissioned by Refining NZ to investigate a proposal to deepen the Whangarei Harbour shipping channel to allow Crude freight ships that carry larger cargo volumes into port at the Marsden Point Oil Refinery. Information contained within the report will be used for feasibility and options studies. The report would also be used to identify areas which require further investigation, or updating of information, prior to the preparation of an assessment of environmental effects of dredging and disposal of marine sediments.

The brief for this exercise was to complete a review and summary of all available literature regarding the marine biology of Whangarei Harbour shipping channel, Bream Bay and its adjacent shoreline.

The specific area of interest is that encompassed to the west of a line from Bream Head to Bream Tail and south of a line between One Tree Point and Darch Point. The area is bounded on the western side by outer harbour sandy beaches and inlets from One Tree Point to Marsden Point, by open ocean beaches from Marsden Point to Waipu Cove, interspersed by the estuaries of the Ruakaka and Waipu Rivers, and on the northern side by a rocky embayed coastline Darch Point to Bream Tail, with sandy beaches at Taurikura and Smugglers Cove. The area contains the entrance to Whangarei Harbour and consists of a deep channel adjacent to; several extensive sand and shell banks, Calliope Bank and Mair Bank, islands, Motukaroro Island, High Island, Calliope Island and Frenchman Island and include the Motukaroro Island Whangarei Marine Reserve. Greater emphasis has been directed to areas closer to the Whangarei Harbour shipping channel and in areas of Bream Bay identified as possible disposal areas.

The larger study area of Whangarei Harbour mouth, Bream Bay, as described by the wider area encompassed to the west of a line from Bream Head to Bream Tail and south of a line between One Tree Point and Darch Point, and its peripheral shoreline, as shown in Figure 1.1. The area has been divided into four sub areas for discussion; the division is largely based on the habitats present within each. The locations of sites discussed in the following sections are shown in Figure 1.2, Figure 1.3 and Figure 1.4.

The report is based on a survey of literature, both published and some unpublished, and on discussions with and assistance from the following organisations - Department of Conservation, Northland Regional Council, Ministry of Primary Industries and Birds New Zealand, Patuharakeke Te Iwi Trust and members of the public during information days in early 2015.

This report covers the following aspects of Whangarei Harbour mouth and Bream Bay – marine habitats, sediment quality, coastal birds and fishing commercial activities.

Recreational fishing and other recreational activities are discussed in a separate report (Greenway, 2014). Cultural values and cultural fishing activities are discussed in a separate report (Patuharakeke Te Iwi Trust Board, 2015). No field work or new data collection specific to the project was carried out for the purposes of this report. It is expected that subsequent work will involve an analysis of the impact of any effects of dredging, an assessment of locations for dredge spoil disposal, and further data collection.



Figure 1.1 Wider Study Area, showing study area boundaries in yellow.

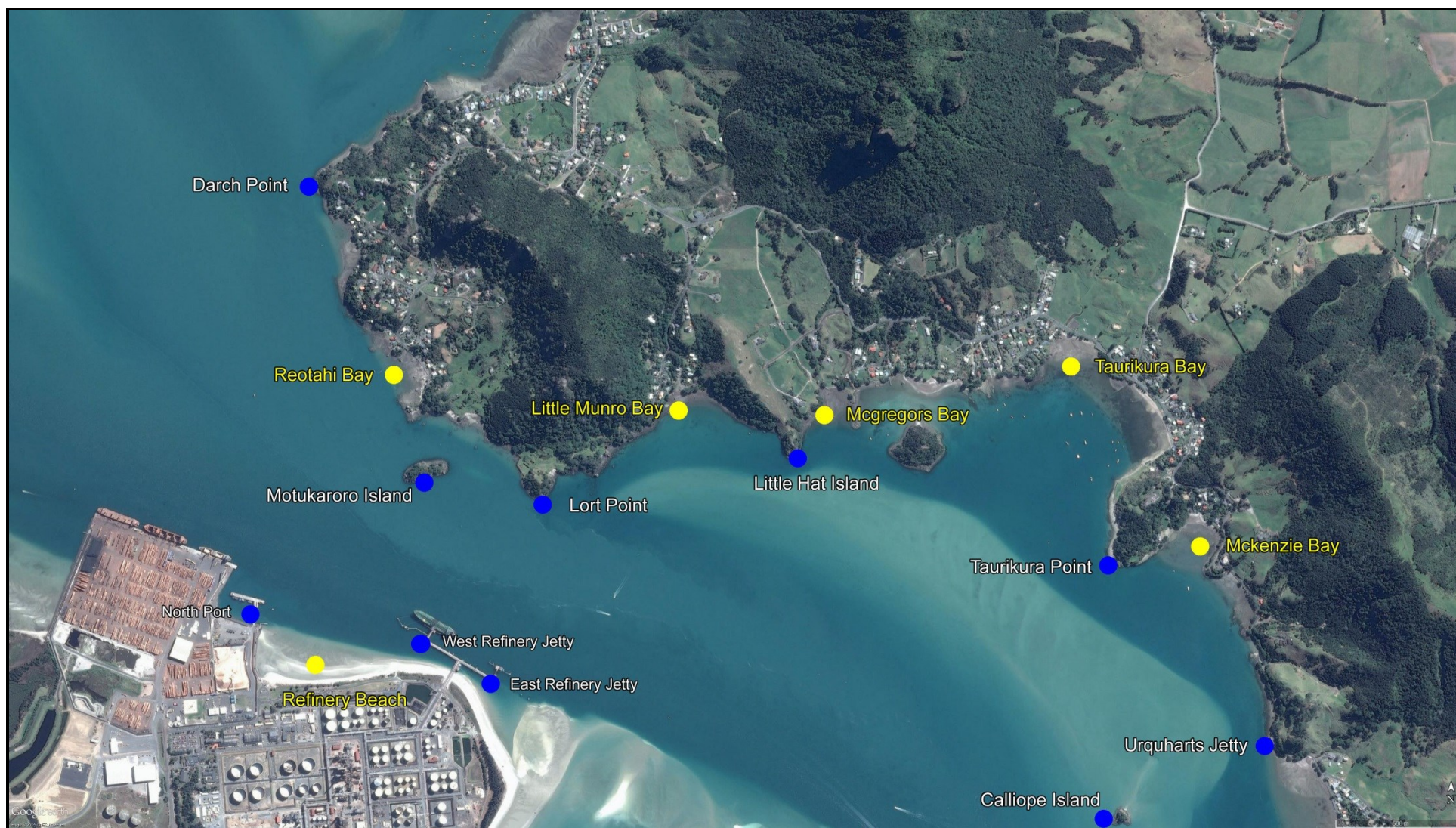


Figure 1.2 Locations of Sites Discussed in the Literature, Darch Point to Urquharts Jetty. (● Soft shore studies, ● Hard shore studies)



Figure 1.3 Locations of Sites Discussed in the Literature, Urquharts Jetty to Bream Head. (● Soft shore studies, ● Hard shore studies)



Figure 1.4 Locations of Sites Discussed in the Literature, One Tree Point to Mair Bank. (● Soft shore studies, ● Hard shore studies)

2 INTERTIDAL HABITATS

2.1 Lower Whangarei Harbour

2.1.1 Darch Point to Busby Head

This area contains predominantly rocky intertidal shorelines broken by several areas of sandy or shingle beaches at Reotahi, Little Munro Bay, McGregors Bay, Taurikura Bay, McKenzie Bay and Urquharts Bay. Rock types vary though out this area between hard volcanic rock and softer sandstone and limestone.

Of significance is the 26.2 ha Motukaroro Island Whangarei Marine Reserve. In addition the Regional Coastal Plan for Northland (NRC, 2004) identifies the coastal regions of the Snake Bank, Calliope Bank, Home Point to Busby Head, One Tree Point, Blacksmiths Creek and Mair Bank, as ‘Marine 1 (Protection) Management Area’, (Refer Figure 2.1).

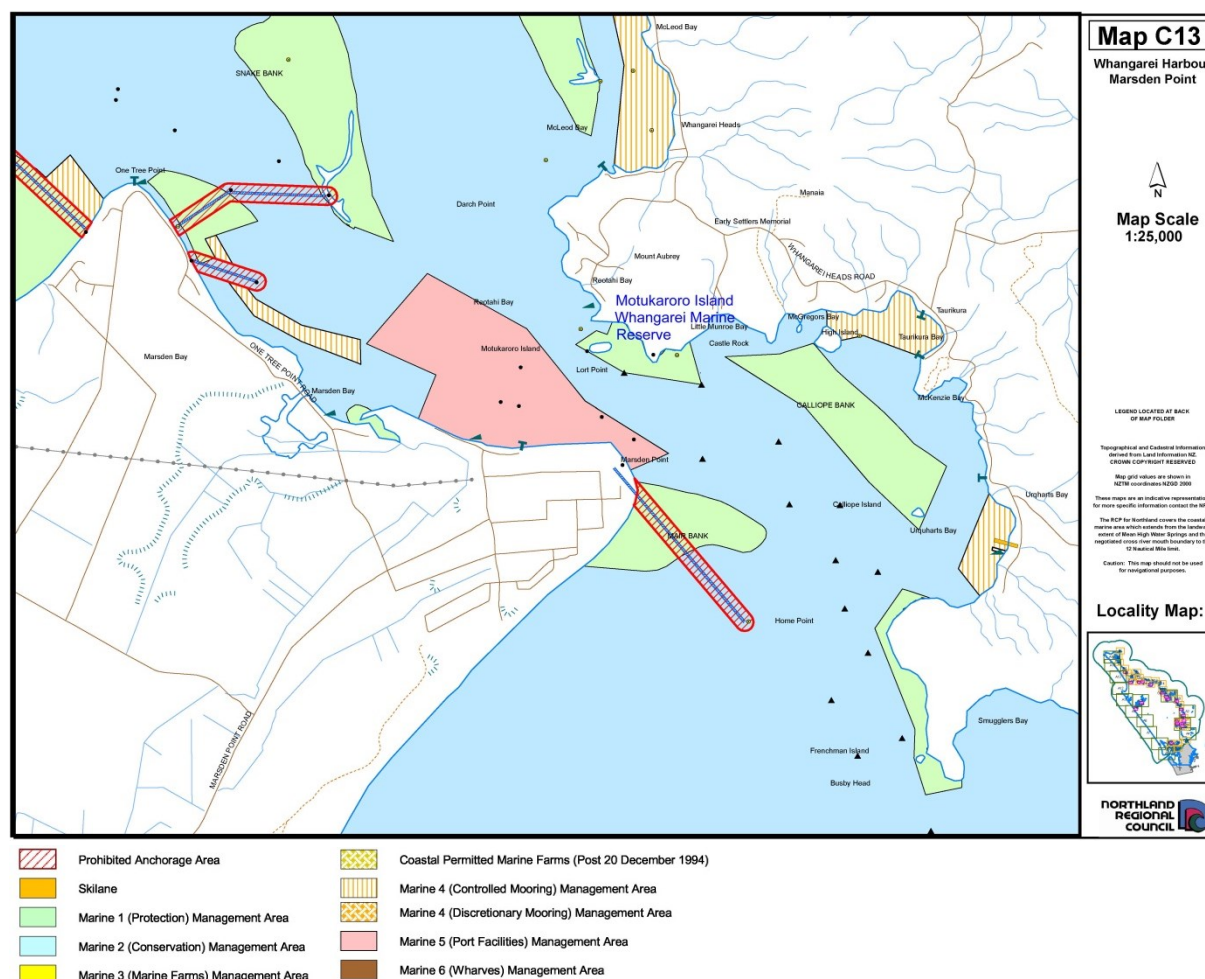


Figure 2.1 Map C13 and key from Northland Regional Council Coastal Plan (NRC 2004) showing marine management areas.

The areas, summarised below, are considered to have important conservation values (NRC 2004) and are required to be managed in such a manner that the conservation values (coastal wetlands, marine mammals, birds, ecosystems and habitat values) of the areas are protected.

Whangarei Harbour – Home Point to Busby Head

Protected areas, ecosystems, habitats. Rocky shore internationally significant habitat for NZ endemic wading and coastal birds, including threatened species.

Whangarei Harbour – Outer Harbour sandbanks (Snake Bank, Mair bank, Calliope Bank)

Protected areas, ecosystems, birds, habitats, coastal landforms. Inter-tidal areas provide internationally significant habitat for international migratory and NZ endemic wading and wetland birds, including threatened species

Whangarei Harbour – Blacksmith's Creek

Protected areas, ecosystems, birds, habitats, Maori cultural values as a sacred waka landing site. Contains a roosting habitat for international migratory and NZ endemic wading and wetland birds, including threatened species.

Whangarei Harbour – One Tree Point

Protected areas. Inter-tidal areas provide internationally significant habitat for international migratory and NZ endemic wading birds, including threatened species. Important shellfish gathering area. Seagrass habitat.

2.1.1.1 Soft Shores

There have previously been investigations of intertidal biota in this area. Bioresearches Ltd, 1976 sampled and presented descriptions of the intertidal biota at seven areas on soft shores at Reotahi, Little Munro Bay, McGregors Bay, Taurikura Bay, McKenzie Bay, Urquharts Bay north and Urquharts Bay south. Dickie, 1984a, sampled and presented descriptions of the intertidal biota at three areas on soft shores at Taurikura Bay, Urquharts Bay north and Urquharts Bay south. Sample locations are shown in Figure 1.2, Figure 1.3 and Figure 1.4 as yellow dots.

Close proximity to the harbour mouth and main channels ensures fast flowing clean water reaches these shores on both the incoming and outgoing tides. The soft shores in this zone have many features in common including firm substrata of coarse sands or fine gravels, a deep aerobic layer of up to 100 mm below the surface and a bivalve dominated fauna.

Species diversity varied little from ten at Taurikura Bay to thirteen at the northern end of Urquharts Bay with many species being common to two of the three sample stations. Cockles, Tuangi, *Austrovenus stutchburyi* were present at all three sites. Pipis, *Paphies australis* were more abundant nearer the harbour entrance. Other bivalve molluscs found at this zone include the wedge shell, Hanikura, *Tellina liliana* and the nut shell, *Nucula hartvigiana*. Mobile gastropod species were found at all three sites with the mudflat top shell, *Diloma subrostrata* the most numerous, also recorded was the Catseye, *Turbo smaragdus*. As well as epifaunal species such as the limpet, *Notoacmea elongata* and the green chiton, Papatua, *Chiton glaucus*, the stoney fraction of the substrata near the harbour entrance also supports epifloral species, such as turfing algae, *Corallina officinalis*.

The only two echinoderm species found during the sampling exercise were from the southern end of Urquharts Bay. One heart-urchin, *Echinocardium cordatum* was found buried in the sand and a small starfish, Patakaroa, *Coscinasterias muricata* on the surface. Two additional species were found at this station and nowhere else during the survey; one was the brown bubble shell, Pupu-waharoa, *Bulla quoyii*, the other was the paddle crab, Papaka, *Ovalipes catharus*.

Seagrass

Seagrass (*Zostera capricorni*) was once a dominant and ecologically important feature of Whangarei Harbour (at least 12 km²) (NIWA 2003), with most of the lower harbour intertidal flats, (and some subtidal areas), being covered, including Snake and MacDonald Banks, and the Marsden Point foreshore, as well as the entrance to Parua Bay, Wellington Reach, Blacksmiths Creek and Takahiwai.

In the 1960's there was a New Zealand wide die off of seagrass, by 1971 the majority of seagrass beds in the Whangarei Harbour were gone or severely depleted (Bioresarches, 1976, 1979). NIWA 2003 attributed the seagrass die off in Whangarei harbour in the 1960's to the dumping of massive amounts of sediments into the system through cement processing and channel dredging operations, which changed both the turbidity levels of the harbour, and the physical nature of the seafloor sediments. However for seagrass to die off in other areas of New Zealand as well, some other factor may have been involved.

Recent Google earth images show that beds of seagrass have recolonised Taurikura Bay and Urquharts Bay as shown in the yellow circles in Figure 2.2. In November 2010 (Figure 2.2) small patches of seagrass were present at the southern end of Taurikura Bay, as were very small patches at Urquharts Bay just offshore from the car park at the of the road. In December 2012 (Figure 2.3) the seagrass at both Taurikura Bay and Urquharts Bay had expanded. In March 2014 (Figure 2.4) the seagrass fills the southern bay at Taurikura from mid to low tide and possibly beyond. At Urquharts Bay the seagrass fills the soft shore area out from the car park and has spread along the low tide edge of the channel in both directions.



Figure 2.2 Eastern Shore Bays, 2 November 2010, (Google Earth) showing re-establishment of seagrass beds.

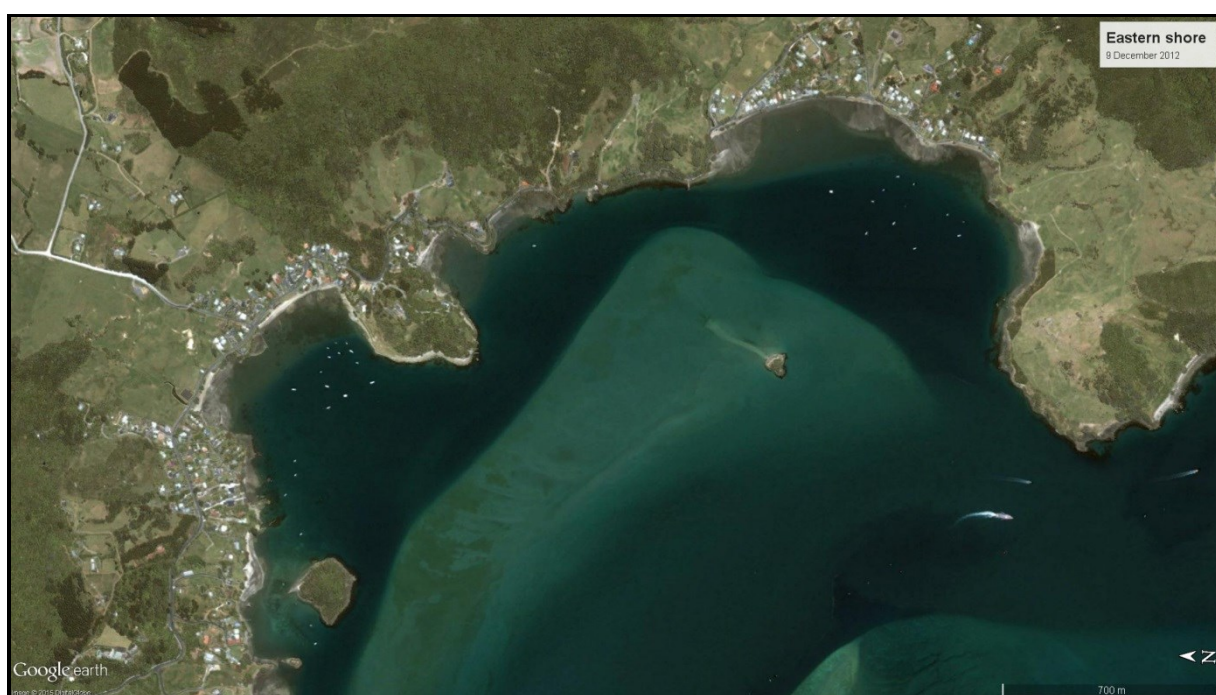


Figure 2.3 Eastern Shore Bays, 9 December 2012, (Google Earth).

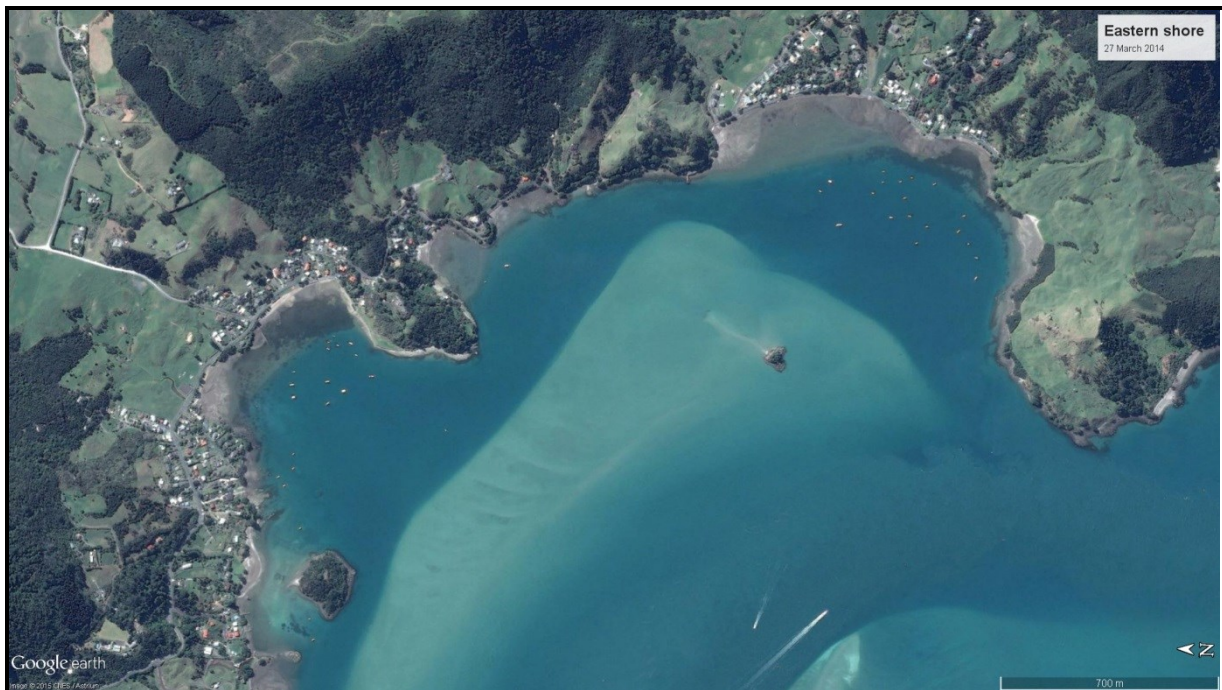


Figure 2.4 Eastern Shore Bays, 27 March 2014, (Google Earth).

2.1.1.2 Rocky Shores

There have previously been investigations of intertidal biota in this area BioResearches Ltd, 1976 sampled and presented descriptions of the intertidal biota along four rocky shore transects at Darch Point, Motukaroro Island, Calliope Island and Frenchman Island. Dickie, 1984c sampled and presented descriptions of the intertidal biota along nine transect areas on rocky shores at Darch Point, Reotahi, Motukaroro Island, Lort Point, Little Hat Island, Taurikura Bay, Urquharts Bay Wharf, Home Point and Frenchman Island. Sample locations are shown in Figure 1.2, Figure 1.3 and Figure 1.4 as blue dots.

Darch Point

The innermost site sampled in Dickie, 1984c, is situated on a headland at the southern end of McLeods Bay. The substratum is smooth andesite with cracks of up to 150 mm and small ledges of up to 300 mm depth. There were no pools in these ledges but they were shaded from direct sunlight. The slope averages 45° over the mid-lower littoral tapering off to 20° above the barnacle line. Darch Point has an aspect of 315° and is situated beside the main tidal channel along the northern side of the harbour. This site showed no evidence of silting indicating tidal currents and wave action to be relatively strong (Dickie, 1984c).

In 1984 the intertidal shore was divided into four distinct biological zones.

- The upper most comprised of low numbers of the top shell, Maihi, *Diloma aethiops* and the periwinkle, Ngaeti, *Austrolittorina antipodum*.
- Barnacle (*Chamaesipho columna*) densities reached over 80% rock cover in some areas. Patches of the alga *Ralfsia* sp. covering up to 25% rock cover were noted within this zone. The dominant grazing mollusc species was the black nerita, Matangaarahu, *Nerita melanotragus*. However the limpet,

Ngakihi, *Cellana ornata*, *Diloma aethiops* and *Austrolittorina antipodum* were also common.

- A zone of rock oysters, Tio reperepe, *Saccostrea glomerata*, in densities of up to 30% rock cover were found above the turfing corallines. Many molluscan species were also found in this zone with the dominant grazing species being the snakeskin chiton, Papatua, *Sypharochiton pelliserpentis*.
- Lowest a zone characterized by the turfing algae *Corallina officinalis*, the fucoid algae *Hormosira banksii* and the grazing mollusc *Turbo smaragdus*.

Reotahi

Reotahi was chosen as being representative of the surrounding shoreline. The shore is a mixture of conglomerate rock and mudstone with loose boulders on the lower shoreline grading into pebbles on the upper shore with a sandy upper limit. Boulders of up to 0.5 metres in diameter are common on this shore. The littoral zone extended 12 metres up the shore. The shore slope was a gentle 8°. Some evidence of silting was noted in the turfing corallines on the lower shore, evidence of a sheltered environment. Motukaroro Island directly shields this shoreline from any waves coming from a westerly direction.

The slight slope of this shore and its sheltered location combine to give five distinct bands of zonation in 1984.

- The upper most was near vertical with a ledge. *Chamaesipho columna* and *C. brunnea* were found in approximately equal densities with *Austrolittorina antipodum* and *Nerita melanotragus* being the only grazing mollusc species found at this level.
- A zone of broken shells and small rocks included the chitons *Chiton glaucus*, *Sypharochiton pelliserpentis* and *Ischnochiton maorianus* in low numbers.
- A band of mixed rock oysters and barnacles. The grazing mollusc species were represented by *Sypharochiton pelliserpentis* and *Nerita melanotragus* whilst high densities of the carnivorous oyster borer, Kaikai tio, *Haustrum scobina* were also noted.
- A pure band of turfing *Corallina officinalis* (up to 95% rock cover) with some individual seaweeds *Hormosira banksii* and *Leathesia difformis* plants. The most common mollusc species was *Turbo smaragdus*.
- The lowest zone is characterised by large brown algae. Common species included the seaweeds *Carpophyllum maschalocarpum* (up to 50% rock cover) and *Corallina officinalis*.

Motukaroro (Passage) Island

The Motukaroro Island site was on the south side of the island; the shore sampled was of uniform 40° slope with a smooth surface and no significant cracks. The southerly aspect of 168° and overhanging vegetation shade this shore for most of the day. This shore is not exposed to the open sea but is subjected to tidal currents of the main harbour channel and seas with a maximum fetch of 3,100 metres.

Five biological zones on this shore were all characterised by low species diversity but high numbers of zone forming organisms in 1984.

- At the top of the shore was a well-developed lichen zone. The three species identified during this study may be potentially viewed as indicators of changes in the marine environment. No littoral animals were found in this zone during the study.
- A zone of bare rock with few Littorinids.
- A mixed zone of two barnacle species, *Chamaesipho brunnea* and *C. columna* with the former being the dominant barnacle. This zone was also characterised by high numbers of Littorinids.
- A zone of mixed algae *Liagora harveyana* / *Epopella plicata*. Characteristic molluscan species included low numbers of *Sypharochiton pelliserpentis* and *Nerita melanotragus*.
- A zone of brown algae dominated by an association of *Corallina officinalis* and *Hormosira banksii*. Characteristic animal species included *Turbo smaragdus* and clumped distributions of the anemone, *Humenga*, *Anthopleura aureoradiata*.

Lort Point

Lort Point, directly opposite the Marsden Point oil wharf, consists of sandstone with an even 45° slope. Surface texture is relatively uniform, there being no sharp edges to cracks; the maximum depth of cracks is 150 mm. The steep slope and lack of shading meant there were no intertidal pools, however, evidence of surface runoff from the upper slopes was seen. This shore is subjected to strong tidal flows and is open to seas with a maximum fetch of 3,500 metres. In 1984 the shore showed no evidence of siltation, indicating relatively moderate exposure.

Five distinct biological zones were identified on this shore in 1984.

- A dense zone of lichens
- A zone of bare rock with the only zoning species being moderate numbers of *Austrolittorina antipodum*.
- A mixed zone of two barnacle species, *Chamaesipho brunnea* and *C. columna*
- A lower barnacle zone dominated by *Chamaesipho columna* with rock oysters *Saccostrea glomerata* found in low densities.
- A brown algae zone. Common species were *Corallina officinalis*, *Codium convolutum*, *Hormosira banksii* and *Carpophyllum maschalocarpum*. Common grazing molluscs in this zone included *Turbo smaragdus* and *Sypharochiton pelliserpentis*.

Motukaroro Island Whangarei Marine Reserve

The Dickie 1984 transects at Motukaroro Island and Lort Point are now located within the Motukaroro Island Whangarei Marine Reserve. More recent studies have been conducted within the marine reserve (Kerr and Grace, 2006, Kerr and Moretti, 2012). These have shown similar results when compared with the 1984 studies. Information provided by Dr. B. Ballantine in support of the creation of the marine reserve contended that the area had shorelines with well defined zonation of biota, that were some of the best examples in New Zealand.

Little Hat Island

The Little Hat Island site is of uniform 20° slope on the south western side of the island. The substratum is andesite with some jointing and deep narrow cracks of up to 150 mm depth. The island is sheltered from main tidal flows by High Island and Calliope Bank, and coupled with a maximum fetch of only 800 metres from Marsden Point, suggests this shore is relatively sheltered, although no evidence of silting was observed in 1984.

Five distinct biological zones were identified at this site in 1984;

- A zone of lichens
- A zone of mixed barnacles, *Chamaesipho columna* and *C. brunnea*, moderate numbers of *Nerita melanotragus* and low numbers of Littorinids were also present.
- A zone of barnacles mixed with the moderate numbers of *Saccostrea glomerata*.
- A zone of grazing molluscs, *Turbo smaragdus*, *Sypharochiton pelliserpentis*, *Diloma aethiops* and the predatory whelk *Haustorium scobina*.
- A zone of *Corallina officinalis* and *Hormosira banksii* occupies the lower shore. The characteristic grazing mollusc species of this level was *Turbo smaragdus*.

Taurikura Point

Taurikura Point was chosen for its location on the headland between Taurikura and McKenzie Bays and also the physical and biological characteristics representative of surrounding rocky shores. This shore is terraced limestone with scattered boulders and many cracks, some of which are over 150 mm deep. On the lower littoral small shallow tide pools are common. The shore has a westerly aspect of 265° and is enclosed by the surrounding headlands of Home Point and Lort Point with Calliope Bank sheltering the site from the South. The overall slope on this shore is 10° made up of three distinct terraces and due to the enclosed situation is subjected to seas with a maximum fetch of 1,000 metres.

Four distinct biological zones were identified at this site in 1984;

- The upper most comprised of low numbers of the gastropods *Nerita melanotragus* and Littorinids.
- A mixed barnacle zone *Elminius modestus* typically 50% covered and lesser cover by *Chamaesipho columna* and *Epopella plicata*. Other characteristic species of this zone included the grazing molluscs *Nerita melanotragus*, *Diloma aethiops*, *Sypharochiton pelliserpentis* and *Haustorium scobina*. *Saccostrea glomerata* was only found on the underside of boulders on this shore.
- *Corallina officinalis* turf and *Hormosira banksii* and grazing mollusc species *Turbo smaragdus*, *Sypharochiton pelliserpentis*, *Diloma aethiops* and the carnivorous *Haustorium scobina*.
- *Corallina officinalis* turf and *Hormosira banksii*.

Urquharts Bay

The Urquharts Bay transect runs down a shore of artificially placed limestone blocks and is shaded from direct sunlight by the wooden decking of the jetty. The manmade shore gives the appearance of a steep boulder shore with large cracks and crevices, some up to 1 metre deep.

The slope of this shore is 30° with a westerly aspect of 270°; maximum fetch for waves is 1,300 metres with Mair and Calliope Banks forming barriers to incoming waves from Bream Bay and the upper harbour. The location of this site and the faunal communities present suggest a relatively sheltered situation although fast tidal currents have been observed between the jetty and Calliope Bank.

The intertidal was divided into four zones in 1984;

- The common barnacle *Chamaesipho columna*
- Rock oysters in moderate densities of up to 50% rock cover form the next distinctive zone. Grazing mollusc species were absent or present on the outer rock surfaces in very low numbers, with *Diloma aethiops* and *Sypharochiton pelliserpentis* being the only species on the outer rock faces. *Haustrum scobina* and the limpet *Patelloida corticata* were found in cracks between blocks.
- A zone of algae characterized by high densities of *Bostrychia arbuscula* and patches of *Codium convolutum*. Grazing molluscs were scarce at this level with only *Turbo smaragdus* and *Patelloida corticata* recorded.
- On the lower shore a band of large brown algae *Ecklonia radiata* and *Carpophyllum maschalocarpum* in association with *Sargassum sinclairii* and *Bostrychia arbuscula*.

Home Point

Home Point at the south western tip of Urquharts Bay is a gently sloping shore (5°) of mixed substrata and has a north westerly aspect of 327°. Three types of substrata are found on this shore - the upper littoral is mobile beach sand, the middle shore is rock flats, and the lower littoral was a matrix of small boulders set in sand gravel and shell fragments. The completely enclosed situation of Home Point gives a maximum fetch of 3,200 metres to waves from the direction of the main shipping channel.

The intertidal shore was divided into five distinct biological zones in 1984;

- A barnacle zone with low densities of *Chamaesipho columna*. *Nerita melanotragus* was the characteristic molluscan species of this level.
- A zone of mobile beach sands.
- A zone of boulder tops and rock flats without algae. Characteristic encrusting fauna includes moderate densities of *Chamaesipho columna* and low densities of the rock oyster *Saccostrea glomerata*. This zone is also characterised by the molluscs *Diloma aethiops*, *Nerita melanotragus*, *Haustrum scobina* and *Sypharochiton pelliserpentis*.
- A zone of *Corallina officinalis* / *Hormosira banksii* flats. The characteristic animal species present includes *Chamaesipho columna* and some mobile molluscs, *Nerita melanotragus* and *Turbo smaragdus*.
- Below the coralline flats, boulders extend sub tidally and have a relatively dense algal cover of over 50% *Carpophyllum flexuosum* with lesser densities of *Corallina officinalis* and *Hormosira banksii*.

Frenchman Island

A transect was surveyed along the northwestern side of a platform reef extending into the channel towards The Frenchman Island. The transect sampled has a westerly aspect of 290° and is flat for most of its length dropping quickly into the subtidal zone. At the upper end of this shore the slope also increases forming the base of the cliff. The top of the platform is dissected with relief features in the order of 150-200 mm deep (cracks, channels and pools). There was no evidence of silting or gravel in the cracks in 1984, indeed the entire shoreline was clean with only a few relatively large boulders (between 0.5 and 1 metre in diameter) at the base of the cliff. This would indicate a relatively high energy shoreline, either from wave action and or water currents. The maximum fetch for waves reaching this shore is only 3,500 metres from the direction of the harbour but currents and wind direction may increase the wave action acting on this shore at certain times.

The intertidal shore was divided into six distinct biological zones in 1984;

- A splash zone in which only Littorinids were found.
- A zone of *Ralfsia verrucosa* and rock oysters *Saccostrea glomerata*.
- A zone characterised by bare rock surfaces, shallow rock pools and the surf barnacle *Chamaesipho brunnea* in drainage channels. *Enteromorpha intestinalis* (green alga) was present in the pools. Grazing molluscs were virtually absent with low numbers of *Nerita melanotragus* and *Austrolittorina antipodum* being recorded.
- A zone of dense mixed barnacles *Chamaesipho columna* and *Epopella plicata*. Mobile molluscan species *Haustrum scobina* were very abundant while the grazing molluscs, *Sypharochiton pelliserpentis*, *Diloma aethiops* and *Cellana ornata* were not as abundant.
- A zone of algae with moderate densities of *Hormosira banksii* and *Xiphophora chondrophylla*. Characteristic animals found at this level include *Chamaesipho columna*, the grazing molluscs *Turbo smaragdus* and *Cellana radians*, and the carnivorous whelks *Haustrum scobina* and *Haustrum haustorium*.
- A dense zone of *Carpophyllum maschalocarpum* and *Corallina officinalis* was present at low tide level and beyond. Animals found in this zone are typical of lower littoral forms, including *Turbo smaragdus*, *Calliostoma pellucidum* and the chitons *Eudoxochiton nobilis*, *Cryptoconchus porosus* and *Sypharochiton pelliserpentis*.

Busby Head

Busby Head is the southernmost tip of the peninsula bordering the entrance to Whangarei Harbour. This shore is representative of the southwestern andesitic shores along the peninsula and was chosen for its uniform slope of 30°, and regular micro topography with relief features of between 50 and 150 mm. The shore sampled has a southerly aspect of 178° and is open to seas from Bream Bay. Busby Head is an exposed shore as indicated by the animal species present and the extended height of the littoral zone giving a large splash and spray zone.

The intertidal shore was divided into six distinct biological zones in 1976;

- Splash zone
- Lichen zone

- The littorinid zone was characterized by sparse *Chamaesipho brunnea* and littorinid snails, with the large shore crab *Leptograpsus variegatus*, in cracks.
- Upper barnacle zone is dominated by *Chamaesipho brunnea*. The only animals found in this dense surf barnacle zone were Littorinids and those limpets small enough to fit into the gaps left by dead barnacles such as *Notoacmea pileopsis*.
- Lower barnacle zone is characterised by a mixture of barnacles *Epopella plicata*, *Chamaesipho columna*. Other characteristic animals of the lower barnacle zone include the limpets *Cellana ornata*, *Notoacmea parviconoidea*, *Notoacmea pileopsis* and *Notoacmea scopulina* and *Siphonaria zelandica*.
- Turf zone, species characteristic of this level were *Corallina officinalis* paint', *Xiphophora chondrophylla*, *Patelloida corticata* and *Cellana radians*.

2.1.1.3 Summary

Of the areas previously investigated between Darch Point and Busby Head, the published information points to the areas of rocky shore having greater diversity of biota than soft shores. The area now located within the Motukaroro Island Whangarei Marine Reserve was and is the area of greatest ecological significance within this section of coast. The marine reserve status of the Motukaroro Island area suggests the area is of national importance.

Several areas of re-establishing seagrass beds at Taurikura Bay and Urquharts Bay are also of high ecological value based on the diversity of fauna associated with the seagrass beds. Seagrass does not receive specific mention in the Coastal Policy Statement. However, the protection of areas of significant indigenous vegetation is identified as a national priority for the preservation of the natural character of the environment, Turner & Schwarz (2006).

Based on the Northland Regional Coastal Plan the Home Point to Busby Head area is of regional importance, for the rocky shore ecology and values for the sea birds it supports, Calliope Bank is also of regional importance, based on its value for sea birds (NRC, 2004).

Many of the soft shore beaches have public or private access enabling boat launching which has impacts on the biota, degrading the ecological values.

2.1.2 **One Tree Point to Marsden Point**

This area contains predominantly soft shore intertidal areas. The intertidal areas contain a high diversity of habitats from rush marsh, mangroves, sandflats to modified man made port structures. (Bioresearches Ltd, 1976, Dickie, 1984a, Bioresearches, 2002).

Bioresearches Ltd, 1976, sampled and presented descriptions of the intertidal biota at six areas on soft shores; Snake Bank, east of One Tree Point, Marsden Cove, North Port, West Refinery Jetty, East Refinery Jetty. Dickie, 1984a sampled and presented descriptions of the intertidal biota at one area on a soft shore, east of One Tree Point.

More recently with the development of Marsden Cove Marina Bioresarches, 2002, sampled and presented descriptions of the soft shore intertidal biota in Marsden Cove Bay.

Snake Bank

In 1976 the southern tip of Snake Bank, had a high diversity 31 species in total. Abundant biota included the anemone *Anthopleura aureoradiata* the polychaete worm *Aglaophamus macroura*, the gastropods *Cominella adspersa*, *C. glandiformis*, *C. maculosa*, *Notoacmea elongata*, *Zeacumantus lutulentus*, *Diloma subrostrata*, the bivalves *Austrovenus stutchburyi*, *Tellina liliana*, *Nucula hartvigiana*, and the barnacle *Elminius modestus*. Also common were the polychaete worms *Axiothella australis*, *Boccardia* sp. and *Owenia fusiformis*, and the gastropod *Amalda australis*.

East of One Tree Point

In 1976 the area east of One Tree Point, had a high diversity 36 species in total. Abundant biota included the polychaete worms *Aglaophamus macroura*, *Axiothella australis*, *Boccardia* sp., the bivalves *Austrovenus stutchburyi*, *Tellina liliana*, *Paphies australis*. Also common were the anemone *Anthopleura aureoradiata*, the polychaete worms *Orbinia papillosa*, *Lagis australis*, *Prionospio* sp., gastropod *Cominella glandiformis*, *Zeacumantus lutulentus*, bivalve *Nucula hartvigiana*, the barnacle *Elminius modestus*, and the shrimp *Biffarius filholi*.

Seagrass

In the 1940's there was a large bed of seagrass east of One Tree Point how this was reported as absent in 2005 (NIWA, 2005). More recent google earth images show that this bed of seagrass has recolonised. In November 2010 (Figure 2.5) small patches of seagrass were present at low tide in the side channel north of the Marsden cove entrance. In December 2012 (Figure 2.6) the seagrass along the channel edge had gone but several small colonies were now evident on the offshore bank. In March 2014 (Figure 2.7) the offshore bank colonies had proliferated and spread to the edge of the in shore channel. There is also a very large bed of seagrass in the bay to the west of One Tree Point which has been present for an extended period of time.

There has been a small bed of seagrass present in Blacksmiths Creek (Bioresarches, 2002, 2014).



Figure 2.5 Sand bank east of One Tree Point, 2 November 2010, (Google Earth).



Figure 2.6 Sand bank east of One Tree Point, 9 December 2012, (Google Earth).



Figure 2.7 Sand bank east of One Tree Point, 27 March 2014, (Google Earth).

Marsden Cove

In 1976 the Marsden Cove bay area, had a high diversity 35 species in total. Abundant biota included the gastropods *Cominella glandiformis*, *Zeacumantus lutulentus*, the bivalves *Austrovenus stutchburyi*, *Tellina liliana*, *Nucula hartvigiana*. Also common were the anemone *Anthopleura aureoradiata*, polychaete worms *Aglaophamus macroura*, *Boccardia* sp., *Glycera lamellipodia*, *Ninoe leptognatha*, *Lagis australis*, *Prionospio* sp., *Pseudonereis* sp., the gastropod *Xymene plebeius*, the barnacle *Elminius modestus*, and the shrimp *Biffarius filholi*.

Between 2002 and 2015 Bioresarches conducted monitoring in the Marsden bay area as part of the consent monitoring for Marsden Cove Marina (Bioresarches, 2014). The average number of taxa per sampling site for the 2013 survey was 22.9 taxa. A total of 122 different taxa were recorded from all the sites sampled in 2013. The average number of individuals per sampling site for the 2013 survey was 7,514 per m². The average Shannon Weiner Diversity Index per sampling site for the 2013 survey was 2.10.

The biota was numerically dominated by the polychaete worms *Prionospio aucklandica* (2,072 per m²) and Sabellidae (1,022 per m²) and the cockle *Austrovenus stutchburyi* (1,449 per m²). Also present in numbers were the polychaete worms *Boccardia* sp. (366 per m²), *Capitella* sp. (521 per m²), *Lumbrinereis* sp. (386 per m²) and *Perinereis nuntia* (569 per m²), the gastropods *Notoacmea elongata* (262 per m²) and *Zeacumantus lutulentus* (547 per m²), the bivalves *Paphies australis* (285 per m²) and *Nucula hartvigiana* (590 per m²), the amphipods *Nototropis reductus* (229 per m²), Lysianassidae (373 per m²), Pontoporeiidae (493 per m²) and Phoxocephalidae (330 per m²), the barnacle *Elminius modestus* (341 per m²), and the anemone *Anthopleura aureoradiata* (763 per m²).

Blacksmiths Creek

In 1980 habitats in Blacksmiths Creek were described in Bioresearches Ltd, 1980. Blacksmiths Creek is a small enclosed estuarine area bounded by a small low dune along the harbour side which was colonised by sand convolvulus *Calystegia soldanella* and sand grass *Spinifex sericeus*.

Behind the dune several distinct biotic areas were present in 1980 (Figure 2.8).

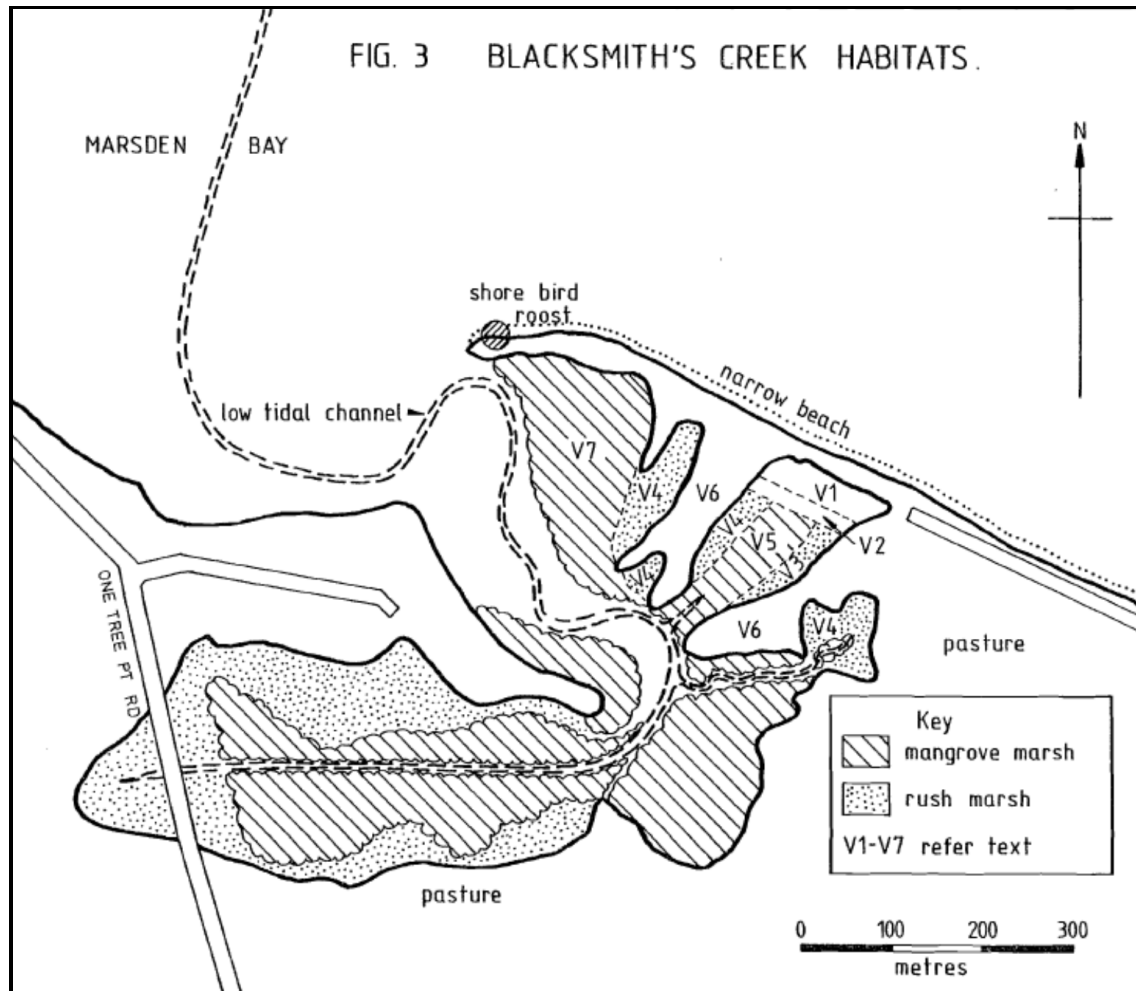


Figure 2.8 Blacksmiths Creek Habitats (from Bioresearches Ltd, 1980)

- V1 Immediately adjacent to the dune was a zone dominated by needle grass *Stipa teretifolia* with small patches of gorse *Ulex europaeus*. The sediment in this area was coarse, dry sand and only sand hoppers *Bellorchestia quoyana* were found.
- V2 South of, and adjacent to (V1) was an area of clean sand colonised by glasswort *Salicornia australis*, and a chenopod *Suaeda novaezelandiae*. Small individuals of the burrowing mud crab, *Helice crassa* were also present.
- V3 On the eastern side the vegetation was dominated by the rush *Juncus maritimus*, which extended to the estuary channel. The gastropod *Pleuroloba costellaris* was present in most of the upper rush and mangrove marsh areas.

- V4 *Juncus* was present on the western side, but in association with needle grass and the jointed rush *Leptocarpus simplex*. Similar areas, with *Juncus* dominant, were present to the west between the scrub and the mangroves. A rush marsh was also present in the south-eastern arm of the estuary.
- V5 The remaining area between the rush zones was occupied by small mangroves *Avicennia resinifera*, up to 1.5 m high. Whereas sediments comprised clean hard sands in the seaward half of the marsh, the proportion of finer sediments increased towards the estuary. Free-living neptune's necklace alga, *Hormosira banksii* was common in the marsh near the estuary. The fauna was dominated throughout by mud crabs and the snail *Zeacumantus lutulentus* (100 per m²). Polychaete worms included a nereid sp., small cockles *Austrovenus stutchburyi*, occurred 200 m from the dune. Near the estuary channel the snail *Diloma subrostrata*, and a few small mud snails, *Amphibola crenata* were present. Common encrusting organisms on mangrove trunks and pneumatophores were the barnacle *Elminius modestus*, black mussel, *Xenostrobus pulex*, and alga *Caloglossa leprieurii*. *Pleuroloba costellaris* was common in the area near the channel.
- V6 The patches of coastal scrub contained the following dominants: manuka *Leptospermum scoparium*; bracken *Pteridium esculentum*; gorse; toetoe *Arundo conspicua*; *Muehlenbeckia complexa*; kikuyu grass *Pennisetum clandestinum*; buffalo grass *Stenotaphrum secundatum*; marsh ribbonwood *Plagianthus divaricatus*; mingimingi *Cyathodes fasciculata* and wattles. Ground cover consisted of a variety of lichens and mosses. Fringing most areas of scrub was a metre-wide strip of *Salicornia*, *Suaeda* and *Samolus repens*. A similar area was present fringing V5 to the east but vegetation tended to be less maritime than in the above area.
- V7 The biota in the western mangrove marsh was similar to those previously described. Mangrove trees were generally larger, and the sediments contained a 1 cm thick surface layer of soft mud over the dense mangrove rootlet zone. The green alga *Enteromorpha compressa*, was present on the seaward side. Polychaetes collected were *Ceratonereis* sp. and *Scolecopelides* sp.

In 1980 the areas of swamp investigated were in a healthy condition and supported a range of organisms which were typical of estuarine areas. It should be noted that Blacksmiths Creek is the most eastern estuarine marsh habitat in the Whangarei Harbour, and therefore closest to the open sea. For this reason it is considered to be potentially important, especially as a possible nursery habitat for fishes. The spit at the estuary entrance was considered to be the most important spring tidal roost for shore birds in the Whangarei Harbour, east of Takahiwai.

North Port

The North port intertidal area was surveyed in 1976 and again in 1980 (Bioresearches Ltd, 1980), however the areas surveyed have now been buried by the construction of the port and the data is no longer relevant.

West Refinery Jetty

In 1976 the area east of One Tree Point, had a moderate diversity 20 species in total. Abundant biota included the gastropod *Cominella glandiformis*, the bivalves *Austrovenus stutchburyi*, *Tellina liliana*, *Nucula hartvigiana*. Also common were the anemone *Anthopleura aureoradiata*, the polychaete worms *Aglaophamus macroura*, *Axiothella australis*, *Boccardia* sp., *Glycera lamellipodia*, *Orbinia papillosa*, *Prionospio* sp., gastropod *Zeacumantus lutulentus*, bivalve *Paphies australis*, the barnacle *Elminius modestus*, and hermit crabs.

East Refinery Jetty

In 1976 the area east of One Tree Point, had a high diversity 31 species in total. Abundant biota included the polychaete worm *Aglaophamus macroura*, the gastropods *Cominella adspersa*, *C. glandiformis*, and the bivalve *Paphies australis*. Also common were the polychaete worms *Axiothella australis*, *Boccardia* sp., and the shrimp *Biffarius filholi*.

2.1.2.1 Summary

Of the areas previously investigated between One Tree Point and Marsden Point, the published information points to several soft shore areas as having higher ecological significance.

The Blacksmiths Creek area has higher ecological significance, due to bird, vegetation and cultural values, and is currently recognised under the Northland Regional Coastal Plan.

The intertidal sandflats between Marsden Cove Bay and One Tree Point have regionally high ecological value for wading bird feeding.

An area of re-establishing seagrass beds at One Tree Point is also of regionally high ecological value based on the diversity of fauna associated with the seagrass beds. Seagrass does not receive specific mention in the Coastal Policy Statement. However, the protection of areas of significant indigenous vegetation is identified as a national priority for the preservation of the natural character of the environment, Turner & Schwarz (2006).

Snake Bank is of regional importance, based on its value for birds (NRC, 2004).

2.2 Bream Bay

Bream Bay is an open embayment at the entrance to Whangarei Harbour on the northeast coast of Northland. Seaward, the Bay faces out to the Pacific Ocean with the Hen and Chicken Islands offshore. It measures some 30km from Bream Head at the northern end to Bream Tail at the south. The coastline is largely composed of clean exposed beach with up to 5m high fore dunes accreting and eroding in response to storm events. Bream Bay has a wide (80m) mid to low tide platform seaward of a relatively narrow (9m) mid to high tide rise to an

upper beach platform. North of the Whangarei Harbour mouth the majority of the coastline is rocky shore backed by steep native forest covered cliffs.

2.2.1 Busby Head to Bream Head

This area contains predominantly rocky intertidal areas. The intertidal areas contained a high diversity of species and habitats (Biosearches Ltd, 1976, Dickie, 1984d).

The intertidal flora and fauna of Busby Head, Peach Cove Point, and Bream Head are summarised in (Biosearches Ltd, 1976). In particular at Bream Head the sessile gastropod *Novastoa lamellosa* was recorded; this species is normally found only on offshore islands (Morton and Miller, 1968) and was considered a subtropical element of the fauna. All transects showed normal zonation.

Morton and Miller, 1968 presented a description of the boulder beach organisms at Smuggler's Bay. Biosearches Ltd, 1976 sampled and presented descriptions of the intertidal biota along five transects - Busby Head, Smugglers Bay east, west of Peach Cove Point, Peach Cove Point and Bream Head. Dickie, 1984c sampled and presented descriptions of the intertidal biota along three transect areas - Busby Head and two areas of Smuggler's Cove. Smuggler's Bay has been sampled quantitatively and the results presented in Dickie, 1984d to allow comparison with any subsequent studies.

Smugglers Bay West

Smugglers Bay is a sandy cove bordered by rocky headlands at the western end of the south coast of the Whangarei Heads. The western side of Smugglers Bay is characterised by platform reefs and the site chosen is representative of the surrounding shoreline. The andesite rock is smooth with minor relief features of up to 200 mm; these consist of rounded mounds and narrow cracks. Tide pools were common on the platform but seasonal in nature supporting only temporary biotic communities. The shore sampled has a south easterly aspect of 125° with an open sea angle of 48°. Seas reaching this shore have a potential maximum fetch in excess of 100 kms.

The intertidal shore was divided into six distinct biological zones in 1984;

- A high shore platform this zone is characterised by low densities of encrusting fauna, *Chamaesipho columna*, *Chamaesipho brunnea* and *Saccostrea glomerata* and low numbers of Littorinids, clumps of *Nerita melanotragus* were also recorded.
- A surge channel contained a diverse group of species (24) characteristic of low shore, shaded perpetually damp or regularly wetted situations.
- A lower shore platform this zone is characterised by low densities of encrusting fauna, *Chamaesipho columna*, *Chamaesipho brunnea* and *Saccostrea glomerata* and low numbers of Littorinids.
- Surf barnacle zone this zone is characterised by the barnacle *Chamaesipho brunnea*; also present in this zone were tufts of the algae *Gelidium pusillum* and the grazing molluscs *Nerita melanotragus*, *Sypharochiton pelliserpentis* and *Cellana ornata*.

- Turf zone there was a narrow zone dominated by *Corallina officinalis* paint; also present were *Sypharochiton pelliserpentis* and *Diloma aethiops*.
- Subtidally the kelp zone was characterised by *Carpophyllum maschalocarpum* and encrusting corallines.

Smugglers Bay East

A second transect was located on the rock platform to the east of the beach. The substrate is broken sandstone with many cracks and ledges but all fractures have rounded edges, a possible function of the rock type and the close proximity to a high energy sand beach. This shore has a south westerly aspect of 215° and is open to waves reaching the Bream Bay area through an angle of 35°, although most of the waves reaching this shore would be reflected around the headland further to the east.

This shore was divided into four distinct biological zones in 1984;

- Barnacle zone characterized by *Chamaesipho brunnea*. Other fauna characteristic of this level were *Nerita melanotragus* and *Austrolittorina antipodum*.
- Barnacle zone characterized by *Chamaesipho columna*. Other fauna characteristic of this level were *Haustrum scobina*, and four grazing mollusc species *Cellana ornata*, *Nerita melanotragus*, *Sypharochiton pelliserpentis* and *Diloma aethiops*.
- Oyster zone a dense zone of *Saccostrea glomerata* was observed, other fauna from this level included the anemone *Isactinia olivacea* and the grazing mollusc species *Sypharochiton pelliserpentis*, *Cellana ornata* and *Diloma aethiops*.
- Algae zone, characterised by moderate densities of *Xiphophora chondrophylla* and *Sargassum sinclairii*. Also present at this level were *Corallina officinalis* both 'turf' and basal 'paint', the encrusting bryozoan *Watersipora cucullata*; mobile molluscan species were not very numerous and did not characterise this level.

West of Peach Cove Point

The rocky shore west of Peach Cove Point is composed of large tumbled blocks of rock, approximately 650 metres east of Smugglers Bay. The dominant intertidal organisms are as listed for Smugglers Bay east, with the exception that rock oysters were absent, and the zone of the large barnacle *Epopella plicata* is better developed, indicating greater wave exposure. The intertidal ecology was normal and healthy for a shore of this type.

Peach Cove Point

At Peach Cove Point, the shore slopes gently with an irregular rock surface. Common flora include *Carpophyllum angustifolium*, *Corallina officinalis* paint, *Xiphophora chondrophylla* and fauna include the barnacles *Chamaesipho columna*, *Chamaesipho brunnea*, *Epopella plicata* the carnivorous whelks *Dicathais orbita*, *Haustrum scobina*, grazing molluscs *Cellana radians*, *Cellana ornata*, *Patelloida corticata*, *Notoacmea pileopsis*, *Sypharochiton pelliserpentis*, and Littorinids. Zonation is normal for the moderately exposed conditions, and the marine life is considered to be normal and healthy.

Bream Head

On the southern side of Bream Head, approximately 100 metres west of the end of the headland. The shore is nearly vertical with a southerly aspect. Common flora include *Carpophyllum angustifolium*, *Corallina officinalis* paint, *Pterocladia lucida*, *Melanthalia abscissa*, *Vidalia colensoi*, *Xiphophora chondrophylla* and fauna include the barnacles *Chamaesipho columna*, *Chamaesipho brunnea*, *Epopella plicata* the carnivorous whelks *Dicathais orbita*, grazing molluscs *Cellana ornata*, *Notoacmea pileopsis*, *Patelloida corticata*, *Sypharochiton pelliserpentis*, and Littorinids, and are characteristic of the moderate to high wave exposure conditions. Splash and spray result in the elevation of some of the upper shore zones compared with those in more sheltered situations. An interesting feature of the fauna is the presence of small numbers of the sessile gastropod *Novastoa lamellosa* in crevices at the 1 metre level. This worm-like gastropod is normally found only on offshore islands such as the Poor Knights, and is a subtropical element in the fauna. The ecology of Bream Head region was in excellent condition.

2.2.1.1 Summary

Of the areas previously investigated between Busby Head and Bream Head, almost all the shoreline is rocky with relatively high diversity and thus of regional ecological value.

2.2.2 Marsden Point to Waipu Cove

This area contains an extensive section of open ocean beach, the outflows of the Ruakaka and Waipu River estuaries.

Bioresearches Ltd, 1976 sampled the intertidal open beach habitats 500m and 2km south of Marsden Point. At 500m south, the worms *Aglaophamus macroura* and *Ninoe leptognatha* and tuatua, *Paphies subtriangulata* were common. Occasional sand shrimp, *Pontophilus australis* were recorded.

At 2km south of Marsden Point, tuatua were common. The spring intertidal area was generally characterised by tuatua with biscuit urchin, *Fellaster zelandiae* and wheel shell, *Zethalia zelandica*. Other organisms typical of the open beach habitat were snails, *Amalda australis* and *Cominella adspersa*, the bivalve, *Tawera spissa*, the ghost shrimp, *Biffarius filholi*, hermit crabs, *Pagurus* sp., the isopod *Isocladus armatus*, the paddle crab, *Ovalipes catharus* and the occasional toheroa, *Paphies ventricosa*. This assemblage of species was reported as occurring at least south to Ruakaka Beach.

Coffey in 2004, reported species present on the breach near the low water mark included polychaete worm species, *Aglaophamus macroura*, *Armandia maculata*, *Glycera americana* and *Orbinia papillosa*, the isopods, *Exosphaeroma lanceolatum*, *Girolana arcuata*, *Isocladus amartus*, Eurydicidae, and an amphipod, *Haustorius* sp. The ghost shrimp, *Biffarius filholi*, the common shrimp, *Palaemon affinis*, the paddle crab, *Ovalipes catharus* and polychaete worms, *Dendrostomum* sp., *Pseudonerine* sp., *Sipunculus mundanus* were present at the mean low water mark (Coffey, 2004).

In 2010, Golder and associates conducted benthic sampling offshore from Ruakaka as part of an assessment of effects for a proposed wastewater outfall. They noted that the species composition and abundance was relatively uniform within their area of study. The range of taxa recorded from Bream Bay was typical of New Zealand open sandy beach areas, including several families of polychaete worms, Paranoidae, Sabellidae, Ophelidae, common molluscs *Paphies* spp., *Dosinia* spp., and crustacean groups amphipods, cumaceans, mysid shrimps. The sand dollar (*Fellaster zelandiae*) was common in the area to the north of the proposed outfall.

Ruakaka and Waipu River mouths

The Regional Coastal Plan for Northland (NRC, 2004) identifies the coastal region of the Ruakaka River mouth and the Waipu River mouth as 'Marine 1 (Protection) Management Area', that are considered to have important conservation values and are required to be managed in such a manner that the conservation values (coastal wetlands, marine mammals, birds, ecosystems and habitat values) of the areas are protected.

At the mouth of the Ruakaka River there is an extensive area (83ha) of low sand spits and vegetated dune areas on either side of the Ruakaka River, this area is known as the Ruakaka Wildlife Refuge. Up to 45 species of wildlife have been recorded as nesting within this refuge area (Lux, *et al.* 2007). These include the New Zealand Dotterel, the Variable Oystercatcher and the Fairy Tern. The estuarine area of the Ruakaka River is relatively small including; mangrove, intertidal open sand and mudflat habitats, but provides important breeding and feeding habitat for banded rail, fernbird, herons, and shag species.

The Waipu River Estuary is the larger of these two estuarine sites and provides supports a similar array of nationally important bird species. It has good examples of rush land habitats in addition to the saltmarsh and mangrove communities that provide important breeding and feeding habitat for banded rail, fernbird, herons, and shag species.

Mair Bank

In 1976 (Bioresearches Ltd, 1976) the intertidal area of Mair Bank, had a moderate diversity 16 species in total. Abundant biota included the polychaete worm *Axiiothella australis*, the gastropods *Cominella adspersa* and *Xymene plebeius*, bivalve *Paphies australis* and the crab *Hemigrapsus crenulatus*. Also common were the polychaete worms *Aglaophamus macroura*, *Lumbrineris sphaerocephala*, *Ninoleptognatha*, the chiton *Chiton glaucus*, the gastropods *Notoacmea elongata* and *Diloma subrostrata*, bivalve *Paphies subtriangulata*, the barnacle *Elminius modestus*, and hermit crabs.

More recent publications have been targeted at the biomass of the pipi fishery, assessing the abundance and size frequency, both in intertidal and subtidal habitats, this is discussed in section 5.1.2.3.

2.2.2.1 Summary

Of the intertidal areas previously investigated between Marsden Point and Waipu Cove, all the shoreline is sandy with moderate diversity and thus ecological value.

The areas of Ruakaka River mouth and Waipu River mouth are recognised in the Northland Regional Coastal Plan as having habitat values that are regionally important and thus protected as Marine 1 Management Areas. Ecologically these areas are regionally important for birds and some fish species.

The area of Mair Bank is also recognised in the Northland Regional Coastal Plan as having habitat values that are regionally important and thus protected as a Marine 1 Management Area. Ecologically Mair Bank historically has had high shellfish (pipi) biomass and been a regionally important food source for birds and fish.

2.2.3 **Waipu Cove to Bream Tail**

No scientific information was found for this area. However based on aerial photographs, the area contains a mixture of high wave energy, open coastal sandy beaches and rocky shores. Rocky shore habitats generally have a higher diversity of biota than soft shores and thus high ecological values.

2.3 **Discussion**

Of the areas previously investigated in the lower Whangarei Harbour and Bream Bay, the published information points to the areas of rocky shore having greater diversity of biota than soft shores, but some soft shore communities having greater productivity and biomass.

The assessment of ecological significance used in this report is based on that proposed for the Auckland Council (Sawyer & Stanley, 2012). It follows five criteria;

- a) Representativeness
- b) Threat status and rarity
- c) Diversity
- d) Stepping stones, migration pathways and buffers
- e) Uniqueness or distinctiveness

However information for a number of these criteria is lacking in marine environments, so the majority of the ecological significance assessment has been based on first three criteria, representativeness, threat status and diversity.

The area now located within the Motukaroro Island Whangarei Marine Reserve was and is the area of greatest ecological significance within this section of coast. The location of rocky shore within the harbour and diversity and quality of habitats in the marine reserve area qualify the area as of national importance.

Several areas of re-establishing seagrass beds at One Tree Point, Taurikura Bay and Urquharts Bay are also of high ecological value based on the diversity of fauna associated with seagrass beds. Seagrass does not receive specific mention in the Coastal Policy Statement. However, the protection of areas of significant indigenous vegetation is identified as a national priority for the preservation of the natural character of the environment, Turner & Schwarz (2006).

Based on bird usage the sandflats between One Tree Point and NorthPort are of high ecological value. The Northland Regional Coastal Plan identifies the Home Point to Busby Head area is of regional importance, based on the rocky shore ecology and values for birds (NRC, 2004).

The Northland Regional Coastal Plan identifies the outer harbour sandbanks including Snake, Calliope and Mair banks as regionally important for ecosystems, birds, habitats, coastal landforms. The data published to date indicate these areas have had and in some cases still have significant shellfish resources and intertidal biota habitat values; therefore they have a moderate to high ecological significance at a regional level.

The effects of the dredging operation are likely to be the entrainment of fine sediment and its waterborne transfer. The greatest potential impact will be on the water clarity resulting in reduced light levels in subtidal habitats reducing the photosynthetic efficiency of seaweeds. Based on the available historical data the effects are likely to be short term and minor. There is also the possibility that fine sediment could partially cover plant surfaces or small sessile organisms, reducing photosynthetic efficiency or burying and suffocating organisms. Sediment deposition is not expected to be sufficient to adversely affect soft sediment benthic biota communities.

It is predicted that the sheltered river mouths of Ruakaka, Waipu and Blacksmiths Creek are sufficiently remote from the dredging and potential disposal areas that dilution will result in no detectable effects in these areas.

2.4 Conclusions and Recommendations

Recent standard practice by Maritime New Zealand and a number of regional councils is for information older than three years to be deemed insufficient and more recent data required. Thus the age of the majority of the information discussed above is great enough that reliance on the data is not recommended. The collection of new data, to verify that the biological values are still present, will be required in many instances.

The more recent data that is available is relatively sparse and confined to relatively small areas such as;

- Motukaroro Island Whangarei Marine Reserve,
- Marsden Cove consent monitoring,
- Northland Regional Council state of environment monitoring,
- Ministry of Primary Industries Mair Bank Pipi biomass.

Monitoring studies should include mapping and photographic quantification of seagrass beds, a health assessment of intertidal seaweed habitats and the presence of sediment on rocky shores in the vicinity of the dredging operation and disposal area.

The recently reported decline of pipi populations on Mair Bank suggest that a more detailed study of the overall ecology of Mair Bank should be conducted. Given the importance of shellfish harvesting in the harbour mouth area and along the adjacent shorelines, any monitoring studies should include quantification of intertidal shellfish beds in the vicinity of the dredging operation and disposal area.

Based on the reviewed information, in addition to confirming the historical intertidal ecological data, additional ecological data on the soft shore benthic biota present in intertidal habitats at Taurikura and Urquharts bays, at One Tree Point, on the southern tip of Snake Bank, Mair Bank, Marsden Point to Ruakaka River is required to adequately describe the environment adjacent to the dredging area and disposal area.

3 SUBLITTORAL HABITATS

3.1 Sediments

3.1.1 Sediment Distribution

The Whangarei Harbour was formed as a flooded river valley, but there are a number of other processes which have contributed to its present shape. These include earth movements such as volcanic activity, the formation of river valleys and their subsequent drowning and the existence of an enclosing barrier formation at the mouth. The northern entrance to the harbour is characterised by the volcanic peaks of Whangarei Heads and Bream Head and the southern side is characterised by low sand dune formations.

Bioresearches (1976) plotted the distribution of sediments in the area (Figure 3.1) and found that the sediments followed a pattern common to harbour entrance environments, becoming progressively finer away from the influence of tidal currents or wave action. In sheltered areas fine muds are deposited from freshwater runoff. Bioresearches noted some modification of soft sediments in areas where shell and gravel had accumulated and overlaid the dominant sediment type. The hard surfaces of shells and gravel provide attachment sites and grazing surfaces for a variety of fauna and flora.

3.1.2 Sediment Quality

The sediments of the Marsden Point area are dominated by fine sands. Quartz and feldspar are the dominant minerals with variable content of carbonates, chiefly as mollusc shells (Bioresearches 1982).

The 299 square kilometres of land contained within the Whangarei Harbour catchment is extremely varied representing a wide range of land forms, soil types and associated erosion forms. Erosion type and severity is typical of that experienced in Northland as a whole. The dominant cover types and associated land uses in the Whangarei Harbour catchment have been identified. Slightly over one half of the catchment area has a pastoral cover, while the other major cover types are indigenous forest, exotic forest, shrubland, crops and urban and industrial development.

A significant diffuse sediment discharge have occurred into harbour catchment waters since the beginning of pastoral, forestry, urban and industrial development. However, the actual amount of sediment involved in this input, from natural or from artificial sources, is not known. One major artificial source of sediment to the harbour has been the reject washings from the Golden Bay Cement plant at Portland which reached a peak of 250,000 tonnes in 1967 and averaged approximately 106,000 tonnes per year from 1965 to 1981.

Bottom sediments in the middle harbour are similar to those of the marine beach sands of Bream Bay. In some parts of the main channel, the bottom sediments appear derived from Portland, while on the northern side of the lower and middle harbour, sediments are derived

from streams. In the lower harbour, rapid tidal water movement has been recorded. Despite this, the harbour entrance appears to have been particularly stable, with only small changes being noted in the lower harbour bathymetry in recent years. Stability of the harbour entrance is mainly attributed to the presence of shell material, which provides an armour layer protecting the underlying soft sands. This shell material is considered to be of major importance in the protection of the Whangarei Harbour entrance (Morgan, Kench & Ford, 2011).

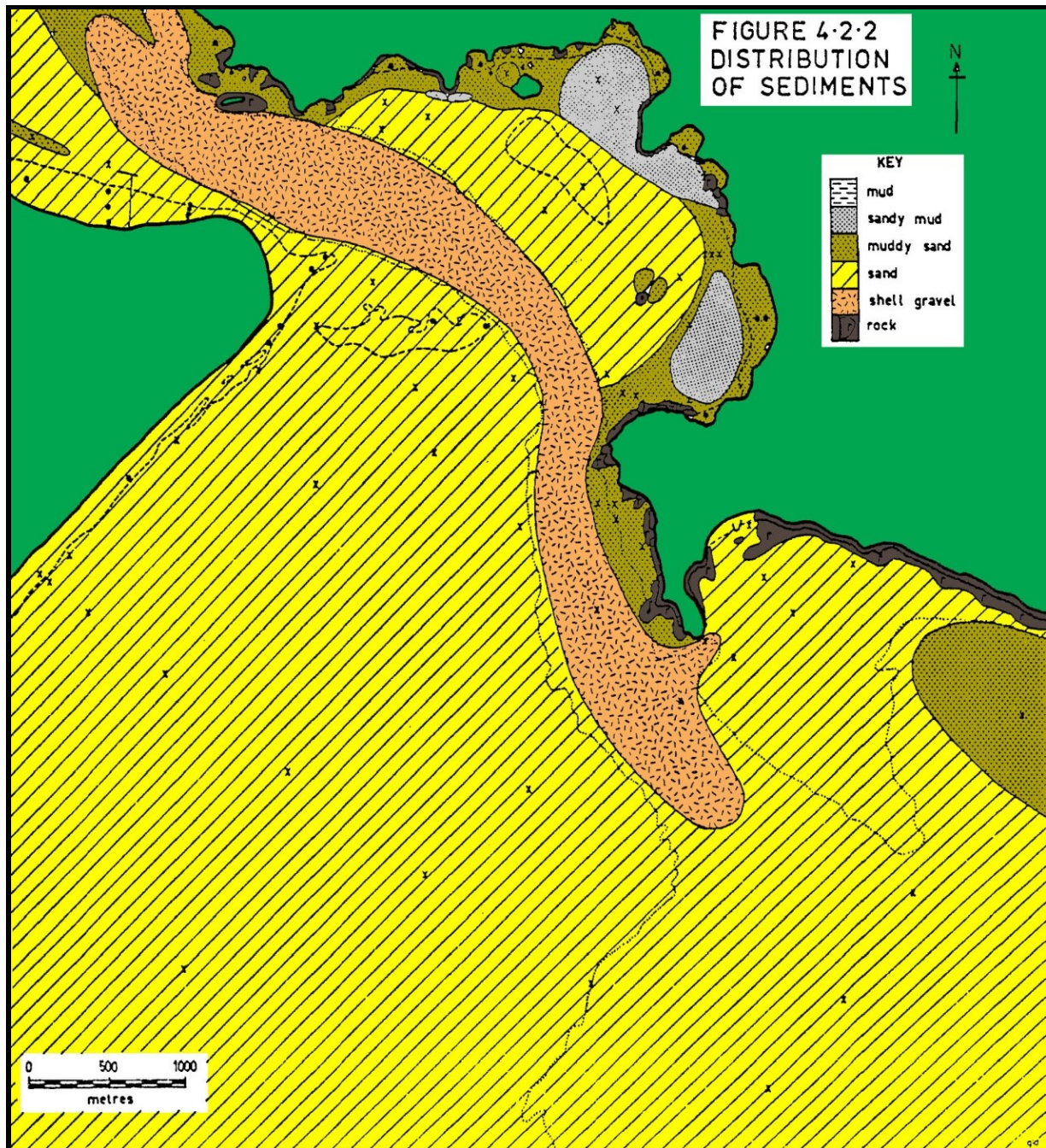


Figure 3.1 Distribution of Sediments (Figure 4.2.2 from Bioresarches, 1976)

Earlier studies of sediment quality within the Whangarei Harbour area, including various resource consent applications, consent monitoring and state of the environment monitoring reports, have indicated that sediment quality is generally good in the lower harbour.

As part of the Whangarei Harbour Study (1989) an investigation was undertaken in 1983 into concentrations of cadmium, chromium, copper, lead, nickel and zinc in upper harbour waters and bottom sediments (Venus, 1984). The absolute levels of the six metals in upper harbour sediments were not particularly high, generally below the ANZECC 2000 ISQG-Low values. It is noted that a 1984 study undertaken by Biosearches Limited for the Whangarei City Council revealed high levels of mercury in water draining from the Pohe Island landfill operation.

Sources of metals in the upper harbour area would include light industry, electroplating firms and fertiliser stores. The Northland Regional Council has continued to investigate metals in sediments.

Sediments from the Portland arm of the harbour are rich in chromium as a result of the discharges of chromium rich “reject washings” from the Golden Bay Cement works. The lime rock that is used in production at Golden Bay Cement is naturally rich in chromium as are the reject washings.

A review for the NRC and New Zealand Refining Company (NZRC) in 2010 (Mortimer 2010) showed the highest recorded levels of contaminants at the monitored lower Whangarei Harbour sediment sites were well within the guideline values for both metals and hydrocarbons (Table 3.1). Levels of individual PAHs in particular are generally 3-5 orders of magnitude below the management trigger levels.

Unexpectedly, results from the broader lower Whangarei Harbour/Bream Bay sampling indicated that sediment from the Fairway Buoy site had the highest levels of all metals. This may be due to a natural gradient of decreasing sediment grain size with increasing water depth but there was also the possibility of contamination of the area from past dredging spoil disposal activity. Table 5.5 in the Whangarei Harbour Study (1989) lists several dredging and disposal operations between 1965 and the 1970’s, one of which is off Peach Cove.

The dredging spoil disposal site has been reported (Mortimer, 2010) to be located approximately 2.4 km south of Peach Cove, and 900 m northeast of Fairway Buoy, and is understood to have been used for the disposal of dredgings from the Town Basin along with other sources. The Town Basin sediments are known to be elevated in terms of copper, lead and zinc as a result of urban stormwater runoff and boat maintenance activity.

Table 3.1 Comparison of Lower Harbour Sediment Quality with ANZECC Interim Sediment Quality Guidelines (From Mortimer 2010)

Determinand	Lower Harbour Sediment (highest)	ISQG – Low (trigger value)
Metals		
Arsenic	4.6	20
Cadmium	0.047	1.5
Chromium	20	80
Copper	0.9	65
Lead	3.9	50
Mercury	0.05	0.15
Zinc	23	200
PAHs		
Acenaphthene	<0.02	16
Acenaphthylene	<0.02	44
Anthracene	<0.02	85
Benzo[a]anthracene	0.0025	261
Benzo[a]pyrene	<0.02	430
Chrysene	0.0034	384
Dibenzo[a,h]anthracene	<0.02	63
Fluoranthene	0.011	600
Fluorene	<0.02	19
Naphthalene	<0.2	160
Phenanthrene	0.0085	240
Pyrene	0.0065	665
Total PAH	0.036	4000

3.1.2.1 Summary

The data reviewed showed historical sediment contaminant concentrations have generally been less than guideline values, indicating no adverse effects from contaminants, would be expected as a result of disturbance and suspension of fine sediment. However the Northland Regional Council monitoring data discussed in Mortimer, 2010 while suitable for surveillance monitoring is insufficient to fully determine potential impacts of the proposed dredging operation. None of the literature reviewed contained data on sediment quality, other than surface sediments; therefore sub surface sediment quality is an unknown.

3.2 Ecology

The wide range of soft sediment and rocky substrates in the study area support an exceptionally high diversity of flora and fauna, many species of which occur in populations with particularly high densities. In 1976, Bioresearches found the Bream Bay area near the entrance to Whangarei Harbour, to be in "excellent ecological condition and of considerable value to surrounding coastal and harbour ecosystems". There appeared to be no major adverse effects from the Marsden Point Refinery, the Marsden Power Station, or any other man-made activity.

3.2.1 Soft Substrates

Figure 3.2 shows the distribution of faunal zones in the harbour and the study area (from Bioresarches 1976). Those zones relevant to the present study are discussed below, using information from Bioresarches (1976) and Mason & Ritchie (1979). Only the sublittoral sites are considered here.

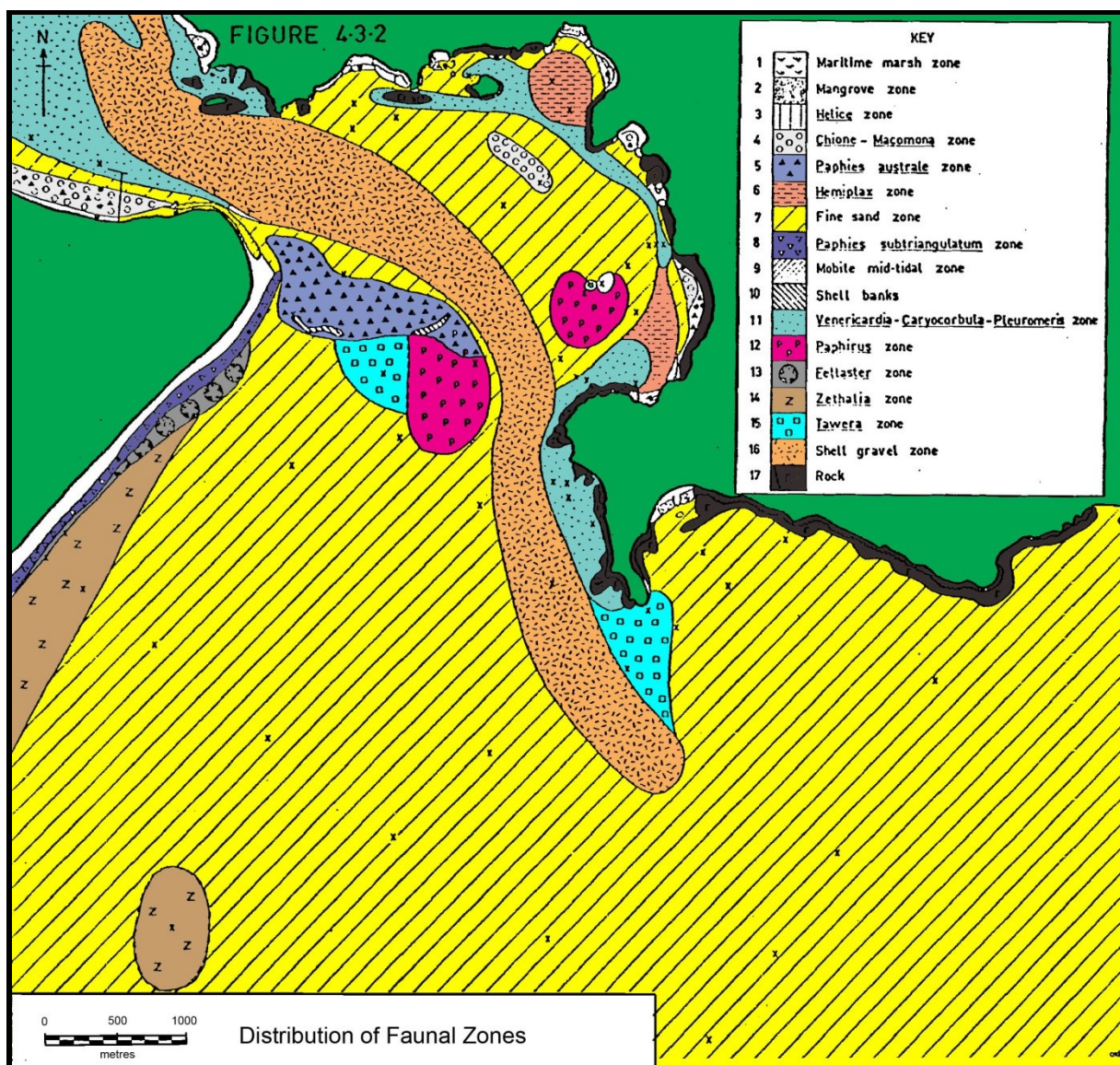


Figure 3.2 Distribution of Faunal Zones (Figure 4.3.2 from Bioresarches 1976)

3.2.1.1 *Paphies australis* Zone

Generally in firm fine sand with variable shell content. The *Paphies australis* zone occupied much of Mair Bank at the entrance to Whangarei Harbour, and consisted of an extensive bed of the common pipi. The bed was approximately 30 hectares in area, of which 10 hectares supported a dense bed of many large individuals, i.e. longer than 60 mm (Mason & Ritchie, 1979). A high density of invertebrate fauna was associated with *P. australis*, with large numbers of fouling organisms occurring where pipi shell is present on the surface. This zone also provides food for a number of bird and fish species.

Details on the current shellfish resource on Mair Bank are outlined in Section 5.1.2 including the results of recent surveys.

3.2.1.2 Fine Sand Zone

Generally firm clean fine sand. Sites include Home Point; Smugglers Bay; mid channel between Ruakaka Beach and Home Point; East and southeast of Marsden Power Station. Outside the harbour the fine sand habitat extends offshore to at least 15 metres depth (Bioresearches 1976).

3.2.1.3 *Paphies subtriangulata* Zone

Firm fine sand (only occasionally sublittoral). Sites include southern part of Ruakaka Beach; and Smugglers Bay. This zone contains species which are adapted to heavy surf conditions; generally these are active burrowers which have adapted to mobile sand.

In the late 1970s, as well as *P. subtriangulata* (tuatua), which is dominant on many wave-exposed beaches throughout New Zealand, *P. ventricosa* (toheroa) was also present, though in low densities, on Ruakaka Beach (Bioresearches 1976; Mason & Ritchie 1979). Juvenile *P. australis* (pipis) can also utilise this zone by attaching to the sand grains by long byssus threads (Mason & Ritchie 1979). *P. subtriangulata* is utilised as food by gulls, oystercatchers, and probably by snapper and paddle crabs at high tide. The tuatuas are a popular edible shellfish.

3.2.1.4 Shell Bank

Shell and sand mixture, generally firm. Sites include Mair Bank. The only shell bank in the study area is a small area on the southern side of Mair Bank. Shell banks are often poorly colonised environments because of constant movement of the bank sediments, hence low densities of invertebrates, if any, inhabit them.

3.2.1.5 *Venericardia* - *Corbula* - *Pleuromeris* Zone

This zone extends to a depth of about 10 metres. Sediments were mainly muddy sand with variable shell content. Sites include northern side of Home Point; between Home Point and Frenchman Is.

This zone occupies extensive areas in shallow harbour channels with predominantly muddy fine-sand sediments containing variable amounts of shell or gravel. A high diversity of small invertebrates occurs in this zone. Beds of scallops, once common, were scarce in 1976 (Bioresearches 1976) but Mason & Ritchie (1979) found them to be abundant in much of the zone. Several invertebrate species found in this zone, for example *Atrina*, *Gari* and *Venericardia*, are important food organisms for bottom-feeding fishes such as snapper and trevally.

3.2.1.6 Paphirus Zone

This zone extends to a depth of about five metres. Sandy sediments with variable shell content. Sites include southeast of Mair Bank.

This zone occupies a limited area in a shallow sublittoral clean sand situation to the south-east of Mair Bank. In 1979 (Mason & Ritchie 1979) the oblong venus shell *Venerupis largillierti* occurred in dense beds within the zone. Associated fauna occurred in low densities; these, along with *Venerupis*, provide important food items for bottom-feeding fishes such as snapper.

3.2.1.7 Fellaster Zone

This zone extends to a depth of about three metres. Firm fine sand off wave-exposed beaches. Sites include north and centre of Ruakaka Beach short distance offshore.

Bioresearches (1976) found the snapper biscuit or sand dollar *Fellaster zelandiae* to be dominant in a narrow zone offshore from Ruakaka Beach, occurring in high densities, with adults reaching a large size.

3.2.1.8 Zethalia Zone

This zone extends to a depth of about 7 metres. Firm fine sand off wave-exposed beaches. Sites include offshore from southern part of Ruakaka Beach; one site in mid channel to the southeast of Ruakaka Beach.

In 1976, very high densities of the wheel shell *Zethalia zelandica* occurred seawards of the *Fellaster* zone off Ruakaka Beach (Bioresearches 1976). *Fellaster* usually excludes *Zethalia* because its movement through the surface sediment prevents settlement of the *Zethalia* juveniles. However when adult *Zethalia* are common, *Fellaster* is excluded as it cannot move through the dense shells.

3.2.1.9 Tawera Zone

This zone extends from about 1 metre to about 15 metres depth and occasionally deeper. Shelly sandy substrate, usually close to channels in the outer Harbour area. Sites include south of Busby Head; south of Mair Bank

The bivalve *Tawera spissa* was dominant only in small pockets off Mair Bank and Busby Head (Bioresearches 1976). A high diversity and abundance of invertebrates occurs in this zone, many being associated with the deposits of shell as fouling organisms. The shells of *Tawera* form an important part of the sediment in parts of the ecosystem outside the zone. Also this bivalve, along with other invertebrates in the zone, is an important component of the diet of the snapper (Bioresearches 1976).

3.2.1.10 Shell Gravel Zone

This zone extends from 7 to 30 metres depth and deeper. Coarse shell deposits in deeper Harbour channels. Sites include west of Busby Head.

This zone occurs at only one site in the study area, near Busby Head, where strong tidal currents prevent the deposition of finer material. In 1976, the shell gravel zone was exceptionally rich in invertebrates, the majority of which are dependent on the hard surfaces of the shells which characterise the bottom sediment. Fouling organisms included bryozoans, sponges, serpulid polychaetes, hydroids and anemones. A number of unattached invertebrates were common amongst the shell, including crabs and hermit crabs, amphipods, brittle stars and gastropods (Bioresearches 1976). Bivalve infauna were common in places, with the dog cockle *Glycymeris laticostata* being characteristic of the zone, and often contributing large volumes of dead shell to the sediment. The shell gravel zone supported a large number of invertebrates that are potentially important as food for fishes (Bioresearches 1976).

3.2.1.11 Deep Sand

Beyond 30 m depth the seabed is sparsely populated. EQC (1996) reported the seabed communities at 45 m approximately midway between Waipu Cove, Hen and Chicken, Bream Head and Bream Tail, contained low numbers of individuals; diversity was dominated by polychaete worms and crustacea. South of the study area off Pakiri Beach in similar depth habitat, dredge tows showed the presence of larger molluscs and starfish, (Bioresearches, 2011b).

3.2.2 **Hard Substrates**

Bioresearches (1976) and Venus (1984b) studied transects at a number of stations in the study area, and also made notes on the shallow sublittoral area at Bream Head.

3.2.2.1 Motukaroro Island (Station 3) (Bioresearches, 1976)

The transect studied is a sublittoral extension of the intertidal transect. The rocky bottom slopes evenly to the shell gravel floor of the harbour channel. Dominant organisms present are listed in Table 3.2. Large brown algae are restricted to the upper 12 metres below low spring tide level, at greater depths a variety of sessile filter feeding invertebrates, including sponges, coelenterates, and ascidians are dominant. Algae are probably excluded from greater depths because of low light intensities as a result of moderate turbidity of harbour waters. Filter-feeding organisms thrive because of the abundant supply of planktonic food carried by the strong tidal currents. Specialised carnivores such as the tiger shells, *Maurea tigris* and *Maurea punctulata*, and the brightly coloured nudibranch *Chromodoris amoena*, feed on the abundant sponge fauna. Figure 3.3 illustrates the marine life at depths of 12, 21 and 23 metres. At 12 m the photograph shows some kelp, yellow sponge, and anemones. At 21 m the kelp is gone and there are longer finger sponges, pink sponges, orange golf ball sponges and anemones. At 23 m the dominant species present are the anemones and orange golf ball

sponges. The sublittoral area at this station supported a high diversity and abundance of flora and fauna, and is in excellent ecological condition. Strong tidal currents are important to a wide variety of filter-feeding organisms which cover most of the underwater surface below the algal zone.

Kerr and Grace (2006) identified and mapped 4 intertidal and 10 subtidal habitat types within the marine reserve. The intertidal habitats included sandy beaches, gravel and cobble beaches, Rocky shores, mixed rock and sand. Subtidal habitats included sand and soft sediments, gravel or cobbles, shallow mixed weed, urchin barrens, tangle weed forest, Ecklonia forest, deep reef, mixed sand and rock, sponge patches and coralline turf. From drop camera and sonar studies they produced the map shown in Figure 3.4.

Kerr and Moretti (2012) reported fish species observed in the marine reserve in both 2007 and 2012. These included Banded wrasse (*Notolabrus fucicola*), Blue maomao (*Scorpius violacea*), Butterfish (*Odax pullus*), Goatfish (*Upeneichthys porosus*), Jack mackerel (*Trachurus novaezelandiae*), John dory (*Zeus faber*), Kahawai (*Arripis trutta*), Kelpfish (*Chironemus marmoratus*), Kingfish (*Seriola lalandi*), Koheru (*Decapterus koheru*), Leatherjacket (*Parika scaber*), Black Shortsnout pipefish (*Lissocampus filum*), Parore (*Girella tricuspidata*), Red moki (*Cheilodactylus spectabilis*), Scarlet wrasse (*Pseudolabrus miles*), Short-tail stingray (*Dasyatis brevicaudata*), Snapper (*Pagrus auratus*), Spotty (*Notolabrus celidotus*), Sweep (*Scorpius lineolatus*). Red cray fish (*Jasus edwardsii*) were also reported as being present within the marine reserve.

Table 3.2 Station 3. Motukaroro Island. Major sublittoral organisms. (Table 4.3.7 from Bioresearches, 1976)

Depth (metres)	3	6	9	12	15	18	21	23
<i>Carpophyllum flexuosum</i> (AL)	A	C	O	O				
<i>Ecklonia radiata</i> (AL)	O	C	O	O				
<i>Sargassum sinclairi</i> (AL)	O							
<i>Actinothoe albocincta</i> (CO)	O	C	C	C	C	C	A	A
<i>Cliona celata</i> (SP)		O	O	O	O	O	O	O
<i>Callyspongia ramosa</i> (SP)		O	O	O	C	C	C	O
unidentified hydroids (CO)		O	C	C	C	C	C	O
<i>Evechinus chloroticus</i> (E)		O						
<i>Siphonochalina latituba</i> (SP)			O	O	C	C	C	
<i>Ancorina alata</i> (SP)			O	O	O	O	O	O
<i>Tethya aurantium</i> (SP)			O	O	C	C	A	A
unidentified orange sponge (SP)						O	A	A
unidentified compound ascidian (PR)						O	C	C
unidentified blue-grey sponge (SP)							C	C
<i>Corynactis haddoni</i> (CO)							O	C
<i>Tethya ingalli</i> (SP)							O	O

A = abundant, C = common, O = occasional,

(AL) = algae, (CO) = coelenterate, (SP) = sponge, (P) = polychaete, (G) = gastropod, (E) = Echinoderm, (PR) = ascidian

Additional species noted in the area were:

small red algae (unidentified) (AL)

Polymastia granulosa (SP)

Culicia rubeola (CO)

Megalomma suspiciens (P)

Waltonia inconspicua (brachiopod)

Maurea pellucida (G)

Pectinura maculata (E)

Ophiothrix oliveri (E)

Coscinasterias calamaria (E)

Asterocarpa coerulea (PR)

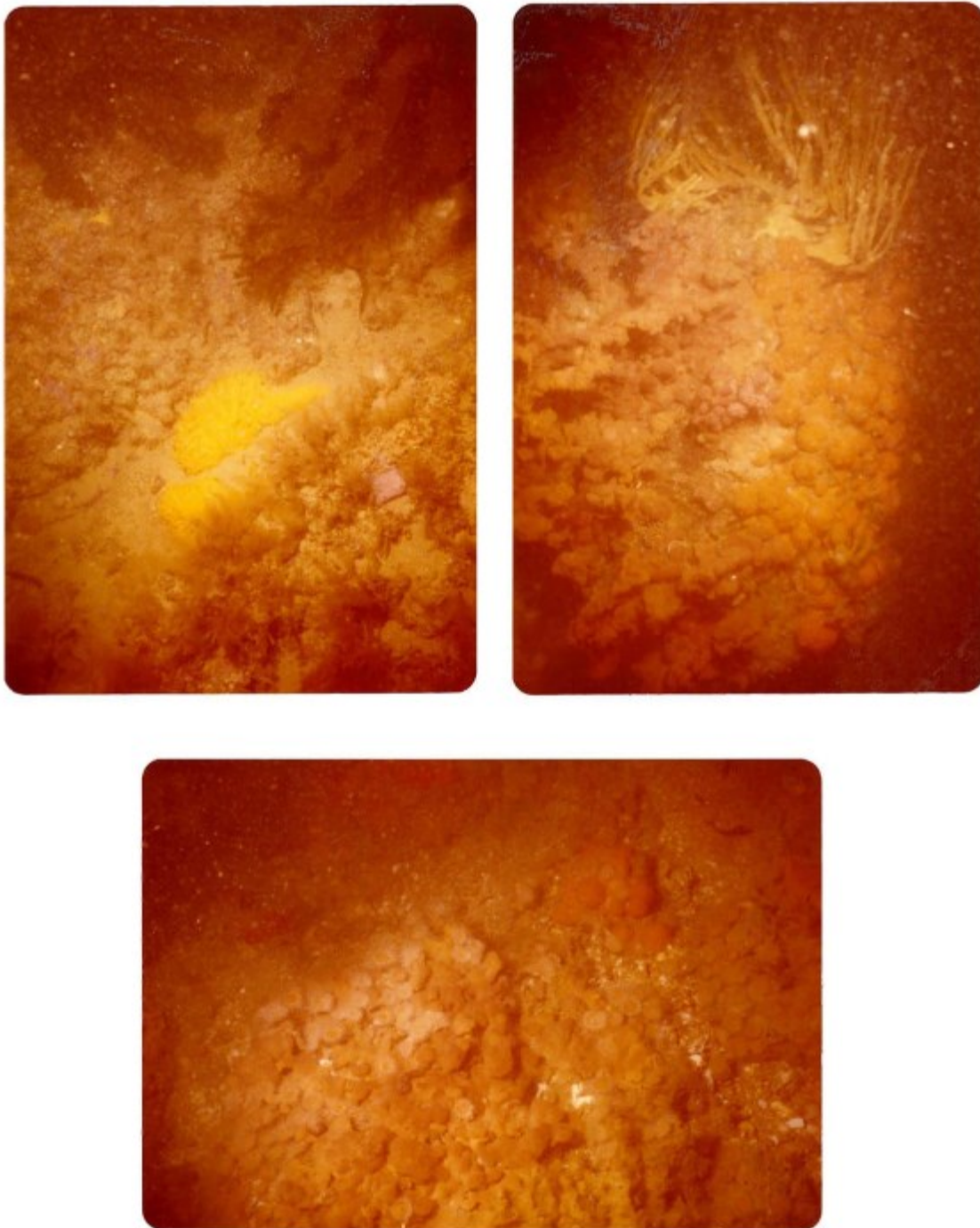


Figure 3.3 Benthic flora and fauna, Motukaroro Island. PLATE 4.7 (Bioresearches, 1976) (top left: 12 metres depth, top right: 21 metres depth, bottom: 23 metres depth)

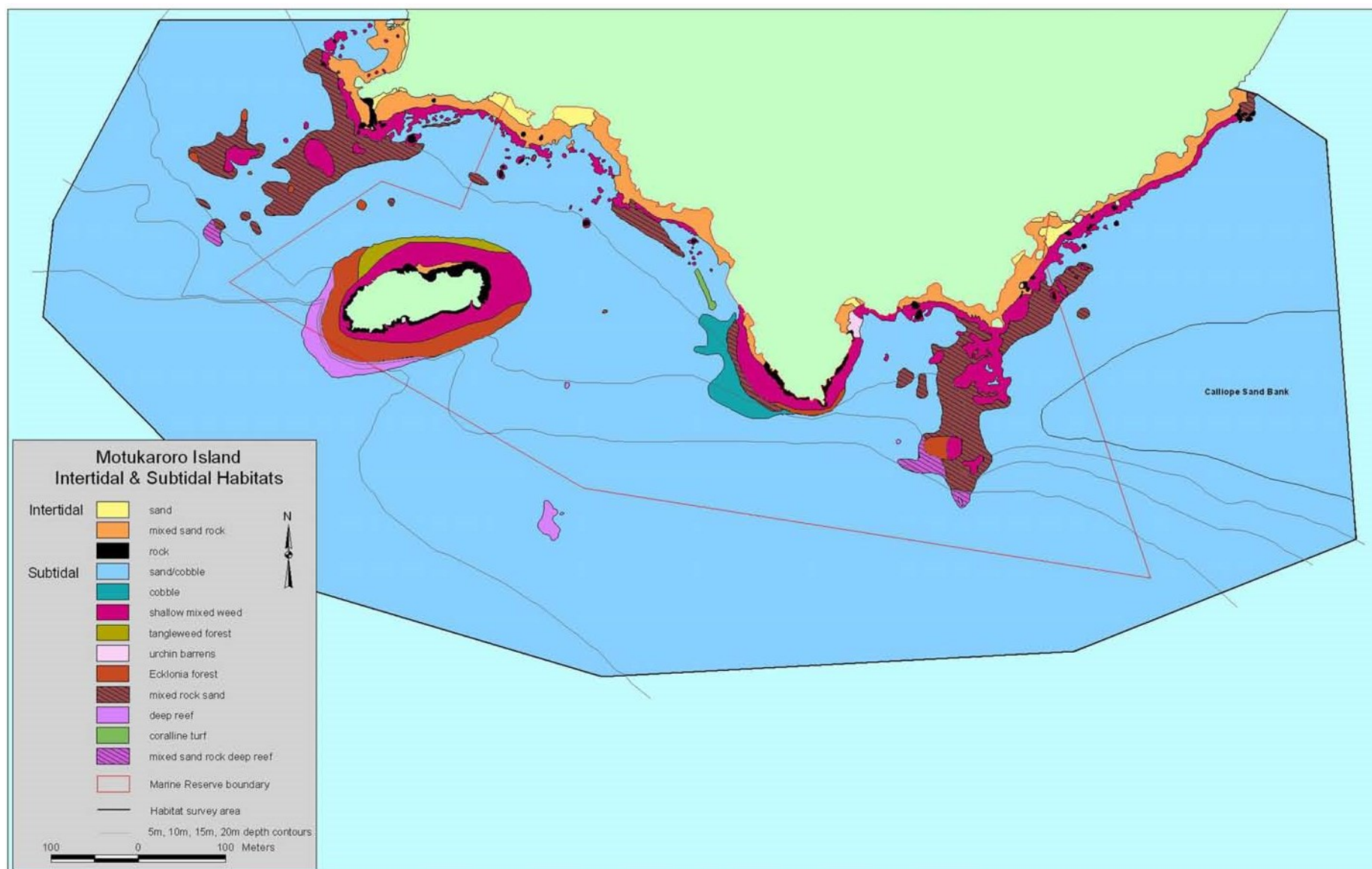


Figure 3.4 Motukaroro Island Marine Reserve Habitat Map, from Kerr and Grace 2006

3.2.2.2 Busby Head (Station 4) (Bioresearches, 1976)

The area studied is a sublittoral extension of the intertidal transect. The rock drops very steeply to a sandy shell-gravel bottom at 14 metres depth. Dominant organisms present are listed in Table 3.3.

Table 3.3 Station 4. Busby Head. Major sublittoral organisms. (Table 4.3.8 from Bioresearches, 1976)

Depth (metres)	3	4.5	7.5	11	14
<i>Carpophyllum angustifolium</i> (AL)	A				
<i>Pterocladia lucida</i> (AL)	C	C			
<i>Cellana stellifera</i> (G)	C	C			
Coralline paint (AL)	A	A	C	C	O
<i>Thais orbita</i> (G)	O	O	O	O	O
<i>Carpophyllum maschalocarpum</i> (AL)		A	C		
Coralline turf (AL)		C	O		
<i>Cnemidocarpa bicornuata</i> (PR)		O	O		
<i>Carpophyllum plumosum</i> (AL)		O	O		
<i>Evechinus chloroticus</i> (E)		O	O		
<i>Ecklonia radiata</i> (AL)		O	C	A	
<i>Cookia sulcata</i> (G)		O	O	O	
<i>Carpophyllum flexuosum</i> (AL)			O	O	
<i>Ancorina alata</i> (SP)			O	O	O
<i>Entalophora australis</i> (E)			O	O	O
<i>Actinothoe albocincta</i> (CO)				O	
unidentified hydroids (CO)				C	C
unidentified small orange simple ascidian (PR)				C	C
<i>Cliona celata</i> (SP)				O	O
<i>Aplysilla sulfuria</i> (SP)					C
<i>Sigillinaria arenosa</i> (PR)					C

Additional species occurring in low densities were:

<i>Zonaria angustata</i> (AL)	<i>Waltonia inconspicua</i> (brachiopod)
<i>Sargassum sinclairii</i> (AL)	<i>Charonia capax</i> (G)
<i>Caulerpa sedoides</i> (AL)	<i>Maurea punctulata</i> (G)
<i>Tethya aurantium</i> (SP)	<i>Haliotis virginea</i> (G)
red encrusting sponge (SP)	hermit crabs (C)
<i>Culicia rubeola</i> (C)	<i>Pectinura maculata</i> (E)
<i>Alcyonium auranticum</i> (CO)	<i>Asterocarpa coerulea</i> (PR)
terebellid polychaete (P)	

The bottom metre of the rock face is devoid of large algae, probably as a result of occasional scouring by moving sand and shell. Generally, however, the ecology is characteristic of a steep rocky area in moderate exposure conditions, with possible slight modifications as a result of strong tidal currents. Immediately north of the station the bottom consists of large tumbled boulders which support a dense forest of the kelp *Ecklonia radiata* each plant being approximately one metre high. In the shallower water at the transect studied the *E. radiata* plants are smaller (0.5m at 7.5m depth; 0.25m at 4.5m depth) probably as a result of increased turbulence at shallower depths. The high diversity and abundance of algae and invertebrates is indicative of the excellent ecological condition of the area.

3.2.2.3 Rocky Shore East of Smugglers Bay (Station 13) (Bioresearches, 1976)

The transect studied is a sublittoral extension of the intertidal transect. The bottom is irregular with large blocks of rock separated by pockets of cobbles and gravel and slopes gently to sand at 7.5 metres depth. A profile of the transect is shown in Figure 3.5.

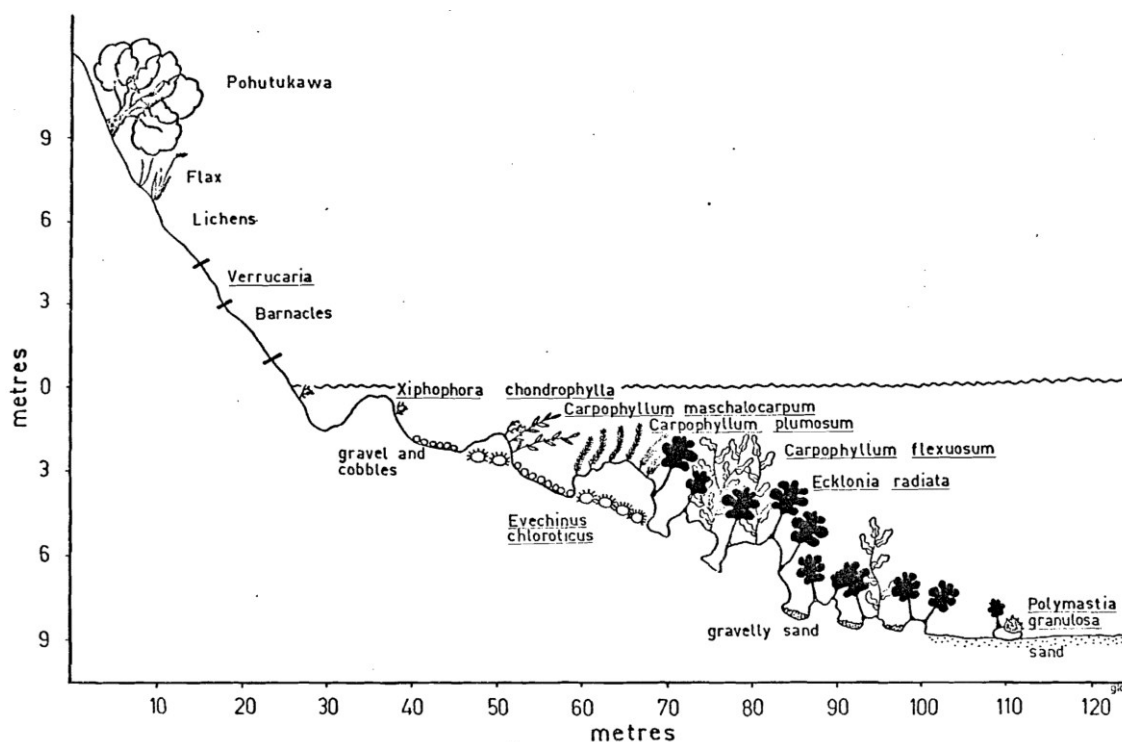


Figure 3.5 Underwater Profile of Station 13 (Figure 4.3.4 from Bioresearches, 1976)

In 1976 a succession of large brown algal species occurred with increasing depth. A dense bed of mixed *Carpophyllum flexuosum* (30% cover) and *Ecklonia radiata* (70% cover) extends from about 2.5 metres depth to the lower rock limit. Epiphytic filamentous algae are common on both larger species. In deeper areas *Ecklonia radiata* attains a height of up to one metre. At the time of survey in 1976 a small proportion of the *Ecklonia* plants were in poor condition, with the tops dying. This is a normal and cyclic occurrence in beds of *Ecklonia*. The sea urchin *Evechinus chloroticus* occurs in moderate densities about the bases of rocks in the upper few metres of the transect, but does not extend into the *Ecklonia* beds. Holes and caves are sometimes occupied by groups of young crayfish, *Jasus edwardsi*, mainly smaller than the minimum legal size. In deeper areas the brachiopod *Waltonia inconspicua* and the encrusting compound ascidian *Didemnum candidum* are common on the shaded sides of rocks beneath the kelp canopy. Numerous other species associated with sublittoral areas of this type are present. Although apparently suitable habitats for the black-foot pua, *Haliotis iris* are present in shallow water, no pua were found in the area.

The marine life in this area was normal for a coastal area of this type, in 1976, although it was noted that numbers of pua and crayfish may have been reduced by commercial and amateur exploitation.

3.2.2.4 Rocky shore west of Peach Cove Point (Station 14) (Bioresearches, 1976)

Both intertidal and sublittoral ecology of this area was very similar to that described for Station 13. The depth of the rock / sand boundary was 9 metres, and the underwater profile is slightly steeper than that at Station 13. The dense kelp canopy consisted of 50% *Carpophyllum flexuosum* and 50% *Ecklonia radiata*. Sublittoral ecology was in a normal and healthy condition.

3.2.2.5 Peach Cove Point (Station 5) (Bioresearches, 1976)

The sublittoral area studied is an extension of the intertidal transect. A sublittoral profile is shown in Figure 3.6. The dominant organisms are listed in Table 3.4.

Table 3.4 Station 5. Peach Cove Point. Major sublittoral organisms (Table 4.3.9 from Bioresearches, 1976)

Depth (metres)	0	2	5	7.5	10	15	18
<i>Carpophyllum angustifolium</i> (AL)	A						
<i>Evechinus chloroticus</i> (E)	O						
<i>Carpophyllum maschalocarpum</i> (AL)		A					
<i>Pterocladia lucida</i> (AL)		C					
<i>Xiphophora chondrophylla</i> (AL)		O					
<i>Ecklonia radiata</i> (AL)			A	O		A	O
<i>Actinothoe albocincta</i> (CO)			O	A			
small red algae (AL)				O	C	C	C
<i>Solanderia</i> sp. (CO)					C		
<i>Pennaria australis</i> (CO)					C		
<i>Ancorina alata</i> (SP)						C	
<i>Flabellum rubrum</i> (CO)						C	
<i>Pectinura maculata</i> (E)						C	
<i>Raspailia</i> sp. (SP)							C
<i>Calyspongia ramosa</i> (SP)							C
<i>Polymastia granulosa</i> (SP)							C
<i>Aglaophenia laxa</i> (CO)							C
<i>Carpomitra costata</i> (AL)							C
<i>Ciocalypa</i> sp. (SP)							C

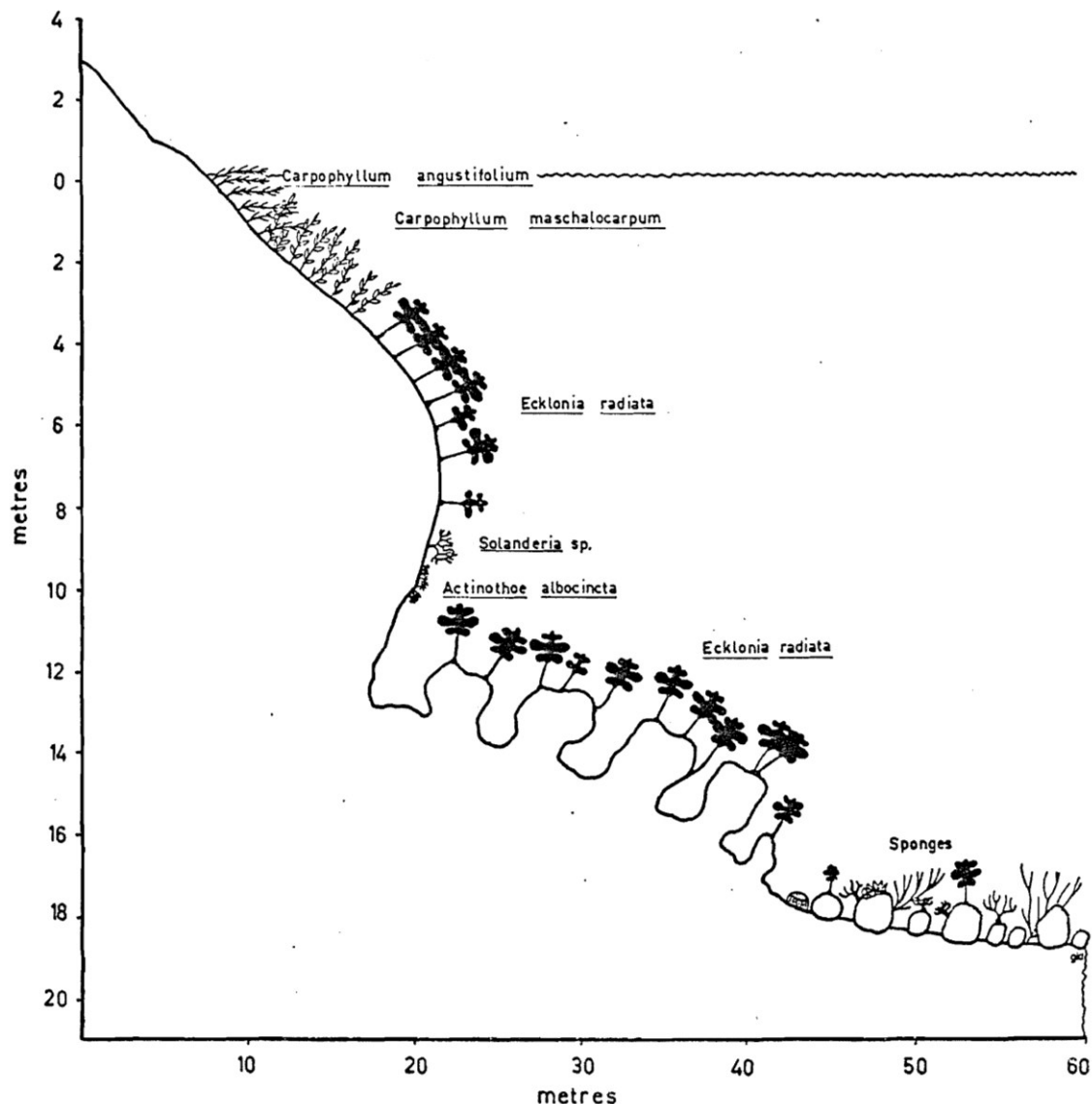


Figure 3.6 Underwater Profile of Station 5 (Figure 4.3.5 from Bioresarches, 1976)

The normal sublittoral zonation sequence was interrupted by an overhanging cliff, where reduced light intensity excluded the large brown kelp *Ecklonia radiata* from the shaded area. Fans of the hydroid *Solanderia* sp. thrived in the shade of the overhang. Solid rock bottom gives way to a field of small boulders and gravel at 17 metres depth, where the kelp *Ecklonia radiata* is reduced in abundance because of low light intensity and the scarcity of hard attachment sites. Several species of sponges are present below the 17 metre level. The sublittoral ecology of this area was considered to be in good condition, with no changes to be expected.

3.2.2.6 Bream Head (Station 6) (Bioresarches, 1976)

The rocky bottom slopes steeply below the intertidal area. The kelp *Ecklonia radiata* occurred in a dense bed below 3 metres depth. Dominant organisms in the upper 4 metres are listed in Table 3.5.

The fauna and flora present indicate that this region is more exposed than areas further towards the Harbour entrance. The absence of *Carpophyllum maschalocarpum* from the zonation sequence, together with the development of zones of the surge-tolerant algae *Melanthalia abscissa*, *Vidalia colensoi*, *Pterocladia lucida*, and a species of *Jania*, all indicate that this shore is often subjected to strong wave action. The opinion of the Bioresearches 1976 report was that the sublittoral ecology was in excellent condition.

Table 3.5 Station 6. Bream Head. Major sublittoral organisms (Table 4.3.10 from Bioresearches, 1976)

Depth (metres)	0	1	2	4
<i>Carpophyllum angustifolium</i> (AL)	A			
<i>Melanthalia abscissa</i> (AL)	C			
<i>Vidalia colensoi</i> (AL)	C	C		
Coralline paint (AL)	A	C		
<i>Pterocladia lucida</i> (AL)	C	A		
<i>Corynactis haddoni</i> (CO)	O	C		
<i>Xiphophora chondrophylla</i> (AL)		O		
Coralline turf (AL)		C	A	C
<i>Ecklonia radiata</i> (AL)			O	C
<i>Actinothoe albocincta</i> (CO)				C

3.2.2.7 Artificial Hard Structures

The marine life present on wharf piles at Marsden Point in 1976 was characteristic of strong current regimes close to the open sea. Ecologically, the artificial substrates of the pilings add to the diversity of life in the area, providing attachment surfaces for a rich fauna of filter-feeding invertebrates. Large numbers of fish of several species are attracted to the wharf areas, both as a result of the shelter provided by the structures, and the rich invertebrate populations of the piles which provide food resources for some species.

3.2.3 Fishes

Bioresearches (1976) reported a large number of species to be present in the study area. Table 3.6 presents a list based mainly on snorkel and scuba diving observations made while carrying out ecological investigations as part of the Bioresearches 1976 studies. The table also includes other fishes not seen, but expected to occur in the area, and marked with an asterisk on the list. The list is likely to be incomplete, but most of the common species, or species likely to be used as food, are included. The fishes are grouped according to their habitat, and an arbitrary scale of abundance is used (A - abundant, C - common, o - occasional, R - rare) to describe the relative abundance within each habitat. The fishes are listed alphabetically by their scientific names, given some of these have changed the list is only roughly ordered. The classification of habitats is based initially on the distinction between demersal fishes, which live in close association with the seabed, and pelagic fishes, which are generally found in open waters. Further subdivision into six habitats allowed more detailed analysis.

Venus (1984b) also recorded a high abundance and diversity of fishes in the shallow water region at Busby Head. He suggested this may be attributable to high current speeds at the mouth of the harbour. At Bream Head, where a reef drops to 27 – 30 metres, planktivorous fishes were abundant. In 1984 Venus (1984b) considered the fish populations of the area to be comparable with the marine reserve near Leigh and other coastal northeastern New Zealand sites. The Cape Rodney-Okakari Point marine reserve was established in 1975 with full protection of fish species. The Bream Head to Busby Head area has no protection and is subject to recreational fishing. Considering the differences in habitat protection status between Leigh and these areas, it is likely that this has now changed.

The list of fishes presented in Table 3.7 is adapted from Venus (1984b). Five sites were sampled between, and including, Busby Head and Bream Head, in August 1983. Samples were from depths varying from 4.5 to 21 metres.

Brook (1997) stated that “Passage Island had the highest reef-fish species diversity of any of the harbour sites sampled in Northland (i.e. including Hokianga, Parengarenga, Houhora, Rangaunu, Bay of Islands)”. Brook (2002) surveyed 9 sites within the study area, using 15 minute fish counts, and compiled a list of fish species present. This included 12 species not reported in Bioresearches (1976) or Venus (1984b), Pink Maomao (*Caprodon longimanus*), Yellow and black triplefin (*Forsterygion flavonigrum*), Common triplefin (*Forsterygion lapillum*), Mottled triplefin (*Forsterygion malcolmi*), Blue knifefish (*Labracoglossa nitida*), Rock Cod (*Lotella rhacinus*), Blue dot triplefin (*Notoclinops caerulepunctus*), Inscribed wrasse (*Notolabrus inscriptus*), Mimic blenny (*Plagiotremus tapeinosoma*), Spectacled triplefin (*Ruanoho decemdigitatus*), Spectacled triplefin (*Ruanoho whew*) and Dwarf scorpionfish (*Scorpaena papillosus*).

Kerr and Moretti (2012) reported fish species observed in the marine reserve and at control sites in the study area, in both 2007 and 2012. These included the following additional species Black Shortsnout pipefish (*Lissocampus filum*) and Sea horse (*Hippocampus abdominalis*).

Table 3.6 Marine fishes of the Whangarei Heads area, with estimates of abundance in each of six major habitats (Table 4.5 from Bioresarches, 1976)

Scientific name	Common name	Demersal				Pelagic	
		Rocky open coast 1	Rocky harbour coast 2	Offshore sandy bottom 3	Harbour channels and Flats 4	Open coast 5	Harbours 6
<i>Acanthoclinus littoreus</i>	rockfish		O				
<i>Aldrichetta forsteri</i>	'sprat', yellow-eye mullet						C
<i>Tragulichthys jaculiferus</i>	porcupine fish	R					
<i>Aplodactylus arctidens</i>	marblefish	C					
<i>Arripis trutta</i>	kahawai					C	O
<i>Parablennius laticlavius</i>	crested blenny	C	C				
<i>Caesioperca lepidoptera</i>	butterfly perch	C	O				
<i>Canthigaster callisterna</i>	sharp-nosed puffer	R					
<i>Pseudocaranx dentex</i>	trevally					C	O
* <i>Carcharhinus brachyurus</i>	bronze whaler shark	O		O	R		
<i>Nemadactylus douglasii</i>	porae	O		O			
<i>Cheilodactylus spectabilis</i>	red moki	C	O				
* <i>Chelidonichthys kumu</i>	red gurnard			C			
<i>Chironemus marmoratus</i>	kelpfish	C	O				
<i>Chromis dispilus</i>	demoiselle	C					
<i>Chrysophrys auratus</i>	snapper	C	C	C	C		
<i>Odax pullus</i>	butterfish	O					
<i>Coris sandeyeri</i>	sandagers parrotfish	R					
* <i>Dasyatis brevicaudata</i>	short-tail stingray	O		O	O		
<i>Decapterus koheru</i>	koheru					O	
<i>Hypoplectrodes huntii</i>	red-banded perch	O					
* <i>Galeorhinus galeus</i>	school shark			O	O		
* <i>Genyagnus monopterygius</i>	stargazer			O	O		
<i>Gilloblennius trippensis</i>	spectacled blenny	C	C				
<i>Girella tricuspidata</i>	parore	C	C		O		
<i>Gobiomorphus gobioides</i>	sand goby				A		
<i>Gymnothorax prasinus</i>	yellow moray	O					
<i>Hemerocoetes</i> sp?	sand fish				C		
* <i>Hippocampus abdominalis</i>	seahorse	O	O				
<i>Optivus elongatus</i>	roughy	C	O				
<i>Kyphosus sydneyanus</i>	silver drummer	O	O				
<i>Latridopsis ciliaris</i>	blue moki	R		R			
<i>Mugil cephalus</i>	grey mullet					O	O
* <i>Mustelus antarcticus</i>	dogfish			O	O		
<i>Myliobatis tenuicaudatus</i>	eagle ray	O	O	O	O		
<i>Meuschenia scaber</i>	leather jacket	C	O				
<i>Parapercis colias</i>	blue cod	O					
<i>Parma microlepis</i>	black angelfish	O					
<i>Pempheris adspersa</i>	bigeye	C	O				
<i>Notolabrus celidotus</i>	spotty	A	A				
<i>Notolabrus fucicola</i>	banded parrotfish	C	O				
<i>Pseudolabrus luculentus</i>	orange parrotfish	R					
<i>Hyporhamphus ihi</i>	piper					O	O
<i>Rhombosolea plebeia</i>	sand flounder			O	C		
<i>Scorpaena cardinalis</i>	scorpion fish	O					
<i>Scorpius violacea</i>	blue maomao	A	C			O	
<i>Seriola lalandi</i>	kingfish					C	O
* <i>Sphyrna zygaena</i>	hammerhead shark					O	
* <i>Stigmatopora macropterygia</i>	long-snouted pipefish	O	O				
<i>Trachelochismus pinnulatus</i>	suckerfish	O	O				
<i>Notoclinops segmentatus</i>	banded blenny	C					
<i>Forsterygion varium</i>	mottled blenny	A	C				
<i>Forsterygion maryannae</i>	oblique blenny	C					
<i>Notoclinops yaldwyni</i>	yaldwyn's blenny	C	C				
<i>Upeneichthys lineatus</i>	red mullet, goat fish	C	C				
<i>Zeus faber</i>	john dory	O					

KEY: A - abundant, C - common, O - occasional, R - rare.

Fishes marked * were not seen during this survey, but are expected to occur in the area.

Table 3.7 Fishes in the Shallow Water Region at Busby Head and Bream Head, in August 1983 (from Venus, 1984b)

Scientific name	Common name	Comments
<i>Aplodactylus arctidens</i>	Marblefish	Some large individuals of this species were observed in shallow broken rock areas where large algae were present
<i>Arripis trutta</i>	Kahawai	Groups of this school fish species were seen at East Peach Cove and Busby Head
<i>Caesioperca lepidoptera</i>	Butterfly perch	This species was recorded in low numbers, usually in deep localities
<i>Cheilodactylus spectabilis</i>	Red moki	Abundances of this species were similar to those recorded near the Marine Laboratory and Reserve at Leigh. The smallest individuals of <i>C. spectabilis</i> were observed in shallow water areas
<i>Chironemus marmoratus</i>	Hiwihiwi or kelpfish	One individual was observed under a rock in shallow water at East Peach Cove
<i>Chromis dispilus</i>	Demoiselle	This was the most abundant species of planktivorous fishes. Densities of up to 149 per 250 square metres were recorded in deep reef areas, which are higher than those recorded at Leigh, but lower than those at the Poor Knights Islands
<i>Conger verreauxi</i>	Conger eel	One very large individual was observed
<i>Girella tricuspidata</i>	Parore	This species was only observed at shallow sites and was the most abundant herbivore observed
<i>Gymnothorax prasinus</i>	Yellow moray	This species was observed in topographically complex rocky reef areas, in abundances of up to 0.7 per 250 square metres. This was similar to Leigh, near the University of Auckland Marine Laboratory
<i>Kyphosus sydneyanus</i>	Silver drummer	A large group of these fishes was observed at Busby Head, in shallow water
<i>Odax pullus</i>	Butterfish	Some very large individuals of this species were observed in Ecklonia forest
<i>Optivus elongatus</i>	Slender roughy	This nocturnal planktivore was common in topographically complex reef areas
<i>Parapercis colias</i>	Blue cod	This species was not found in Ecklonia forest. All fish were located on the open sea floor but abundances were low
<i>Meuschenia scaber</i>	Leatherjacket	This species was most abundant on deep reefs inhabited by the encrusting animals on which they feed
<i>Pempheris adspersa</i>	Bigeye	This nocturnal planktivore, like <i>Optivus</i> , was common in topographically complex reef areas, but was more abundant than <i>Optivus</i>
<i>Notolabrus celidotus</i>	Spotty	This species was most abundant in Ecklonia forest and individuals observed in this habitat were predominantly small initial phase fish. This is attributable to the fact that new recruits of <i>P. celidotus</i> settle from the plankton into the heads of Ecklonia plants. Fish counted in the deep habitat types were mainly large terminal phase fish. The abundances and sizes of fish recorded in each habitat type in the present survey were similar to density estimates at other localities around Northland
<i>Notolabrus fucicola</i>	Banded wrasse	This species was present in abundances similar to those recorded in the Leigh Marine Reserve
<i>Pseudolabrus miles</i>	Scarlet wrasse	This species was present in low numbers similar to those at Leigh
<i>Pseudophycis breviuscula</i>	Northern bastard red cod	This species was only observed at Bream Head. The abundance estimates of <i>P. breviuscula</i> are probably inaccurate as these fish are nocturnal feeders and are secretive in habit during the day
<i>Scorpaena cardinalis</i>	Scorpion fish	Mainly small individuals of this species were observed under boulders. Densities were similar to those seen in other Northland coastal areas
<i>Scorpius aequipinnis</i>	Sweep	This species was only observed at Busby Head
<i>Scorpius violacea</i>	Blue maomao	This species was present in low numbers and was only recorded at Busby Head
<i>Trachurus novaezelandiae</i>	Mackerel	A large school of this species was observed at Bream Head
<i>Forsterygion marylannae</i>	Oblique swimming triplefin	This plankton feeding tripterygiid was abundant close to the substratum, usually in loose aggregations of 10 - 50 individuals. The maximum length of individuals was 90 mm
<i>Upeneichthys lineatus</i>	Goatfish	This species was rarely found in Ecklonia forest and was usually observed on open seafloor. Densities on deep reefs were low compared with counts at Leigh
<i>Zeus faber</i>	John dory	This species was observed in abundances similar to those recorded at Leigh

In all 76 species of fish have been reported as being present in the study area in the literature.

In general the areas surveyed which contained extensive areas of rocky habitat and a high diversity of habitat types, contained a wide diversity of fishes. A lower diversity of fish to utilise open sand habitats, however, some of the typically rocky shore species, such as spotty, leatherjacket and red moki, would be attracted to manmade structures such as pipelines.

3.3 Discussion

Subtidal habitats in the study area are diverse. Rocky habitats have very high species diversity, while sandy habitats generally have a lower diversity. None of the species recorded as being present in the past are nationally threatened. Several subtidal habitats are nationally

significant in the harbour namely Motukaroro Island and any areas of subtidal seagrass. The subtidal habitat between Home Point and Bream Head are rocky and as such support a greater diversity of biota and fish. The habitats between Home Point and Busby Head have strong tidal currents and are similar to Motukaroro Island, however the shoreline is not as steep or deep, resulting in the habitat being regionally significant. The habitats between Busby Head and Bream Head are similar to other rocky shores in the region, however it is the longest continuous stretch of rocky coastline between Tutukaka and Okakari Point. The Bream Head end of the shoreline drops steeply to depth which is more similar to offshore island topography like the Hen and Chicken Islands. The diversity and rare species recorded in 1976 suggest this shoreline is of regional importance.

The reviewed literature shows that the area outside the harbour is dominated by fine sand habitat whereas the area to be dredged is mostly shell gravel habitat. There is a lack of ecological data from the wider deeper offshore Bream Bay area.

In general the natural hard shore rocky habitats are similar in that they are initially steep and then adjoin flatter sandy habitats. All rocky shores had *Carpophyllum* algal communities in the shallows which graded into *Ecklonia* kelp forest and sponge garden communities. The high current which flows past these habitats within the harbour mouth, contributes to making them very ecologically rich and differentiating them from those outside the harbour mouth.

As stated earlier the effects of dredging operation are likely to be from the waterborne transfer of fine sediment. The greatest potential impact will be on the water clarity resulting in reduced light levels in subtidal habitats reducing the photosynthetic efficiency of seaweeds. The affects are likely to be short term and minor. There is also the possibility that fine sediment could partially cover plant surfaces, or sessile organisms (such as sponges), or be incorporated into the sediment, reducing photosynthetic efficiency or burying and suffocating organisms, changing the sediment characteristics such that changes in benthic biota species composition and abundance may result.

3.4 Conclusions and Recommendations

Standard practice by Maritime New Zealand and a number of regional councils in relation to dredging activities is for information older than three years to be deemed out of date and more recent data required. International literature for dredge area sediment characterisation has precedents for data up to five years old, still being sufficient (USEPA, 2012).

The age of the majority of the published information discussed above is great enough that reliance on the data is not warranted, the collection of more recent data to verify that the contaminant concentrations are still low or biological values are still present, will be required in many instances.

Refining NZ, as part of initial environmental studies, will be collecting surface sediment samples from the dredge area to be analysed for grain size, and selected metals and organic contaminant concentrations and benthic biota. Similar sampling is to be undertaken at some

potential disposal sites in Bream Bay. Additional samples for subsurface sediment quality at selected sites within the dredge area are planned.

Monitoring studies should include photographic quantification and a health assessment of intertidal seaweed and sponge habitats and the presence of sediment on rocky shores in the vicinity of the dredging operation and disposal area if present.

4 BIRDS

4.1 Introduction

Whangarei Harbour comprises an area of about 10000 hectares (ha) and at low tide the uncovered area consists of about 5392 ha (Parrish, 1985). In comparison the Manukau Harbour in Auckland is about 34000 ha in area and c.14500 ha is exposed at low tide (Cromarty, 1996).

Parrish, 1985 reported that the habitats in Whangarei Harbour that were exposed at low tide were comprised of the following –

mangroves	1379 ha
saltmarsh	189 ha
open sand & mudflats	3824 ha

Since 1985 the area of mangroves would have increased while the areas of saltmarsh and open sand/mudflats would have decreased as a consequence.

Regardless of the precise habitat proportions in 2015, the Harbour supports a notable population of coastal birds that includes a variety of waders, shags, gulls and terns together with typically pelagic species such as gannet, shearwaters, penguin, skuas and petrels with the pelagics especially prevalent in the outer Harbour and/or main channel habitats. A notable inner Harbour exception is a breeding population of grey-faced petrel (northern mutton bird; Oi; *Pterodroma macroptera gouldi*) that is being established on Matakohē – Limestone Island that has been restored to regenerating forest habitat (www.limestoneisland.org.nz). It is understood that grey-faced petrel was not recorded breeding on the Island previously.

Overall, the coastal bird populations using Whangarei Harbour are modest in the context of the upper North Island as a result of the Harbour's relatively limited size. An example is provided by information collated by Southey, 2009 for the Department of Conservation. The results in Table 4.1 and Table 4.2, below relate to species in Southey 2009 that are typically present in Marsden Bay which is the closest area to the Project for which long-term data is known to exist (BioResearches 2003 to 2015).

Table 4.1 SUMMER (1994 – 2003) November counts (Southey 2009)

	WHANGAREI HARBOUR			MANUKAU HARBOUR		
	average count	SE	n	average count	SE	n
South Island pied oystercatcher	218	57	10	4296	514	10
pied stilt	119	38	10	681	79	10
banded dotterel	19	3	10	7	3	10
variable oystercatcher	56	18	10	<50	–	–
spur-winged plover	22	7	10	120	20	10
NZ dotterel	10	6	9	27	3	9
eastern bar-tailed godwit	307	29	9	2050	327	9
lesser knot	33	17	9	2339	489	9

Table 4.2 WINTER (1995 – 2003) June; occasionally July; counts (Southey 2009)

	WHANGAREI HARBOUR			MANUKAU HARBOUR		
	average count	SE	n	average count	SE	n
South Island pied oystercatcher	1362	229	9	29334	1938	10
pied stilt	422	72	9	3981	376	9
banded dotterel	272	43	9	1225	273	6
variable oystercatcher	63	11	9	<50	–	–
spur-winged plover	32	7	9	187	39	9
NZ dotterel	22	4	9	30	3	9
eastern bar-tailed godwit	3043	374	10	16859	1674	10
lesser knot	1988	221	10	12522	1658	10

SE = standard error of the mean

The following summary is biased towards coastal species, especially wading birds, because that has been the focus of previous studies. It is recognised however that the northern part of inner Bream Bay and the area in the vicinity of Fairway Shoal are commonly utilised by pelagic species and are part of the Project area. The nearby Hen & Chickens Islands and more distant Poor Knights Islands are utilised for breeding by a number of species that feed in the open water habitat of Bream Bay.

4.2 Harbour Birds

The earliest Harbour-wide report that has been retrieved for this review is that of Murray Munro 1972 (Report on the Birds of Whangarei Harbour). That was an addition to and expansion of the paper published in 1971 (Munro, 1971) and was supplied by the Auckland War Memorial Museum Library.

Munro, 1971 noted the following points relating to the eastern part of the Harbour and therefore the Project area :-

- little penguins breeding around the northern shoreline.
- large flocks of gannets (eg. 150) in Taurikura Bay during winter.
- c.25 little black shag in Taurikura Bay.
- reef heron breeding on Motukaroro Island and present along the northern shore.
- up to 20 variable oystercatcher in the outer Harbour.
- 37 NZ dotterel in Marsden Bay in March.
- up to 12 wrybill reported in Marsden Bay.
- nesting colonies of up to 200 pairs of red-billed gulls on various rocky islets.
- up to 150 pairs of white-fronted tern nesting on Frenchman Island near Busby Head.

In the 1972 report Munro commented that the only waders recorded on the rocky beaches at McLeods Bay and Taurikura were up to 6 godwit, pied stilt and heron (species not stated), 15 variable oystercatchers (VO) and 40 South Island pied oystercatchers (SIPO).

The main roost for the south-eastern part of the Harbour was the Marsden Bay sandspit – eg. 350 godwit, 60 knot, 350 SIPO, 25 VO, 50 pied stilt, 35 NZ dotterel and 2 banded dotterel.

Single pairs of NZ dotterel, gulls (?) and terns (?) often nest there in summer. Marsden Bay was the main roost for SIPO in the Harbour.

Additional notes were of flocks of shearwaters at Whangarei Heads, large roosting pied shag flocks on the northern side and flocks of 15 – 85 little black shags at Taurikura. Flocks of up to 6 white-faced heron and 50 – 100 pied stilt were recorded at Marsden Bay with one white heron reported from “Whangarei Heads”.

Parrish, 1985 provided a NZ Wildlife Service update of the Whangarei Harbour birds. The relevant survey sections in the context of this Project were –

- (i) Marsden Point (i.e. Blacksmiths Creek in Marsden Bay to Marsden Point itself).
- (ii) Taurikura – McKenzie and Urquharts Bays.

The features of (i) Marsden Point were noted as follows –

- NZ dotterel regular users.
- high numbers of bar-tailed godwit (250), SIPO (750) and VO (20).
- many black-backed gulls but very few ducks and shags; low numbers of banded dotterel and pied stilts.
- there is a permanently used roost, at Marsden Spit i.e. Blacksmiths Creek’s entrance.
- Mair Bank was not noted as a feeding habitat.

The northern side of this part of the Harbour (ii) was characterised as follows :

- dominated by SIPO and VO.
- occasional white-faced heron, reef heron and shags.
- a large red-billed gull colony (i.e. breeding) on High Island and Castle Rock.
- reef heron breeding on Passage and Calliope Islands – one pair on each.
- breeding little penguin along the northern shoreline and on High and Calliope Islands.

Ogle, 1982 reported on the Wildlife and Wildlife Values of Northland and essentially relied on material from Parrish 1980; Whangarei Harbour was rated as being of “outstanding value” as a coastal/estuarine habitat.

The Whangarei Harbour Study included a report on high tide roost surveys (Dickie, 1984) using Ornithological Society of NZ data. Blacksmiths Creek (i.e. Marsden Bay) was identified as a Major High Tide Wading Bird Roost. The nearest “Major Wader Feeding Area” was at One Tree Point but did not include Marsden Bay or any areas to the east i.e. the northern shoreline and Mair Bank were not noted.

The total numbers of birds recorded roosting at Blacksmiths Creek (Marsden Bay) in the March period were as follows (Dickie, 1984) –

Date		Total numbers of birds
March	1975	723
March	1976	1091
March	1977	488
March	1978	1377
March	1979	no data
March	1980	713
March	1981	1016
March	1982	1248
March	1983	858
March	1984	453
average		885.2

Those numbers can be compared with high tide maxima in more recent years following the cessation of works in the access channel and along the foreshore of Marsden Bay for the Marsden Cove development (Bioresarches 2009-2015) –

Date		Total numbers of birds
17 February	2009	848
no survey	2010	–
22 March	2011	1011
14 February	2012	828
12 March	2013	1013
no survey	2014	–
6 March	2015	968
average		933.6

Although there has been a change in roosting behaviour in Marsden Bay, the maximum numbers roosting at high tide have remained similar (chi-squared = 1.3; not significant). Therefore Marsden Bay remains the pre-eminent coastal bird (especially wading bird) roosting area in the vicinity of the Project area.

The most recent Harbour-wide coastal bird survey is that of Pierce, 2005 which aimed at providing information to Northland Regional Council to assist it to reclassify a substantial part of the Harbour as a Marine/Management (MM1) Area.

The following points are relevant with respect to “Harbour birds” as opposed to typically pelagic birds.

- a colony of pied shags was noted at Home Point – five to ten nests were present.
- red-billed gulls sometimes nest on Frenchman Island at Busby Head.
- white-fronted terns frequently nest at Frenchman Island.
- the Harbour generally is an important feeding habitat for both caspian tern and white-fronted terns.
- 520 white-fronted terns were recorded in the Marsden Point – Busby Head area (the oil refinery jetty is a key roosting area for white-fronted tern, pers. obs).
- reef heron was found mainly along the northern Harbour edge out to Busby Head.
- high-potential breeding sites for little penguin are especially in the Reotahi Bay to High Island area, Calliope Island, Home Point to Busby Head and Smugglers Bay.
- Mair Bank is a notable feeding area for South Island pied oystercatcher (>100 individuals) and variable oystercatcher (10+ individuals) especially the latter.

- the nearest notable feeding area for both New Zealand dotterel (42) and banded dotterel (20) near the Project area is the Marsden Bay to One Tree Point habitat.
- the area east of a line from Reotahi Bay to Marsden Bay is not a notable feeding habitat for either pied stilt, eastern bar-tailed godwit or lesser knot.
- important islands in the Project area for breeding threatened species were identified as follows –
 - Frenchman : white-fronted tern, red-billed gull
 - Calliope : little penguin, reef heron
 - High : little penguin, reef heron
 - Motukaroro : reef heron

In summary the key locally significant habitats for “Harbour birds” immediately adjacent to and within the Project area are Mair Bank (oystercatchers : feeding) the islands and northern shoreline (breeding generally) and the open water habitats (terns : feeding). Clearly, breeding activities are seasonal and of limited duration whereas feeding occurs on a continual basis.

4.3 Pelagic Species

The following summarises information regarding “pelagic species” i.e. birds that most commonly occur in Bream Bay rather than the Harbour although clearly there is overlap and the distinction often an arbitrary one.

Within the Harbour typical “pelagic species” include fluttering shearwater, grey-faced petrel, little penguin, Australasian gannet, arctic skua with shags and terns, including little tern (Pierce, 2005).

On the mainland, fluttering shearwater breeds at Bream Head (Scofield and Stephenson, 2013).

The Hen and Chickens Islands situated c.10 km southeast of Whangarei Heads are significant breeding habitats for a number of species, many of which feed in Bream Bay’s open water areas at times.

Species breeding on the Hen & Chickens Islands are as follows –

little penguin	<i>Eudyptula minor</i>
grey-faced petrel	<i>Pterodroma macroptera gouldi</i>
Pycroft’s petrel	<i>Pterodroma pycrofti</i>
flesh-footed shearwater	<i>Puffinus carneipes</i>
sooty shearwater	<i>Puffinus griseus</i>
fluttering shearwater	<i>Puffinus gavia</i>
little shearwater	<i>Puffinus assimilis haurakiensis</i>
northern diving petrel	<i>Pelecanoides urinatrix urinatrix</i>

(Merton & Atkinson, 1968; McCallum *et al* 1984; Scofield & Stephenson, 2013; Waugh & Taylor, 2012).

Additional pelagic species recorded in nearshore and offshore (eg. Fairway Shoal) waters of Bream Bay have included the following (from Ogle, 1984 and Classified Summarised Notes of the Ornithological Society of NZ; Notornis : 1980–2003) :

australasian gannet	<i>Morus serrator</i>
white-faced storm petrel	<i>Pelagodroma marina maoriana</i>
Indian Ocean yellow-nosed mollymawk	<i>Thalassarche carteri</i>
shy mollymawk	<i>Thalassarche cauta</i>
giant petrel	<i>Macronectes</i> (probably northern <i>M. halli</i>)
arctic skua (jaeger)	<i>Stercorarius parasiticus</i>
Buller's shearwater	<i>Puffinus bulleri</i>
black-winged petrel	<i>Pterodroma nigripennis</i>

Species that nest on the Poor Knights Islands, c.40 km northeast of Bream Head are as follows (Scofield & Stevenson, 2013);

australasian gannet	<i>Morus serrator</i>
fairy prion	<i>Pachyptila turtur</i>
Buller's shearwater	<i>Puffinus bulleri</i>
sooty shearwater *	<i>Puffinus griseus</i>
fluttering shearwater *	<i>Puffinus gavia</i>
little shearwater *	<i>Puffinus assimilis haurakiensis</i>
white-faced storm petrel	<i>Pelagodroma marina maoriana</i>

(* also breed on Hen and Chickens Islands)

Therefore there is a high diversity of pelagic species that utilise the open water habitats of Bream Bay. Some of those species typically occur in high numbers at times e.g. large groups of up to 800 fluttering shearwater recorded in late summer and flocks of up to 200 diving petrel during the winter (Classified Summarised Notes; Notornis) Ruakaka resident Margaret Hicks kindly provided photographs of hundreds of, probably, fluttering shearwaters in the nearshore zone between Sime and Mair Roads moving towards Whangarei Heads taken on 10 April 2010. Fluttering shearwaters form huge flocks during late summer when they are moulting and are reluctant to fly (Scofield & Stephenson, 2013; p.183).

4.4 Conservation Status

In this section the conservation status of species referred to above is provided and follows Robertson *et al*, 2013. The right column contains qualifiers to the status that are defined below.

4.4.1 Threatened Species

(i) Nationally Critical

white heron	<i>Ardea modesta</i>	OL, SO, St
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(ii) Nationally Endangered

reef heron	<i>Egretta sacra sacra</i>	DP, SO, Sp, St
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(iii) Nationally Vulnerable

banded dotterel	<i>Charadrius bicinctus bicinctus</i>	DP
caspian tern	<i>Hydroprogne caspia</i>	SO, Sp
flesh-footed shearwater	<i>Puffinus carneipes</i>	RR, TO
lesser knot	<i>Calidris canutus rogersi</i>	TO
NZ dotterel	<i>Charadrius obscurus aquilonius</i>	CD, Inc
pied shag	<i>Phalacrocorax varius varius</i>	
red-billed gull	<i>Larus novaehollandiae scopulinus</i>	
wrybill	<i>Anarhynchus frontalis</i>	RR

4.4.2 At Risk Species

At Risk taxa meet the criteria of Townsend *et al* 2008 for Declining, Recovering, Relict and Naturally Uncommon.

At Risk – Declining taxa do not qualify as “Threatened” because they are buffered by large population size and/or a slower rate of decline than the trigger points (Robertson *et al* 2013).

(i) Declining

eastern bar-tailed godwit	<i>Limosa lapponica baueri</i>	TO
little penguin	<i>Eudyptula minor</i>	DP, EF
pied stilt	<i>Himantopus himantopus leucocephalus</i>	SO
sooty shearwater	<i>Puffinus griseus</i>	SO
South Island pied oystercatcher	<i>Haematopus ostralegus finschi</i>	
white-fronted tern	<i>Sterna striata</i>	DP

(ii) Recovering

little shearwater	<i>Puffinus assimilis haurakiensis</i>	Inc, RR
Pycroft’s petrel	<i>Pterodroma pycrofti</i>	Inc, RR
variable oystercatcher	<i>Haematopus unicolor</i>	Inc

(iii) Relict

fairy prion	<i>Pachyptila turtur</i>	RR, SO
fluttering shearwater	<i>Puffinus gavia</i>	RR
northern diving petrel	<i>Pelecanoides urinatrix urinatrix</i>	Inc, RR, SO
white-faced storm petrel	<i>Pelagodroma marina maoriana</i>	RR

(iv) Naturally Uncommon

Buller’s shearwater	<i>Puffinus bulleri</i>	OL, St
little black shag	<i>Phalacrocorax sulcirostris</i>	RR
giant petrel	<i>Macronectes (?) halli</i>	RR, SO

4.4.3 Non-Resident Native Species

Migrant

Arctic skua *Stercorarius parasiticus* SO

Vagrant

shy mollymawk *Thalassarche cauta* SO

Colonised

Indian Ocean yellow-nosed mollymawk *Thalassarche carteri* TO

4.4.4 Not Threatened

australasian gannet *Morus serrator*
 black-backed gull *Larus dominicanus dominicanus*
 black-winged petrel *Pterodroma nigripennis*
 grey-faced petrel *Pterodroma macroptera gouldi*
 white-faced heron *Egretta novaehollandiae novaehollandiae*

Key to right hand qualifiers –

CD Conservation Dependent
 DP Data Poor
 EF Extreme Fluctuations
 Inc Increasing
 OL One Location
 RR Range Restricted
 SO Secure Overseas
 Sp Sparse
 St Stable
 TO Threatened Overseas

Overall the spread of species in the main conservation status categories can be summarised as follows –

	“Harbour”	“Pelagic”
Threatened	9	1
At Risk	7	9
Non-resident native	–	3
Not Threatened	3	2

The two species recorded using the Project area with the highest conservation ratings are white heron (Nationally Critical) and reef heron (Nationally Endangered). White heron is unlikely to frequent the habitats within the Project area on a regular basis, however reef heron is relatively common in the area and breeding has been reported.

The following summary is based on information obtained from the literature surveys and familiarity with area but it does not include the results from any recent breeding season survey. Such a survey is scheduled for spring 2015.

<u>Threatened Species</u>	Significant Feeding Area Within Or Immediately Adjacent To The Project Area	Breeding Immediately Adjacent To The Project Area – Excludes Hen & Chickens Islands & RNZ Grounds
white heron	–	–
reef heron	✓ Harbour	✓ Calliope Is; High Is; Motukaroro Is.
banded dotterel	–	–
caspian tern	✓ Harbour Bream Bay	–
flesh-footed shearwater	✓ Bream Bay	–
lesser knot	–	–
NZ dotterel	–	–
pied shag	✓ Harbour Bream Bay	✓ Home Pt
red-billed gull	✓ Harbour Bream Bay	✓ Frenchman Is.
wrybill	–	–

<u>At Risk Species</u>	Significant Feeding Area Within Or Immediately Adjacent To The Project Area	Breeding Immediately Adjacent To The Project Area – Excludes Hen & Chickens Islands & RNZ Grounds
eastern bar-tailed godwit	–	–
little penguin	✓ Harbour Bream Bay	✓ northern shore to Smugglers Bay Calliope Is. High Is.
pied stilt	–	–
sooty shearwater	✓ Bream Bay	–
South Island pied oystercatcher	✓ Mair Bank	–
white-fronted tern	✓ Harbour Bream Bay	✓ Frenchman Is.
little shearwater	✓ Bream Bay	–
Pycrofts petrel	✓ Bream Bay	–
variable oystercatcher	✓ Mair Bank	–
fairy prion	✓ Bream Bay	–
fluttering shearwater	✓ Bream Bay	✓ Bream Head
northern diving petrel	✓ Bream Bay	–
white-faced storm petrel	– *	–
Buller's shearwater	✓ Bream Bay	–
little black shag	✓ Harbour Bream Bay	–
giant petrel	–	–

<u>Non-Resident Native</u>	Significant Feeding Area Within Or Immediately Adjacent To The Project Area	Breeding Immediately Adjacent To The Project Area – Excludes Hen & Chickens Islands & RNZ Grounds
arctic skua	✓ Harbour Bream Bay	–
shy mollymawk	–	–
Indian Ocean yellow-nosed mollymawk	–	–

<u>Not Threatened</u>	Significant Feeding Area Within Or Immediately Adjacent To The Project Area	Breeding Immediately Adjacent To The Project Area – Excludes Hen & Chickens Islands & RNZ Grounds
australasian gannet	✓ Harbour Bream Bay	–
black-backed gull	✓ Harbour Bream Bay	probable
black-winged petrel	– *	–
grey-faced petrel	– *	–
white-faced heron	✓ Harbour	probable

(* continental shelf feeders)

From the above five of the ten threatened species utilise the Project area and/or its immediate environs for feeding – Harbour : reef heron, caspian tern, pied shag and red-billed gull; Bream Bay : caspian tern, flesh-footed shearwater, pied shag and red-billed gull. Nearby nesting by reef heron (solitary; in a cave or on a rock stack), pied shag (colonies; trees along cliffline) and red-billed gull (colonies; rocky coastline) (Scofield & Stevenson, 2013; nzbirdsonline 2015) has been reported.

A total of twelve “at risk” species utilises the Project area and/or its immediate environs for feeding; two use Mair Bank, three mainly use the Harbour and ten mainly use Bream Bay. Breeding activity has been recorded for little penguin (solitary or colonies; caves, rock crevices, under houses), white-fronted tern (colonies; rock stacks, cliffs) and fluttering shearwater (colonies; burrows under scrub or forest) (Scofield & Stevenson, 2013; www.birdsonline.org.nz).

Of the areas discussed above most are of local or regional significance within the Whangarei Harbour area.

4.5 Conclusions

Therefore although the coastal bird populations using the Harbour itself are relatively modest, the diversity is high and that increases significantly in the context of the Project area when combined with the avifauna of Bream Bay which can be abundant at times. Secondly up to six threatened or at risk species are known to breed in the outer, eastern part of the Harbour and on Bream Head. This information review has identified the notable features of the Project area and its immediate environs with a high degree of certainty but has also identified a relative lack of information since 2005 on the area to the east of Marsden Bay. The latter position lead to specific surveys being undertaken in February – March 2015 (Mair Bank; Bream Bay Beach; Taurikura, McKenzie and Urquharts Bays) and the proposal for breeding season surveys in November – December 2015.

5 COMMERCIAL FISHING

The Bream Bay coastline is known to be an important commercial fishing area; with the main commercial fish stocks include snapper, trevally, grey mullet, kahawai, John Dory and tarakihi (Cawthron 2009). Commercial collection of shellfish includes cockles which are taken exclusively from Snake Bank. Commercial gathering of pipi has occurred predominantly on the seaward and northern side of Mair Bank, and commercial harvesting of scallops in the Bream Bay area.

5.1 Commercial

5.1.1 Wetfish

Commercially important stocks include snapper, trevally, grey mullet, kahawai, John Dory and tarakihi (Cawthron 2009).

Bream Bay is has been closed to trawling and Danish Seining inside an area bounded to the east by a line from the southern most extremity of Busby Head (at 35° 51.8'S and 174° 31.9'E) in a straight line to the shore on the southern end of Bream Bay (at 36° 02.9'S and 174° 33.3'E).

Trawling is defined as use of any "net or part thereof (including any warp, rope, chain, material or device used in conjunction with, or attached to, the net) which has a buoyancy system on the top edge and is weighted on the bottom edge and is operated by being drawn over the bed of any waters or through any waters by one or more vessels underway."

Danish seining is defined as the use of any net or part thereof (including any warp, rope, chain, material or device used in conjunction with or attached to, the net) which has a buoyancy system on the top edge and is weighted on the bottom edge and is operated, without the use of any horizontal net opening device by surrounding any fish and being drawn over the bed of any waters or through any waters to one or more vessels."

(The Fisheries (Auckland Commercial Fishing Restriction) Notice 1985) .

The Bream Bay area has been used by commercial fishermen using set netting and long-lining methods but the numbers fishing this area are apparently small (Bioresarches, 1989).

No catch data can be isolated from overall landings at the Port of Whangarei.

It is understood that commercial fishing for paddle crabs (*Ovalipes catharus*) also occurs within the Bream Bay area. However no catch data can be isolated from overall landings at the Port of Whangarei. (MPI, 2014b)

5.1.2 Shellfish

5.1.2.1 Cockle Fishery

Cockles are one of the most abundant bivalve species found within the Whangarei Harbour. Within the Harbour, Snake Bank and McDonald Bank and the northern shores are important areas. Commercial collection of cockles (COC 1A) is undertaken exclusively on Snake Bank. (MPI, 2014a)

Commercial picking in Whangarei Harbour began in the early 1980s, with no particular seasonality. Catch statistics are unreliable before 1986, although it is thought that over 150 tonnes (t) of Snake Bank cockles were exported in 1982. A quota management system (QMS) was introduced in October 2002 with a total allowable catch (TAC) of 400 t, comprising a commercial TAC of 346 t, customary and recreational allowances of 25 t each, and an allowance of 4 t for other fishing related mortality. There is no minimum legal size for cockles however; the mean length of the commercial harvest is about 29.5 mm and cockles smaller than 25 mm are less attractive to both commercial and non-commercial fishers.

Landings have decreased substantially since the fishery entered the QMS (average of 156 t), and landings in 2008–09 (88 t) were the lowest ever recorded. The fishery has been adversely affected by temporary fishery closures during incidents of sewage and stormwater overflows which adversely affected harbour water quality. The last reported commercial catch was in 2012.

5.1.2.2 Scallop Fishery

Scallops (*Pecten novaezelandiae*) support regionally important and valued commercial, recreational, and customary fisheries in various parts of New Zealand, including Northland. The Northland scallop fishery area (SCA 1) is bounded by Reef Point (near Ahipara) on the west coast and Cape Rodney (near Leigh) on the east coast. Commercial scallop fishing in SCA 1 has historically taken place within discrete beds in Spirits Bay, Tom Bowling Bay, Great Exhibition Bay, Rangaunu Bay, Doubtless Bay, Stevenson's Island, the Cavalli Passage, Bream Bay, and along the coast between Mangawhai and Pakiri (Hartill & Williams, 2014). All commercial catches are taken by self-tipping box dredges. The commercial dredge fishery for scallops off eastern northland started in the early 1970s; primarily in Rangaunu Bay, Bream Bay, and Spirits Bay, with lesser harvests taken elsewhere up until the mid-1990s (Hartill & Williams, 2014). Scallop beds occur near the Whangarei harbour entrance and there is an offshore fishery throughout Bream Bay to a depth of 30 m (Oldman, *et al.* 2004).

The commercial take of scallops in Bream Bay is restricted to the area seawards of a line between southern western most extremity of Peach Cove (at 35° 51.75'S and 174° 33.40'E) to the southernmost extremity of Busby Head (at 35° 51.80'S and 174° 31.90'E) to the northern chimney of the Marsden Power Station (at 35° 52.50'S and 174° 28.10'E).

The reported commercial catch for the Bream Bay area has declined since mid 1990's, with a minor resurgence in the 2000's (Hartill & Williams, 2014). The reported performance of the fishery has since been poor and landings are currently at a very low level. Anecdotal comments have suggested the 2015 season has been a significant improvement on recent years.

5.1.2.3 Pipi Fishery

Pipis are present throughout Whangarei Harbour and in sheltered areas nearby including One Tree Point, Marsden Point, Mair Bank and Snake Bank (Venus, 1984., Lundquist & Broekhuizen, 2012). Over 99% of the total commercial landings of pipi in New Zealand have been harvested from Mair Bank. Commercial harvesting has typically been focused on the southern seawards margins of the bank where shell cover is less dense, with the central area being avoided by commercial fishers. All commercial harvesting was conducted by hand, and fishers typically used a mask and snorkel. Commercial pipi harvesting occurred year-around, so there was little seasonality in harvesting pressure. Licensed Fish Receiver Returns have reported steady total commercial landings of pipi harvested in Whangarei Harbour from 1986-87 to 2007-08 (Table 5.1). Total commercial landings have ranged between 55 t and 326 t, generally operating well below total allowable commercial catch. Since 2007-08, the reported harvest has significantly declined from around 130 t to 55 t (2011-12) with no reported landings in 2012-13 (MPI, 2014b).

Table 5.1 The greenweight (t) commercial landings of pipi (from Licensed Fish Receiver Returns) in Whangarei Harbour between 1986-87 to 2010-11 fishing years. (from Pawley 2014)

Year	Reported landings (t)	Limit (t)	Year	Reported landings (t)	Limit (t)
1986 - 87	131	657	1999 - 00	143	657
1987 - 88	133	657	2000 - 01	184	657
1988 - 89	134	657	2001 - 02	191	657
1989 - 90	222	657	2002 - 03	191	657
1990 - 91	285	657	2003 - 04	266	657
1991 - 92	326	657	2004 - 05	206	200
1992 - 93	184	657	2005 - 06	136.7	200
1993 - 94	258	657	2006 - 07	134.7	200
1994 - 95	172	657	2007 - 08	141.6	200
1995 - 96	135	657	2008 - 09	131.1	200
1996 - 97	146	657	2009 - 10	136	200
1997 - 98	122	657	2010 - 11	87	200
1998 - 99	130	657	2011 - 12	55	200

In 2011, the Ministry of Fisheries put in place a two year temporary closure to the take of pipi from Marsden Bank under section 186A of the Fisheries Act 1996, which later was extended another two years, and has now been extended indefinitely.

Three surveys were undertaken in May 1974 (Marsden Point), July 1977 (Mair Bank), and June 1982 (Mair Bank), all by Ministry of Agriculture and Fisheries. Further surveys were completed in 1985 and 1989 by the Northland Regional Council and Ministry of Agriculture and Fisheries.

The 1974 survey was undertaken at the seaward side of the Marsden Point pipi bed very close to Mair Bank. The overall density was a mean of 607.2 per m² (S.D. = 342.5; n=25) with a maximum density of 1290 per m². In summary the bed was considered to be in excellent condition and although no small pipis occurred, the report noted their ability to be extremely mobile. The size of the pipis was considered to be amongst the largest in New Zealand with mean of 68.2 mm length (S.D. = 5.05; n = 292).

The 1977 survey was undertaken on the Marsden Point side of Mair Bank and showed an average density of 431.9 per m² (S.D. = 380.9; n=42) and a maximum density of 1240 per m². The report noted that on Mair Bank the pipis in various areas tended to be of similar age as their density and rapid growth prevented subsequent settlement, and that these areas were then subject to gross change when all the pipis died naturally. The mean length recorded in 1977 was 66.1 mm (S.D. = 11.7; n = 1661).

The 1982 survey found that densities of up to 1140 per m² were recorded at an average of 374.1 per m² (S.D. 424.2; n = 27). Mean length was 69.0 mm (S.D.= 7.0; n = 220).

Roke, 1989, recorded that between 1985 and 1989 pipi distribution and abundance had changed along the southern edge. In particular, average densities had decreased from a consistent 500-1000 per m² in 1985, to a patchy distribution with some densities as high as 1000 per m², but generally between 100 and 500 per m².

It was suggested that this reduction had been caused by Cyclone Bola (early March 1988), harvesting, a natural population decrease, or a combination of those factors. In 1989 the population contained a higher proportion of juvenile pipis than found in the 1985 survey, when the resource was almost exclusively of large adult shellfish. The June 1989 report by the Ministry of Agriculture and Fisheries (Haddon, 1989) concluded that the total annual harvest of pipis was about 120 tonnes, which represents 6% of the estimated 2000 tonnes in the bed. Even at a level of 12% cropping per annum, that rate was considered low and readily sustained. The average size of pipis had not changed significantly in fifteen years, and the present number of licences was considered to be appropriate. It was concluded that the Mair Bank pipi resource was more at risk from physical changes to the Bank (e.g. cyclonic storm events) than from commercial or recreational shellfish gathering.

It is noted, however, that sample sizes, and possibly sampling locations, were not consistent following the 1974 survey. No attempt was apparently made in those surveys to estimate the size of the resource or to map various densities of pipis on Mair Bank.

Comparable biomass surveys of pipi on Mair Bank were completed in 2005 (Williams, *et al*, 2007), 2010 (Pawley, *et al*, 2013) and 2014 (Pawley, 2014). The population estimates were 10,152 t in 2005, 4,450 t in 2010 and 73.5 tonne in 2014. Between the 2010 and 2014 survey estimates a substantial decrease in the total biomass of pipis at Mair Bank was recorded. It has been suggested (Williams and Hume, 2014) that potential causes of the pipi decline are high natural mortality of an ageing pipi population, and low recruitment. They reported there was no evidence of disease in the population, and the decline did not appear to be associated with potential anthropogenic sources of mortality (e.g., sedimentation, contaminants,

harvesting). It is possible that substances not measured in shellfish, sediment, or water quality monitoring work may have influenced the pipi decline.

The decline in the pipi biomass on Mair Banks is currently of concern as no cause has been identified. Earlier population declines have been documented and their subsequent partial recovery, it is possible that the decline is a natural variation in the population. Since pipi have an extended planktonic larval phase (about three weeks) (Hooker, 1995) before settlement and metamorphosis, pipi "stocks" have the potential to recover following spawning and fertilisation, from other nearby pipi populations by larval dispersal.

5.1.2.4 Shellfish Quality

A range of metallic and hydrocarbon constituents have been measured in shellfish adjacent to the Marsden Point oil refinery (Larcombe, 1983; Kingett, 1983; Venus, 1984a; Mortimer, 2010). The three earlier references all refer to the same data collected in the early 1980's. Since 2005 the NRC have collected samples of shellfish for chemical analysis, Mortimer, 2010, reviews this NRC data.

For metallic constituents (Table 5.2), Larcombe, 1983 concluded that none of the samples analysed exceeded the permissible proportions for copper, lead or mercury, the constituents which have specific concentration standards under the Food and Drug Regulations (Department of Health, 1984). In general the concentrations of metals in shellfish from the Marsden Point area had concentrations similar to or lower than those in shellfish in other coastal areas of New Zealand. Venus, 1984a also concluded that concentrations of metals in Whangarei Harbour were low and were not cause for concern.

Kingett, 1983 found that the highest concentrations of cadmium in pipis (*Paphies australis*) occurred at Mair Bank, and the highest concentrations of zinc occurred at Marsden Bank. (Table 5.3)

Kingett, 1983 found that the highest concentrations of total hydrocarbons, lower aromatic hydrocarbons and polynuclear aromatic hydrocarbons in pipis (*Paphies australis*) occurred at Snake Bank, to the north west of Marsden Point, and beside the main shipping channel. A control area remote from industrial activity was also sampled (Horahora Site). (Table 5.4)

Statistical analysis of those results indicates there was no significant difference in mean total hydrocarbon concentrations between Mair Bank and Marsden Point, but that the control location was significantly higher than both. For lower aromatic hydrocarbons the average levels were similar at Marsden Point and the control, the latter of which was higher than Mair Bank. There was no significant difference in mean concentrations of polyaromatic hydrocarbons at Marsden Point, Mair Bank and the Control.

The Northland Regional Council have sampled shellfish in the lower Whangarei Harbour at various sites in since 2002 at infrequent occasions. In the early years the sampling was largely of caged sentinel shellfish (mussels) attached to the mooring dolphins at either end of the NZRC Jetty. However, pipis at Mair Bank were also sampled on occasions for

comparative purposes. Between 2007 and 2009, the use of sentinel shellfish was abandoned for logistical and cost reasons and the shellfish sampling focus was switched to feral shellfish beds.

The shellfish sites sampled between 2002 and 2013 and the analyses results are presented in Table 5.5. Current guidelines / standards for the chemical contamination in foods (including shellfish) that are likely to affect human health are presented in Table 5.6.

All concentrations of contaminants reported in pipis in the lower Whangarei Harbour have been within the current food standards. Note that although the (total) arsenic measured was three-fold higher than the arsenic guideline, the guideline refers to inorganic arsenic which is about 10% or less of total arsenic (Phillips & Depledge 1986).

Table 5.2 Metal Concentrations of *P. australis* Whangarei Harbour and Horahora River (All Concentrations in ppm) from Larcombe, 1983.

CADMIUM			
Site	n	mean	SEM
Marsden Point	6	0.12	0.009
Mair Bank	6	0.28	0.025
Snake Bank	6	0.17	0.009
Horahora River	6	0.16	0.007
CHROMIUM			
Site	n	mean	SEM
Marsden Point	6	<0.1	-
Mair Bank	6	<0.1	-
Snake Bank	6	<0.1	-
Horahora River	6	<0.1	-
LEAD			
Site	n	mean	SEM
Marsden Point	6	<0.1	-
Mair Bank	6	<0.1	-
Snake Bank	6	<0.1	-
Horahora River	6	<0.1	-
ZINC			
Site	n	mean	SEM
Marsden Point	6	11.1	0.58
Mair Bank	6	10.2	0.49
Snake Bank	6	9.3	0.21
Horahora River	6	9.6	0.32

SEM = Standard error of the mean

Table 5.3 Concentrations of cadmium, chromium, lead and zinc in *Paphies australis* at four Whangarei locations, August, 1983. from Kingett, 1983

(a) Cadmium

(a) Cadmium									
Site	Concentration (ug/g wet weight) (ppm)							mean	SEM
	1	2	3	4	5	6			
Marsden Point	0.12	0.09	0.15	0.11	0.12	0.14		0.12	0.009
Mair Bank	0.29	0.39	0.29	0.24	0.22	0.25		0.28	0.025
Snake Bank	0.17	0.14	0.16	0.16	0.20	0.19		0.17	0.009
Horahora River	0.18	0.17	0.17	0.16	0.14	0.14		0.16	0.007

(b) Chromium

(7) Chromium								
Site	Concentration (ug/g wet weight) (ppm)							
	1	2	3	4	5	6	mean	SEM
Marsden Point	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.000
Mair Bank	0.10	0.20	0.10	< 0.10	< 0.10	< 0.10	< 0.12	0.017
Snake Bank	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.000
Horahora River	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.000

(c) Lead

(c) Ecad									
Site	Concentration (ug/g wet weight) (ppm)							mean	SEM
	1	2	3	4	5	6			
Marsden Point	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.000	
Mair Bank	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.000	
Snake Bank	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.000	
Horahora River	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.000	

(d) Zinc

Site	Concentration (ug/g wet weight) (ppm)							
	1	2	3	4	5	6	mean	SEM
Marsden Point	9.8	11.6	9.1	11.9	13	11.3	11.1	0.58
Mair Bank	10.1	11.5	11.6	9.8	9.8	8.1	10.2	0.53
Snake Bank	9.6	9.7	9.2	9.1	8.3	9.6	9.3	0.21
Horahora River	10.1	10.1	9.6	10.3	8.8	8.4	9.6	0.32

Table 5.4 Body burden of hydrocarbons in *Paphies australis* during August 1983 at four locations in the Marsden Point area. (Body burden is expressed as the hydrocarbon concentration in micrograms per gram of lipid and is based on wet weight analyses.) from Kingett, 1983

(a) Total Hydrocarbons

Site	Concentration (ug/g lipid) (ppm)							
	1	2	3	4	5	6	mean	SEM
Marsden Point	23.7	16.7	12.2	6.5	8.8	10.6	13.08	2.5
Mair Bank	22.7	5.9	10.6	6.7	18.8	9.1	12.30	2.8
Snake Bank	256.1	187.6	29.5	64.4	14.4	53.7	100.95	39.9
Horahora River	41.5	24.3	36.0	49.8	53.3	37.5	40.40	4.3

(b) Lower Aromatic Hydrocarbons

Site	Concentration (ug/g lipid) (ppm)							
	1	2	3	4	5	6	mean	SEM
Marsden Point	29.6	12.1	9.5	9.2	5.0	9.9	12.55	3.5
Mair Bank	12.3	3.5	5.7	3.4	10.2	1.4	6.08	1.7
Snake Bank	670.5	431.2	18.2	61.6	7.7	17.4	201.10	115.1
Horahora River	18.6	14.6	18.9	33.8	29.2	15.0	21.68	3.2

(c) Polynuclear Aromatic Hydrocarbons

Site	Concentration (ug/g lipid) (ppm)							
	1	2	3	4	5	6	mean	SEM
Marsden Point	56.6	26.7	30	25.8	11.2	16.9	27.87	6.4
Mair Bank	37.0	19.6	17.0	27.4	21.8	17.0	23.30	3.2
Snake Bank	868.2	545.9	25.0	130.1	56.4	62.7	281.38	141.6
Horahora River	31.0	41.4	34.1	36.9	75.0	33.0	41.90	6.8

Table 5.5 NRC Lower Whangarei Harbour *Paphies australis* Sampling results for 2002 – 2013.

Sampling Site	Mair Bank			Marsden - Mair	Mair Bank – Outer				Marsden Bank
	100190			100191	103247				110624
Date	Dec-08	Nov-09	Dec-12	Jun-03	Nov-02	May-05	Apr-07	Dec-12	Dec-12
Polycyclic Aromatic Hydrocarbons (mg/kg)									
Acenaphthene		<0.0005						<0.0005	
Acenaphthylene		<0.0005						<0.0005	
Anthracene		<0.0002						<0.0002	
Benzo[a]anthracene		<0.0002						<0.0002	
Benzo[a]pyrene (BAP)		<0.0002						<0.0002	
Benzo[b]fluoranthene + Benzo[j] fluoranthene		<0.0002						<0.0002	
Benzo[g,h,i]perylene		<0.0002						<0.0002	
Benzo[k]fluoranthene		<0.0002						<0.0002	
Chrysene		<0.0002						<0.0002	
Dibenzo[a,h]anthracene		<0.0002						<0.0002	
Fluoranthene		<0.0002						<0.0002	
Fluorene		<0.0002						<0.0002	
Indeno(1,2,3-c,d)pyrene		<0.0002						<0.0002	
Naphthalene		<0.005						<0.005	
Phenanthrene		<0.0004						<0.0004	
Pyrene		<0.0005						<0.0005	
Total PAH			560			< 0.0001		370	500
Phenol			<0.5			< 0.2	< 0.2	<0.5	<0.5
Metals (mg/kg)									
Arsenic	3.39	2.8	2.7	4.66	3.16	3.28	2.3	2.8	1.7
Chromium	1.60	<0.098	1	0.03	0.14	0.04	0.02	0.98	1.3
Copper	2.49	1.1	1.9	1	0.82	1.42	0.7	1.6	1.9
Lead	0.027	0.013	0.073	0.012	0.034	0.02	0.008	0.05	0.061
Mercury	0.0052	<0.01	0.0034	-	-	-	-	0.0033	0.0046
Zinc	-	9.6	12	9.92	11.8	9.93	8.3	13	11

Table 5.6 New Zealand Food Standards for Metals in Shellfish

Determinand	Guideline value (mg/kg)	Guideline used
Arsenic	1 (max)	Food Standards Code 2010 (mollusc)
Cadmium	2 (max)	Food Standards Code 2010 (mollusc)
Chromium	20 (mean)	USFDA 1993 (mollusc)
Copper	5 (GEL median) 30 (GEL 90th percentile)	ANZFA 2001 (mollusc)
Lead	2 (max)	Food Standards Code 2010 (mollusc)
Mercury	0.5 (max)	Food Standards Code 2010 (mollusc)
	0.5 (GEL median) 1 (GEL 90th percentile)	ANZFA 2001 (mollusc)
Zinc	130 (GEL median) 290 (GEL 90th percentile)	ANZFA 2001 (oysters)

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