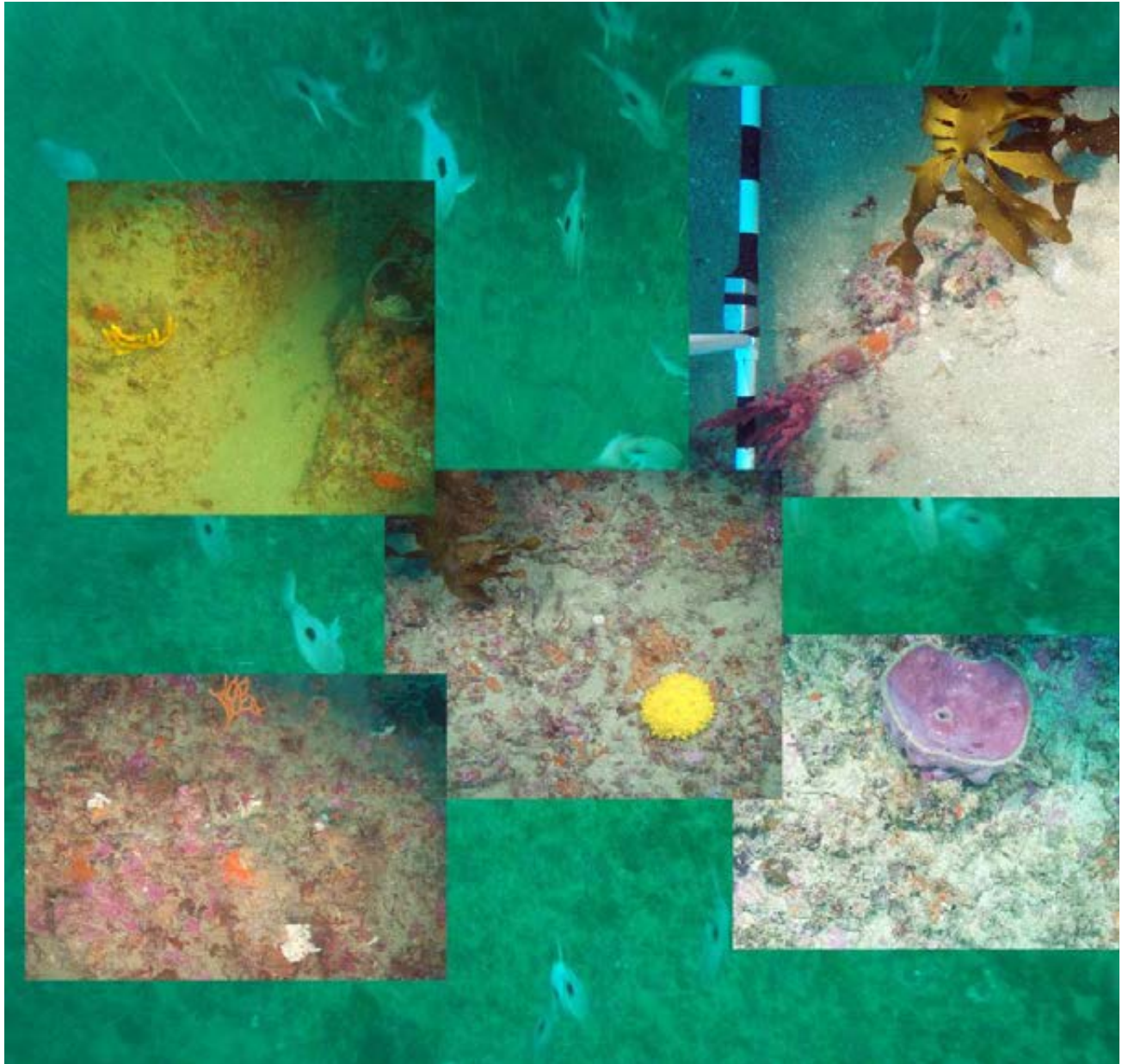


Three Mile Reef, Bream Bay: A Photographic Survey

June 2016



Cover Photo: Scenes from Three Mile Reef

For: Chancery Green on behalf of the Refining New Zealand

Report by: V.C. Kerr B.Sc., Roger Grace Phd.

Kerr and Associates, Whangarei

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1 Introduction

Refining NZ is proposing to carry out dredging work to deepen and re-align the entrance channel into the Whangarei Harbour and the turning basin that exists in front of the Marsden Point tanker jetty and Northport. In preparation for this work a series of studies have been commissioned to look at feasibility and environmental considerations. This includes ecological investigations. Previous ecological work in the area has also been reviewed. This body of background information is summarized in a recent report (Coffey, 2016a) or is to be presented in reports from Bioresarches Limited and Brian T. Coffey and Associates Limited.

This report summarises a study that was designed to provide additional information on the benthic encrusting communities of the subtidal reef area or ‘foul ground’ locally known as ‘Three Mile Reef’. The study will serve as a reference point for discussion of what communities exist on this habitat and how they may or may not be affected by the disposal of material that is dredged from within the Harbour, or the entrance to the same.

A map of the survey area and sample locations is shown in Figure 1. A photo frame was dropped at a total of seven sample locations across the area to gather information on the encrusting and/or algal communities present. The method used replicates that used for the ecological baseline survey of the candidate disposal areas (Coffey, 2016a).

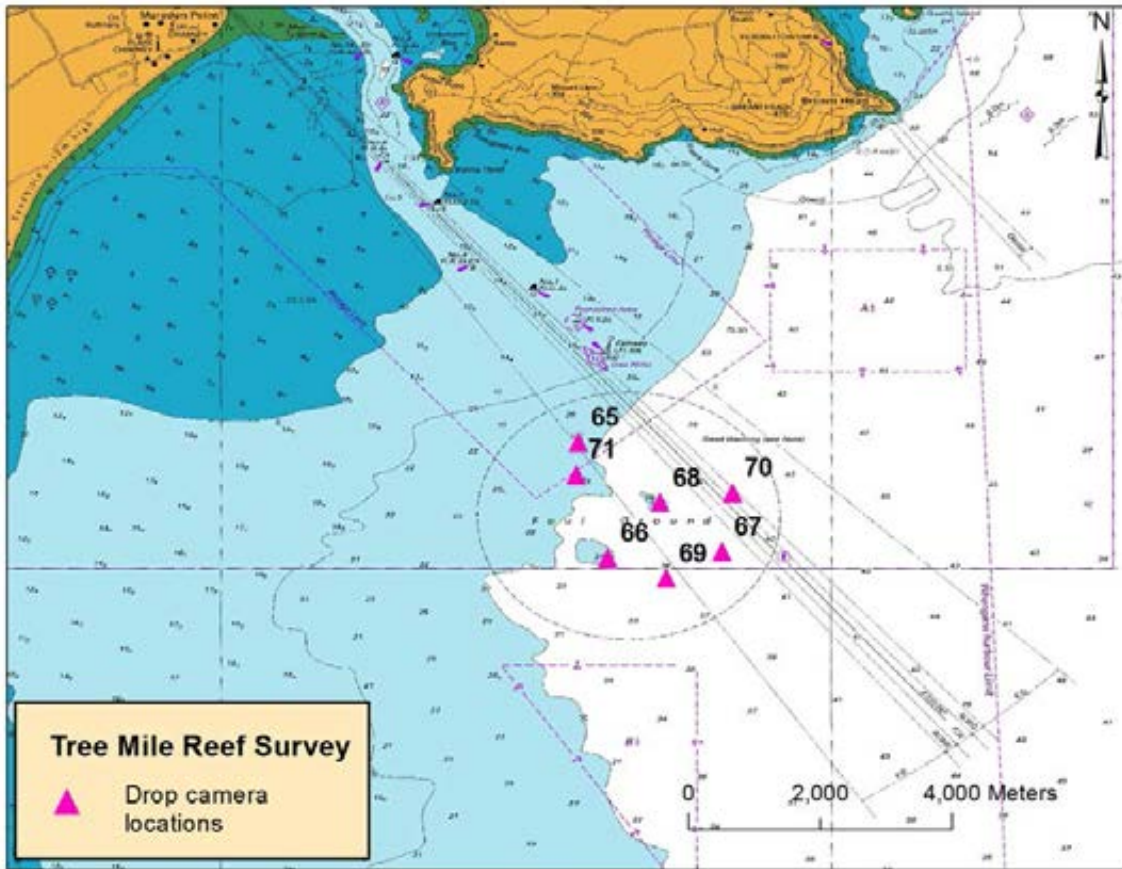


Figure 1 Map of the Three Mile Reef area showing the seven sampling locations.

2 Methods

Seven sample locations were selected to afford even coverage with respect to depth and achieving spatial coverage of what is already known of the reef habitat there. At each sample location, five replicate photo sets were recorded of the sea floor with a 1m² photo frame.

1.1 Identification of Reef Area

Three Mile Reef is an area of ‘foul’, long known by local fisherman. Its spatial extent is roughly indicated on marine charts. To assist in the design of a simple representative

sampling plan, multi-beam bathymetry imagery¹ was brought into a GIS project and seven sample locations we distributed over the reef attempting to cover the spatial extent of the reef system, different depth zones and the reef's central areas and edge areas. The spatial coverage and sampling plan was also compared to the mapped reef area appearing in the Northland Marine Habitat Map (Kerr, 2010). Generally these two sources of information were in agreement in terms of the reefs spatial extent.

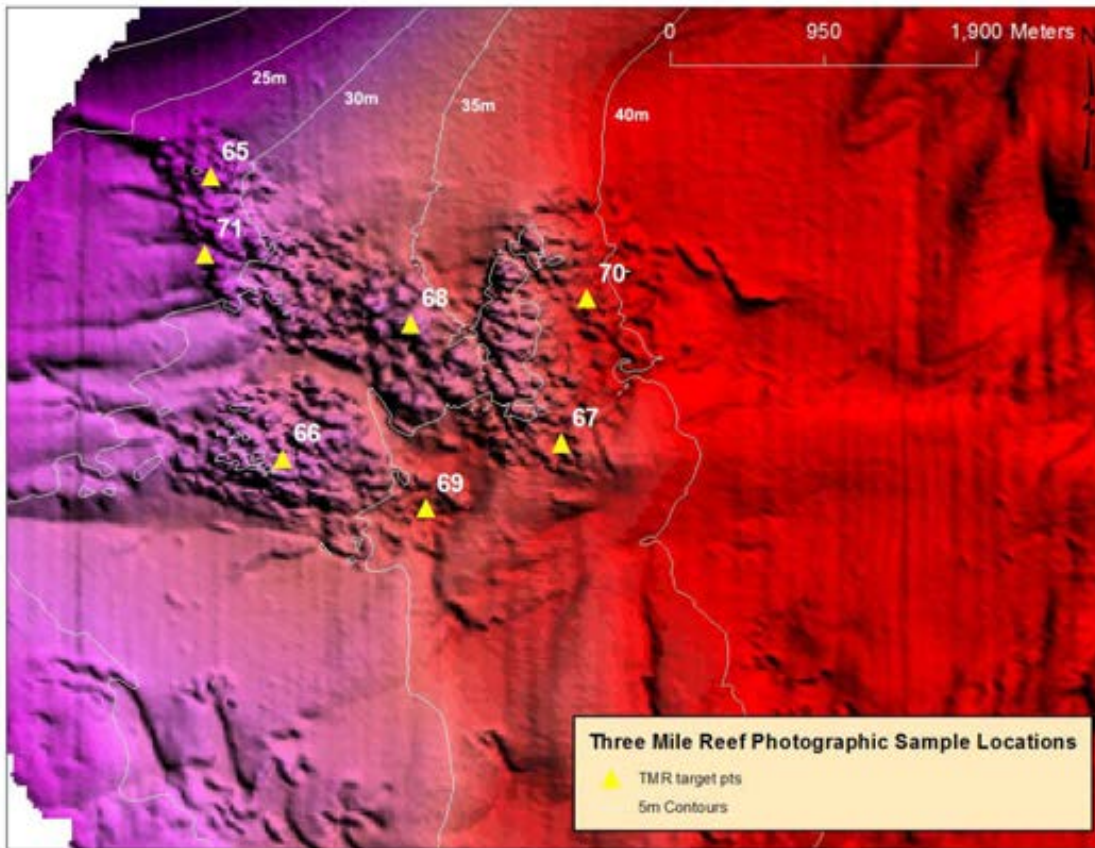


Figure 2 Map¹ of survey areas showing labelled sample locations.

2.1 Photo frame system

The photo frame system used in this survey is picture in Fig 3 below. The camera used was a Gopro Hero 4 Silver set to take a single picture frame at five-second intervals.

¹ Bathymetry data imagery in Figure 2 was kindly supplied by Sarah Gardiner of MetOcean Solutions as imagery based on multibeam survey data supplied by LINZ processed to 10m grid resolution.

Typically the photo frame was allowed to sit on the bottom for at least 30 seconds to assure a good photo was taken; this would allow any disturbed silt had time to settle or drift from view. The camera was set at 12mb resolution in wide mode, providing effective resolution for identification of species down to 1-2cm. Twin Sola 200 video lights provided additional lighting for the system. These lights were set at medium strength, which delivers approximately 800 lumens per light.

At each sample location the frame was lowered to the bottom and then lifted off the bottom and repositioned again, creating five replicated photo sets for each location. The method used to reposition the photo frame was to lift the apparatus off the seabed and allow the boat to either swing on its anchor or release approximately 4m of anchor rope and allowing time for the rope to straighten before lowering the frame to the bottom, thus moving the frame's location several meters for each of the replicate drops.

A compass was mounted on the bottom of the frame, which allowed estimation of a compass bearing for the orientation of seabed sand ripples and sand wave formations.

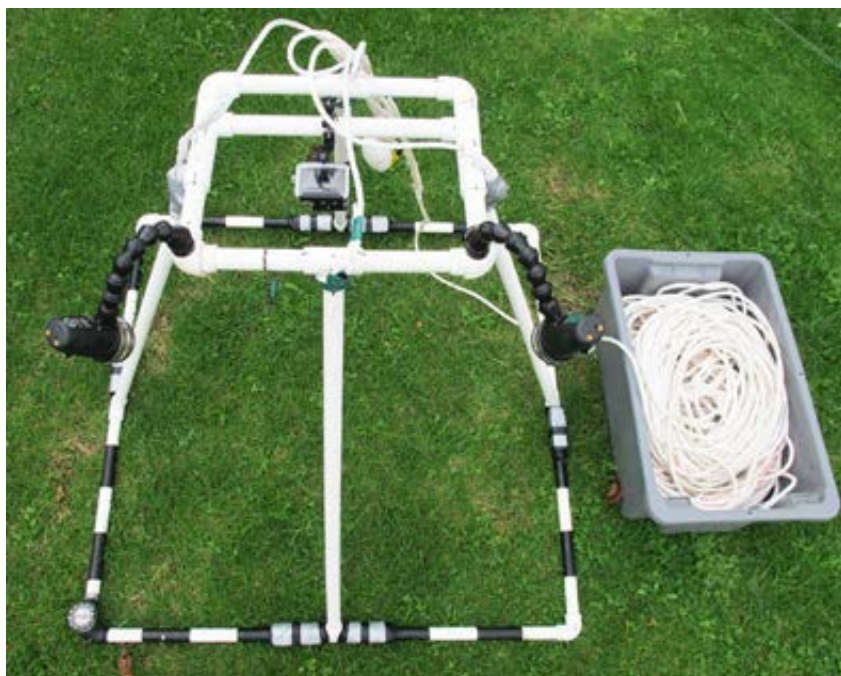


Figure 3 Photo frame apparatus.

2 Results

The photo set for each sampling location and replicate were reviewed for the presence of surface-dwelling organisms large enough to be identified. Notes were made of seabed characteristics. These results are summarized in tables below for each sample location and replicate sample. A representative photograph of the replicated sample is shown under each data table.

2.1 Sample location 65

General observations:

Photo quadrats were associated with some larger areas of patch reef with isolated weak *Eklonia radiata*, and a massive gray sponge, *Anchorina alata* observed when lowering photo frame.

Notes to data summary tables: Location refers to ‘sample location number’ - ‘replicate number’. Depth is listed in meters as read from the boat’s sounder and uncorrected for tide differential from chart datum level.

| Location | Depth (m) | Observations seabed | Observations biotic community |
|----------|-----------|---|--|
| 65-1 | 27 | coarse sand and small amounts of gravel, with considerable shell hash and some larger shell fragments, sand waves approx. period 1m, orientation 110-290° | no biota observed, few worm mounds |
| 65-2 | 27 | coarse sand and small amounts of gravel, with considerable shell hash and some larger shell fragments, period approx. 1m and orientation 170-350° | 1 small drift algae, few worm mounds |
| 65-3 | 27 | coarse sand and small amounts of gravel, with considerable shell hash and some larger shell fragments, period approx. 1m and orientation 170-350° | |
| 65-4 | 27 | flat patch reef 50%, medium sand with shell hash and small amount of gravel 50% | reef has full cover of encrusting invertebrate community consisting of Bryozoan, Hydroids, encrusting sponge and small foliose red algae, 1 triplefin sp. |
| 65-5 | 27 | flat reef 80% and fine sand 20% | reef has full cover of encrusting invertebrate community consisting of Bryozoan, Hydroids, several species of encrusting sponges and small foliose red algae, coraling paint algae, small specimen of sponge, <i>Geodia regina</i> . 1 triplefin sp. |

Table 1 Observations of photo series for sample location 65.

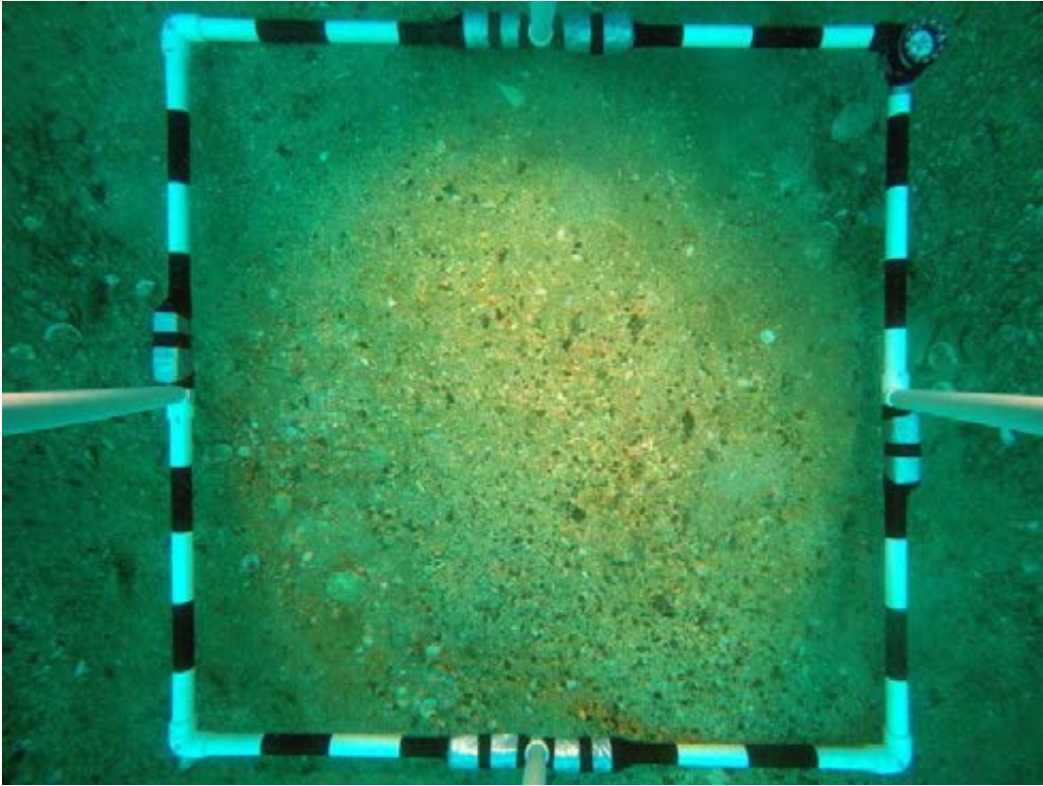


Figure 4 Sample location and replicate 65-1.

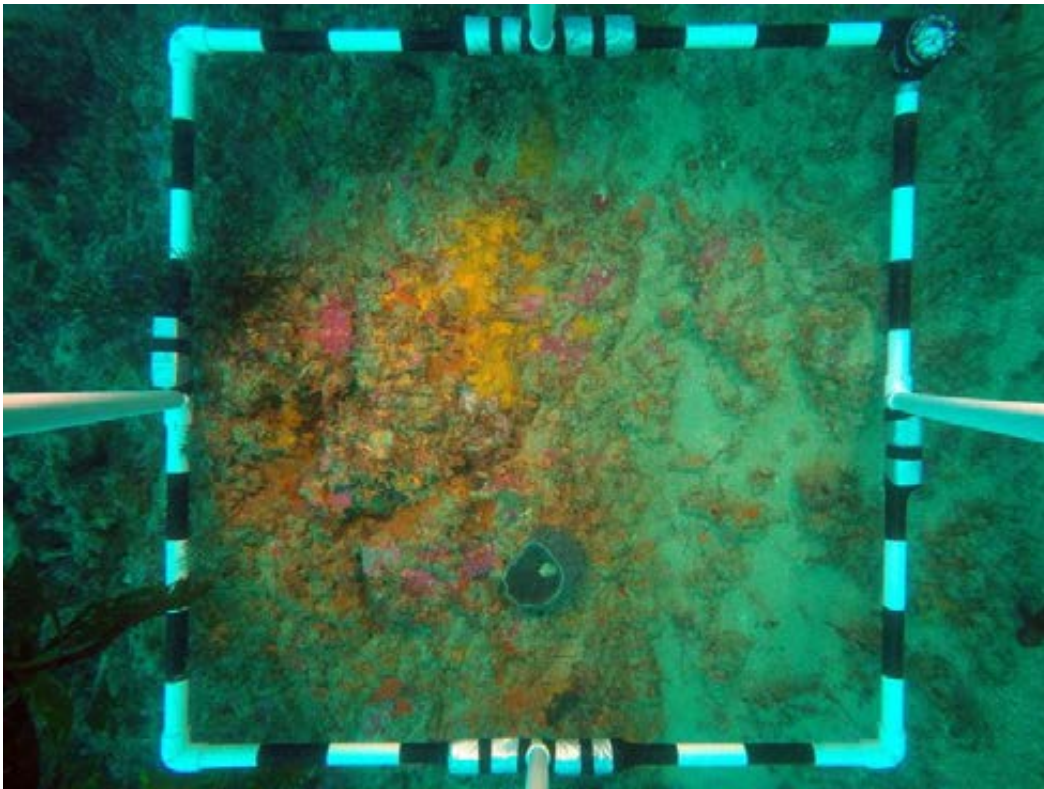


Figure 5 Sample location and replicate 65-5.

2.2 Sample location 71

General observations:

Sample location 71 is an area of patch reef. Reef habitat nearby was seen when lowering camera, one blue cod was seen near 71-4. The area appears to be free of silt.

| Location | Depth (m) | Observations Seabed | Observations biotic community |
|----------|-----------|--|---|
| 71-1 | 29m | fine and coarse sand, no observable bedforms | no biota observed |
| 71-2 | 29m | fine and coarse sand, no observable bedforms | several small pieces of drift algae |
| 71-3 | 29m | medium sand with some shell chip, , bedforms not observable, a little bit of silt shown when surface disturbed | very small encrusting algae or sponge growing on some of the shell chip |

| | | | |
|------|-----|--|--|
| 71-4 | 29m | 50% flat reef and 50% medium sand with some shell hash | rich encrusting community, several small red algae species, one green algae <i>Codium sp.</i> , 2 golf ball sponges, <i>Aaptos globosum</i> , 3 massive sponges <i>Anchorina alata</i> , several species of encrusting sponges, <i>Bryozoans</i> and <i>Hydroids</i> , 1 triplefin |
| 71-5 | 29m | fine and coarse sand, no observable bedforms | several small pieces of drift algae |

Table 2 Observations of photo series for sample location 71

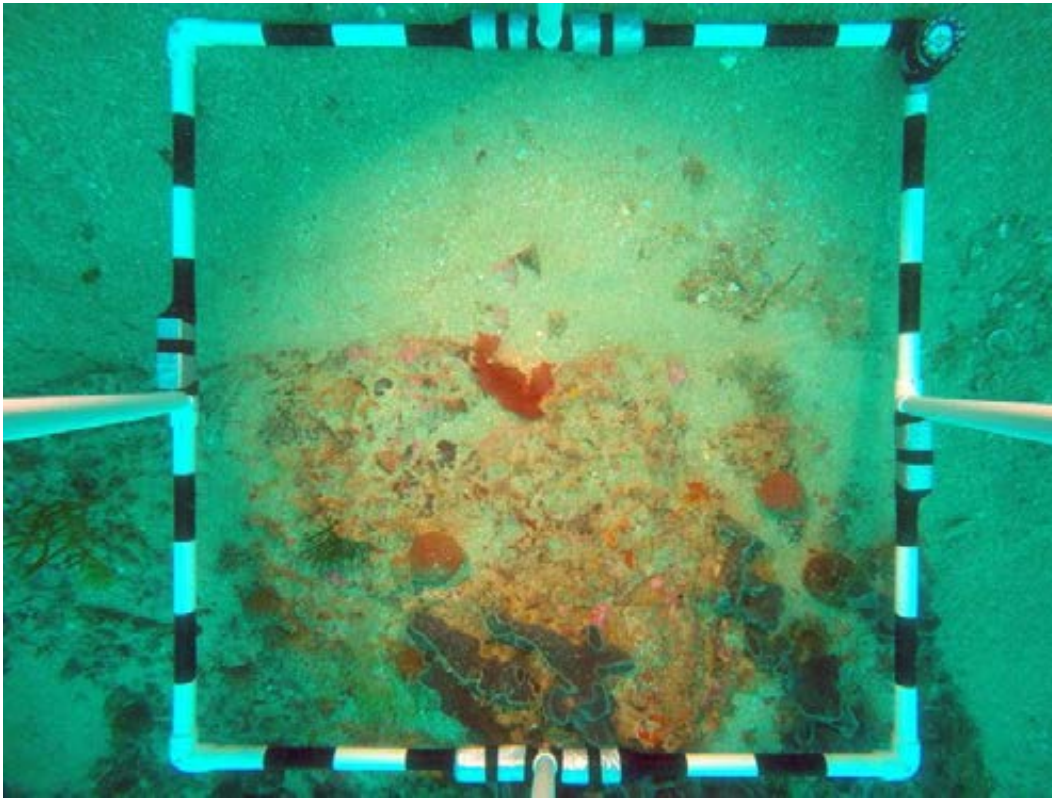


Figure 6 Sample location and replicate 71-4, see Table 2 for species.

2.3 Sample location 68

General observations:

While the site looks very healthy and has a high percentage coverage of encrusting invertebrates typical of a reef of this type, the individuals specimens are overall confined

to small examples of their species, with a few exceptions, suggesting that this part of the reef is being colonized after disturbance such as storm damage or sand scouring as a result of large swells.

| Location | Depth (m) | Observations Seabed | Observations biotic community |
|----------|-----------|---|---|
| 68-1 | 27 | flat solid reef with small deposits of fine sand | healthy encrusting invertebrate community, numerous encrusting sponge species, one massive sponge <i>Stellata maori</i> coralline paint, Bryozoans, cup coral |
| 68-2 | 27 | solid reef with undulations of approximate .3m, small deposits of fine sand | healthy encrusting invertebrate community, numerous encrusting sponge species, one yellow finger sponge, coralline paint algae, small foliose red algae, Bryozoans, cup coral, |
| 68-3 | 27 | flat solid reef with small deposits of fine sand | healthy encrusting invertebrate community, numerous encrusting sponge species, coralline paint algae, small foliose red algae, small brown algae Dictyotaceae, Bryozoan, Honera sp., cup corals |
| 68-4 | 27 | flat solid reef with small deposits of fine sand | healthy encrusting invertebrate community, numerous encrusting sponge species, coralline paint algae, small foliose red algae, small brown algae Dictyotaceae, Bryozoan, Honera sp., cup coral |
| 68-5 | 27 | solid reef with undulations of approximate .2m, small deposits of fine sand | healthy encrusting invertebrate community, numerous encrusting sponge species, one small yellow finger sponge, coralline paint algae, small foliose red algae, small brown algae Dictyotaceae, Bryozoan, Honera sp. |

Table 3 Observations of photo series for sample location 68

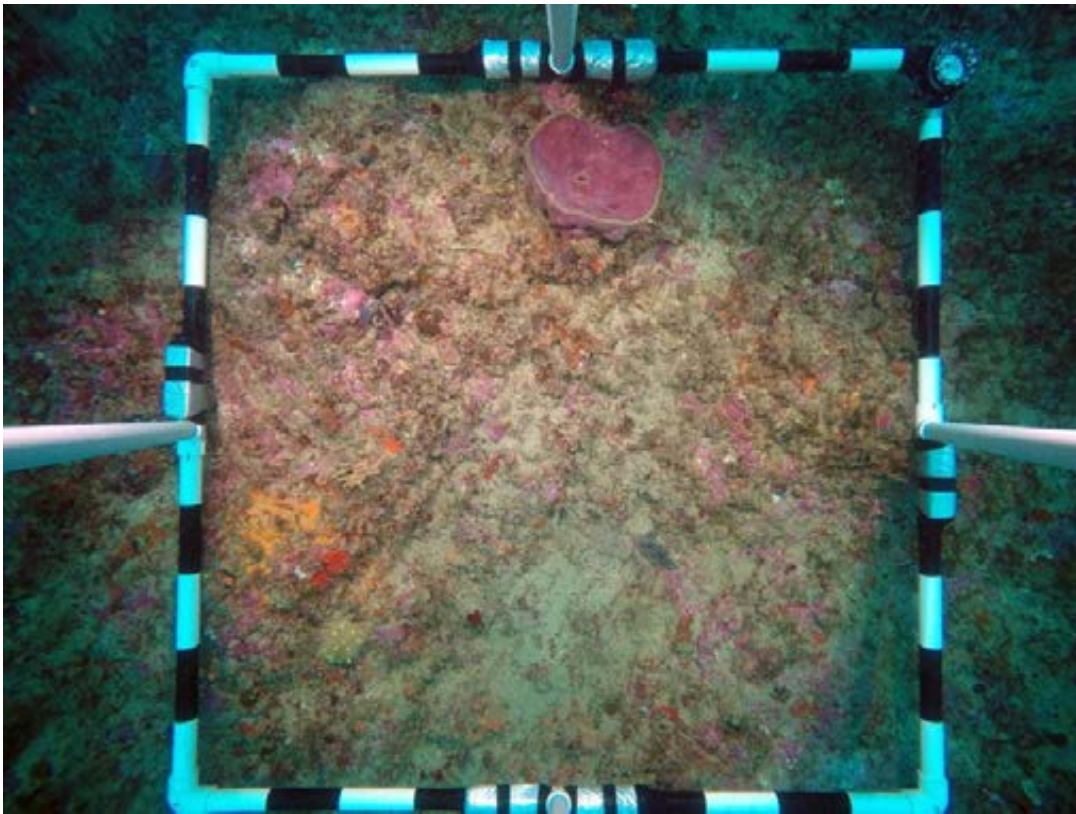


Figure 7 Sample location and replicate 68-1, massive sponge *Stellata maori* top centre.

2.4 Sample location 66

General observations:

Sample location 66 appears to be in a transition area of reef to patch reef and adjacent soft sediment. The reef encrusting community is healthy with very little surface silt observable.

| Location | Depth (m) | Observations Seabed | Observations biotic community |
|----------|-----------|---|--|
| 66-1 | 32 | flat solid reef with small deposits of fine sand | healthy encrusting invertebrate community, numerous encrusting sponge species, one specimen of yellow sponge, <i>Polymastia crocea</i> , several examples of young finger sponges, three specimens of <i>Eklonia radiata</i> small to medium size, coralline paint algae, small foliose red algae, Hydroids, Bryozoans, cup coral, |
| 66-2 | 32 | undulating solid reef 80%, 20% fine to medium sand gutter 20% | healthy encrusting invertebrate community, numerous encrusting sponge species, one specimen of globular sponge <i>Tethya berquistae</i> , two small specimens of <i>Eklonia radiata</i> , coralline paint algae, Hydroids, Bryozoans, cup coral |
| 66-3 | 32 | 70% medium fine sand and 30% flat solid reef | healthy encrusting invertebrate community, numerous encrusting sponge species, one upright sponge specimen of <i>Darwinella sp.</i> , several very small finger sponge specimens, one small specimen of <i>Eklonia radiata</i> , coralline paint algae, small red foliose algae, Hydroids, Bryozoans, cup coral |
| 66-4 | 32 | 90 % medium and fine sand with some shell chip, 10% flat reef | healthy encrusting invertebrate community, numerous encrusting sponge species, one upright sponge specimen of <i>Darwinella sp.</i> , one specimen of globular sponge <i>Tethya berquistae</i> , several very small finger sponge specimens, one small specimen of <i>Eklonia radiata</i> , coralline paint algae, small red foliose algae |
| 66-5 | 32 | medium and fine sand with considerable shell hash, sand waves and shell in troughs, waves have a period of approx. 1m and height of approx 15cm and orientation of ridges is 315°-135°, a small amount of surface silt is visible | some very small unidentified encrusting organisms living on larger shell debris in sand wave trough, otherwise no large epifauna observed |

Table 4 Observations of photo series for sample location 66

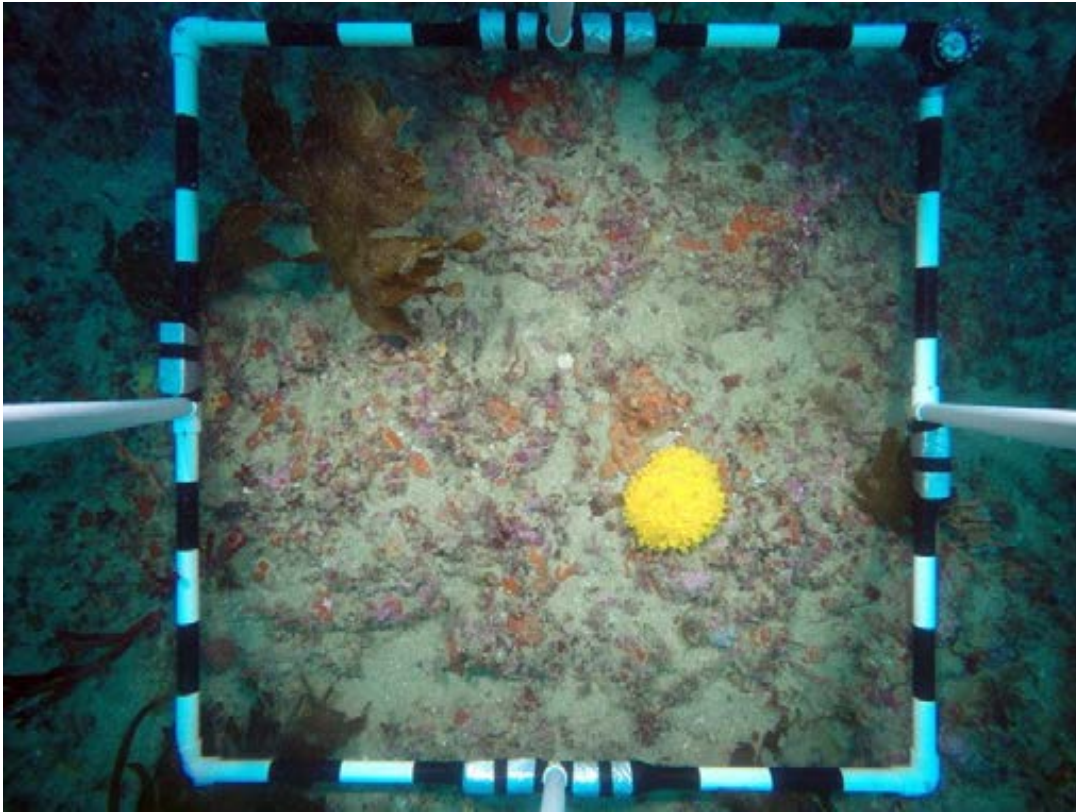


Figure 8 Sample location and replicate 66-1, note *Ecklonia radiata* kelp growing and globular yellow sponge, *Polymastia crocea*

2.5 Sample location 69

General observations:

This location was a patch reef area with larger areas of soft sediment and low lying reef seen when lowering and raising the photo frame. There was also a sizeable (>50) school of butterfly perch, *Caesioperca lepidoptera* seen hovering over the reef.

| Location | Depth | Observations Seabed | Observations biotic community |
|----------|-------|---|--|
| 69-1 | 36 | solid reef 75% with areas of fine sand and light silt overlaying reef surface, reef is undulating verticle height approx. .5 m, area of fine sand (25%) with some silt sediment with some shell fragments | areas of reef not covered with silt and sand have numerous small patches of encrusting sponge species and some areas of coralling paint algae, three species, 5 specimens of massive grey sponges are present one being <i>Geodia regina</i> and the other unidentified, one finger sponge <i>Iophon proximum</i> is present, several small specimens of foliose red algae, cup corals |
| 69-2 | 36 | flat solid reef with small deposits of fine sand | numerous encrusting sponge species, 3 massive grey sponges, (2) <i>Anchorina alata</i> and (1) <i>Geodia regina</i> , 1 orange finger sponge, <i>Pararhaphoxya sinclairi</i> , an upright irregular unidentified calcareous white sponge, areas of coralling paint algae, several small specimens of foliose red algae, cup corals, thecate hydroids |
| 69-3 | 36 | low relief undulating reef 30% cover, fine and meduim sand with shell chip and some silt 70% cover | numerous encrusting sponge species, 1 samll unidentified grey sponge and 1 small sponge <i>Iophon proximum</i> 3 massive grey sponges, two smal unidentified white sponges, areas of coralling paint algae, several small specimens of foliose red algae, cup corals |
| 69-4 | 36 | coarse sand and small amounts of gravel, with considerable shell hash and some larger shell fragments, period approx. 1m and orientation 150°-337°, ridge height approx 15cm | no large >1cm epifauna observed |
| 69-5 | 36 | coarse sand and with gravel noticeable on ridges, with shell hash and some silt in the troughs of sand waves, sand wave period approx. 1.5m and orientation 135°-315, ridge height approx 20cm | no large >1cm epifauna observed |

Table 5 Observations of photo series for sample location 69

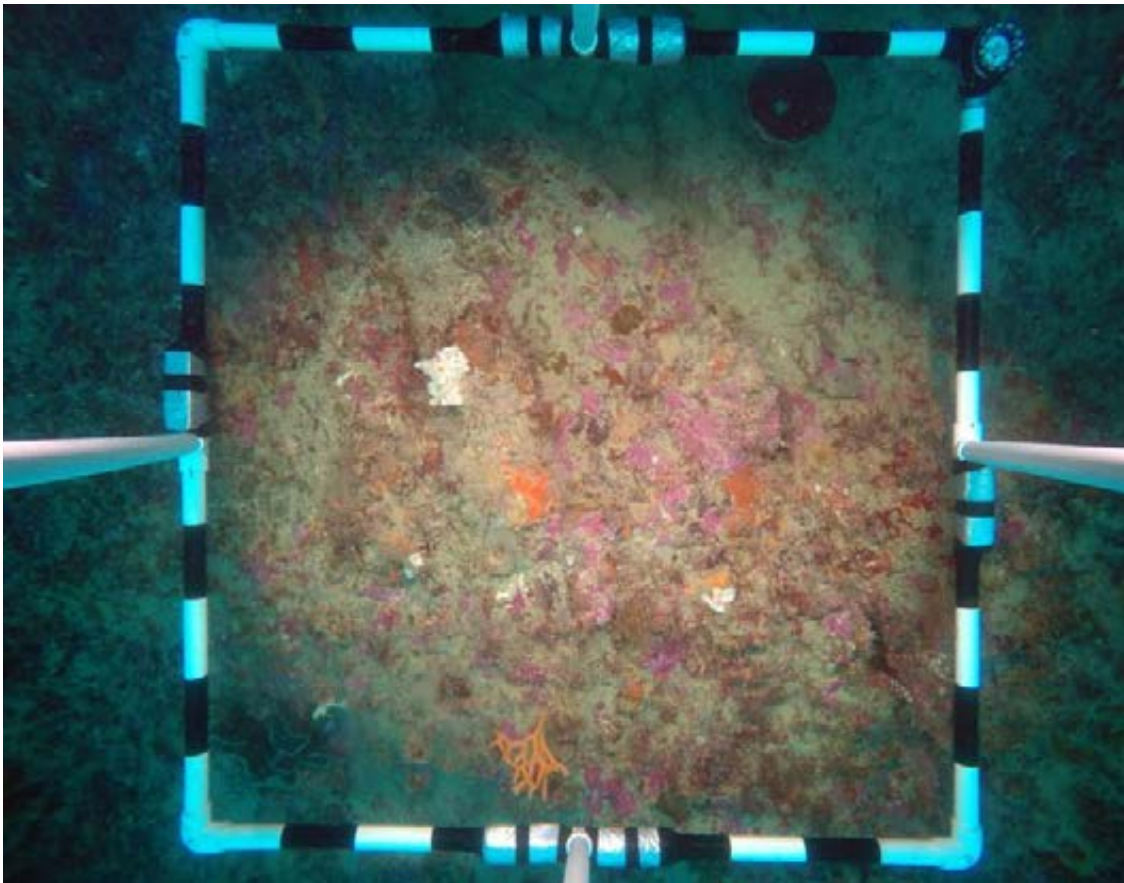


Figure 9 Sample location and replicate, *Anchorina alata* grey sponge lower left corner, grey sponge *Geodia regina* , top right, orange finger sponge, *Pararhaphoxya sinclairi* center bottom, and an upright irregular unidentified white sponge centre left

2.6 Sample location 67

General observations:

This location appeared to be soft sediment habitat but one area of patch reef was seen when lowering and raising photo frame.

| Location | Depth | Observations Seabed | Observations biotic community |
|----------|-------|---|--|
| 67-1 | 37 | coarse sand, with shell hash, sand waves present, sand wave period approx. 2m and orientation 135°-315, ridge height approx 20cm | no large >1cm epifauna observed, small amount of drift algae present |
| 67-2 | 37 | coarse sand, with shell hash, sand waves present, sand wave period approx. 2m and orientation 135°-315, ridge height approx 20cm | no large >1cm epifauna observed, small amount of drift algae present |
| 67-3 | 37 | coarse sand, with shell hash, sand waves present, sand wave period approx. 2m and orientation 135°-315, ridge height approx 20cm | no large >1cm epifauna observed, small amount of drift algae present |
| 67-4 | 37 | coarse sand, with shell hash, sand waves present with shell fragments in trough, sand wave period approx. 1.5m and orientation 135°-315, ridge height approx 20cm | no large >1cm epifauna observed, small amount of drift algae present |
| 67-5 | 37 | coarse sand, with shell hash, sand waves present with shell fragments in trough, sand wave period approx. 1.5m and orientation 135°-315, ridge height approx 20cm | no large >1cm epifauna observed, small amount of drift algae present |

Table 6 Observations of photo series for sample location 67

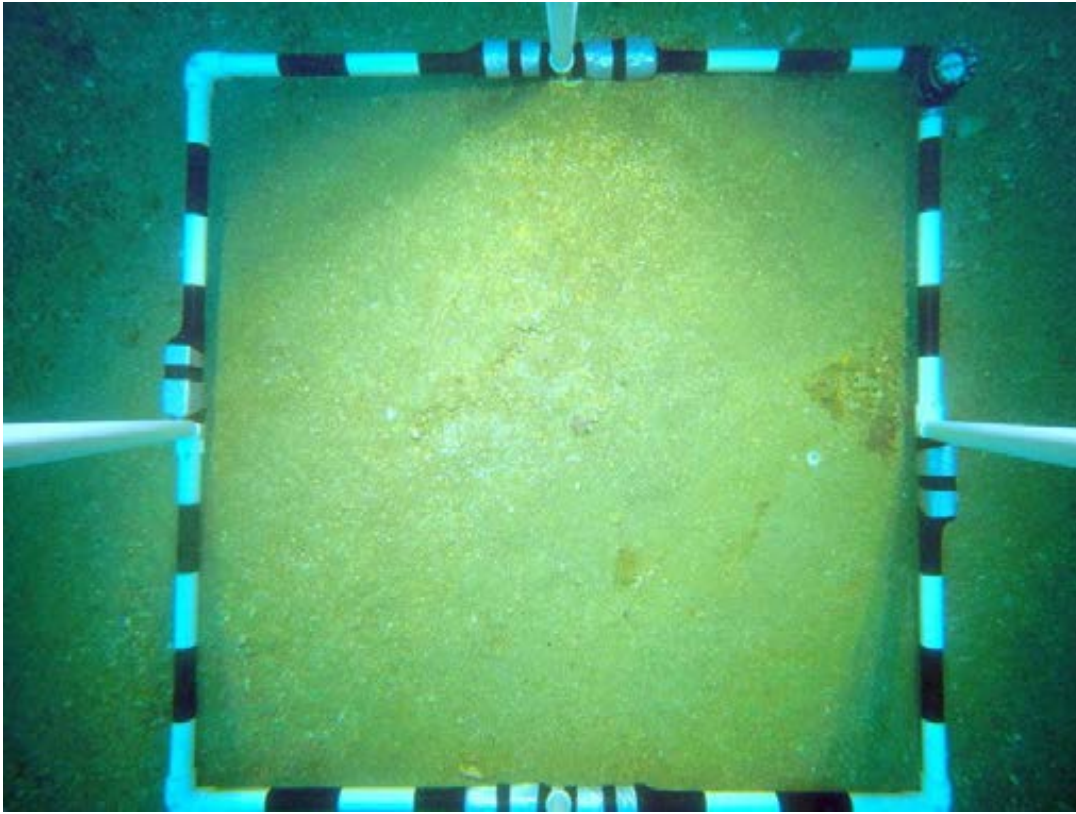


Figure 10 Sample location and replicate 67-2

2.7 Sample location 70

General observations:

This location was patch reef with areas of reef seen consistently along with soft sediment habitat while lowering and raising the photo frame.

| Location | Depth | Observations Seabed | Observations biotic community |
|----------|-------|---|--|
| 70-1 | 39 | undulating solid reef 90% cover, 10% fine to medium sand gutter 20% | healthy encrusting invertebrate community, numerous encrusting sponge species, one specimen of massive grey sponge <i>Geodia regina</i> , coralline paint algae, small red foliose algae, cup corals |

| | | | |
|------|----|--|---|
| 70-2 | 39 | coarse sand, with shell hash, some silt and shell fragments noticeable in troughs, small amounts of gravel present, sand wave period approx. 1.5m and orientation 135°-315, ridge height approx 20cm | no large >1cm epifauna observed |
| 70-3 | 39 | coarse sand, with shell hash, some silt and shell fragments noticeable in troughs, small amounts of gravel present, sand wave period approx. 1.5m and orientation 135°-315, ridge height approx 20cm | no large >1cm epifauna observed |
| 70-4 | 39 | undulating solid reef 50% cover, 50% fine to medium sand gutter | healthy encrusting invertebrate community, numerous encrusting sponge species, coralline paint algae, several species of small red foliose algae, cup corals numerous |
| 70-5 | 39 | undulating solid reef 30% cover, 70% fine to medium sand gutter | healthy encrusting invertebrate community, numerous encrusting sponge species, one unidentified upright white sponge, two grey massive sponges unidentified, one small specimen of grey sponge <i>Geodia regina</i> , one calcareous sponge <i>Leucetusa lancifer</i> , coralline paint algae, several species of small red foliose algae, cup corals |

Table 7 Observations of photo series for sample location 70

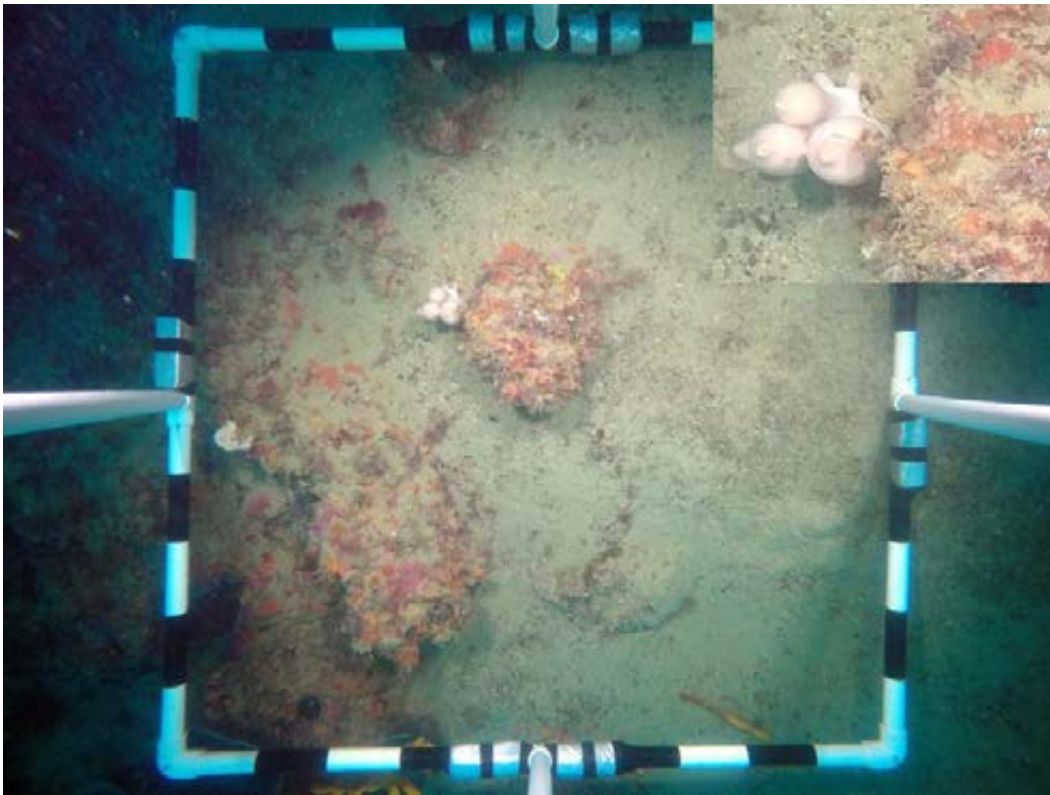


Figure 11 Sample location and replicate 70-5, note inset enlargement of calcareous sponge, *Leucetusa lancifer*

3 Discussion

3.1 General Observations

The reef system locally known as Three Mile Reef is a rocky reef habitat feature located near the centre of Bream Bay with its predominantly soft-sediment habitats. The reef is sizeable in area, being close to 1.5 - 2km across, and roughly shaped like a clover leaf. It is situated at an important depth transition zone of approximately 27m to over around 37m in depth. Within this depth range there is a habitat transition of macro-algal dominated communities in the shallower parts to about 30-33m, changing beyond this to habitats that are dominated by encrusting and filter feeding invertebrate communities, notably the sponges. In our survey, we observed this expected difference of communities in the depth ranges. In terms of its vertical complexity much of Three Mile Reef appears to be very gentle rolling to flat with substantial areas of patch reef mixed with areas of

soft sediment. These patch reef and complex edge communities between soft sediment and hard reef are considered ecologically important; many species forage between the two habitats or use the reef edge and reef to seek shelter.

One observation we made from this photo survey was that in almost all locations sampled, the size of the encrusting species was almost uniformly small, and in some cases very small. This raises the possibility that large parts of Three Mile Reef are occasionally subject to sand scouring from large swells passing over the reef and creating violent movement of the sediments on and near the reef. Following these disturbances, the reef's encrusting community recovers and the species re-colonises available space. Overall the health of the encrusting invertebrate community we observed was high and diversity of species is comparable with reefs of this type and depth in the region, albeit with the scarcity of large specimens of some of the species.

4 Acknowledgements

We would like to thank Sarah Gardiner of MetOcean Solutions for providing us with imagery of multibeam bathymetry data for this area. Catherine Langford provided proof reading of this report.

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6 Appendix 1 GPS coordinates for photo points

| Wpt | Longitude | Latitude |
|------------|------------------|-----------------|
| 65 | 174.5490783 | -35.89963158 |
| 66 | 174.5530756 | -35.9153272 |
| 67 | 174.5686425 | -35.91446323 |
| 68 | 174.5602266 | -35.90780944 |
| 69 | 174.5610701 | -35.9180776 |
| 70 | 174.5700914 | -35.9064159 |
| 71 | 174.5487769 | -35.90392641 |