Deep reef discoveries: Exploration of deep reef biodiversity in the Bay of Plenty

Left: New sponge species “Tumbleweed sponge”, pending a sample. Right: Iophon laevistylis with a bryozoan inside (*cf. Menipea vectifera*).

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1. ABSTRACT

In 2018 the Environment Court determined the creation of three no-take Motiti Protection Areas (MPAs) over coastal reefs around Motiti Island (Figure 2). Local community bodies support different approaches regarding customary fishing and other recreational activities within the area. Due to there being little known about the biodiversity of the deeper reefs and habitat of the wider Motiti Natural Environment Management Area (MNEMA), the Environment Court then issued a directive to the Bay of Plenty Regional Council to gather ecological evidence to inform future decision making about the use of the marine area in the wider MNEMA. This study aimed to investigate Nukutai Reef, one of the prominent deep reefs within the wider MNEMA, in order to inform and provide evidence for discussions around classification of areas within the Bay of Plenty's Regional Coastal Environment Plan (RCEP). A drop camera was used to take video transects at 40-50m depth, being towed behind the boat as it drifted over Nukutai Reef. All species seen in the video transect were identified as close to species level as possible. Ninety-nine different species were seen, showing a high level of biodiversity on the reef. This included ten possibly new and two probably new Porifera and Ascidian species, pending samples to confirm their identification, as well as four naturally rare and six naturally uncommon Porifera species. These results may have significant implications for additional protection measures in the MNEMA under the RCEP, due to Policy 11 in the NZCPS 2010. Moving forward, although a drop camera is a cost-effective and simple way to get a first snapshot of the biodiversity and habit of a deep reef, an ROV is the most suitable method for any further exploration, sampling and monitoring.

2. INTRODUCTION

2.1 Background to this study

This is an investigative study to assess the biodiversity of one chosen deep reef (Nukutai Reef) within the Motiti Natural Environment Management Area (MNEMA) that sits outside the Motiti Protection Areas (Figure 1).

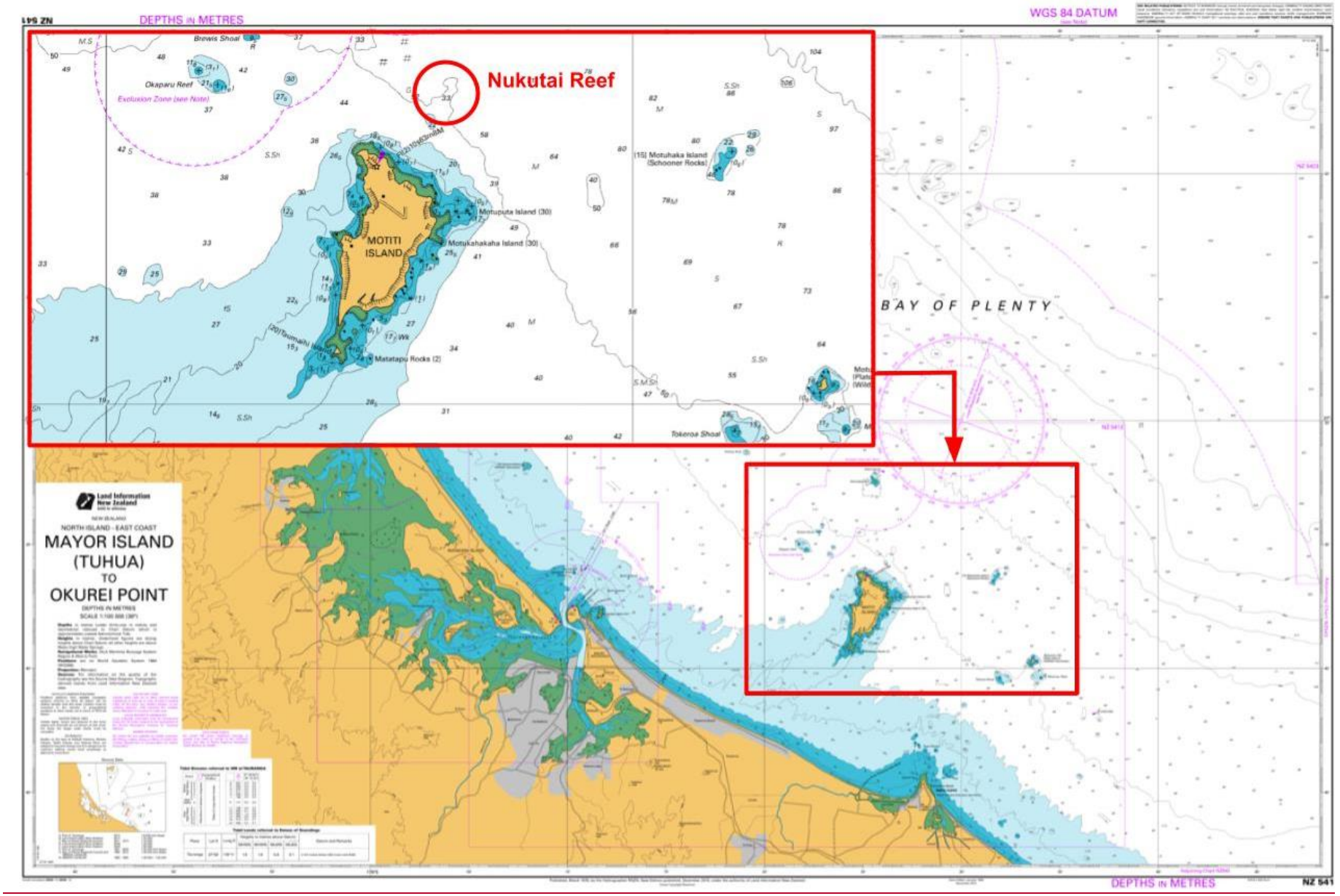

Figure 1. Maritime Chart NZ 541 - Mayor Island (Tuhua) to Okurei Point. Inset picture showing the deep reef chosen for survey; Nukutai Reef (Land Information New Zealand, 2018).

In 2018 the Environment Court determined the creation of three no-take Motiti Protection Areas (MPAs) over coastal reefs around Motiti Island (Figure 2), following public appeals for marine spatial planning to the Proposed Regional Coastal Environment Plan. Local community bodies support different approaches regarding customary fishing and other recreational activities within the area. Due to there being little known about the biodiversity of the deeper reefs and habitat of the wider Motiti Natural Environment Management Area (MNEMA), the Environment Court then issued a directive to the Bay of Plenty Regional Council (BOPRC) to investigate the wider MNEMA in order to provide evidence of biodiversity values for future spatial planning mechanisms in conjunction with tangata whenua, the community, and government authorities (DOC, MPI, DIA).

The need for this study has arisen following the New Zealand Environment Court's Decision in May 2018, in which Section A1 states: "The damage, destruction, removal of flora and fauna within the three Marked Areas of the Motiti Natural Environment Management Area (MNEMA) in the Bay of Plenty Regional Coastal Environment Plan (RCEP) shall be prohibited" ([2018] NZEnvC 067). The Court of Appeal stated that BOPRC has the authority to create and enforce marine protection areas under the Resource Management Act 1991 for the purpose of maintaining indigenous biodiversity, without limitation (Resource Management Act 1991, s 30(1)(ga); *Attorney-General v Trustees of the Motiti Rohe Moana Trust & Ors* [2019] NZCA 532 at [32]; *Motiti Rohe Moana Trust v Bay of Plenty Regional Council* [2020] NZEnvC 50).

The Rohe Moana Trust wishes for the Motiti Protection Areas (Figure 2) to be no-take protection areas, and for the wider MNEMA to be open to sustainable recreational and customary fishing only (ENV-2015-AKL-000-134, at [1]). Since not much is known about the deeper reefs and other habitats in the wider MNEMA, the Environment Court was not able to implement fishing restrictions over the areas outside the Motiti Protection Areas. However, in the final Environment Court Decision ([2020] NZEnvC 50), BOPRC was directed to investigate the wider MNEMA in order to determine whether there are any other significant ecological features that would provide the evidence necessary to make the whole, or parts of, the MNEMA a restricted fishing management area, or for any additional areas of high biodiversity to be classified as Outstanding Natural Features and Landscapes (ONFLs) under the RCEP, and therefore require no-take protection.

A number of methods could be used to fulfill this directive, such as multibeam to determine habitat type and in-detail bathymetry. Marlborough District Council have successfully used multibeam echo sounder to map Queen Charlotte Sounds, Pelorus Sound, Admiralty Bay and French Pass (Marlborough District Council, 2020). The resulting three-dimensional maps allow the Council to identify and target features for sampling with underwater videos, which then assists them in the sustainable management of coastal resources (Marlborough District

Council, n.d.). A variety of survey methods could be implemented to research the rocky reefs in more depth, such as those in Table 1. The reason for focusing more closely on investigating the rocky reefs is that rocky reef structures provide shelter and variety of habitat for marine species, and are therefore likely to be more productive and harbour higher levels of biodiversity than the areas of sand or gravel sea floor (NOAA Fisheries, 2019). These areas of sand or gravel sea floor may have the ability to support highly biodiverse habitats such as those formed by frame-building/habitat-forming bryozoans, but due to destructive bottom-contact fishing techniques (such as dredging, trawling and nets) and that the organisms are slow-growing, these habitats are not given the chance to grow and expand (Wood et al., 2013; Baker et al., 2019).

Table 1. Potential survey methods to map and classify habitats and cultural values in the wider MNEMA.

Survey method	**Required gear**	**Detail**
Multibeam habitat mapping	Multibeam Development of habitat maps next step	Use multibeam data to identify areas with structure indicating reef ecosystems, since current maritime charts and bathymetry data are not detailed or accurate. Identify sites for ROV investigations. Pros: Accurate and can identify sites of interest for further surveying by ROV Cons: Very expensive and doesn't provide visual image of habitat, only the bathymetry
Drop camera video transects	Drop camera	Use drop camera to do video transects by towing behind boat while drifting over reef areas. Pros: Cheap, easy to use, can drop deeper than diving depths. Cons: No ability to look around or take samples, depth limited by pressure limitations on camera equipment.
ROV video transects	Remote operated vehicle	ROV video transects of deep reefs outside of diving limits. Use to also take samples of sponges.
Verbal surveys of cultural values		Verbal surveys of historical and current uses of region from iwi not involved to date.
Dive surveys	Scientific divers	Pros: Can cover large areas. Cons: Divers are depth limited.

2.2 Motiti Protection Areas

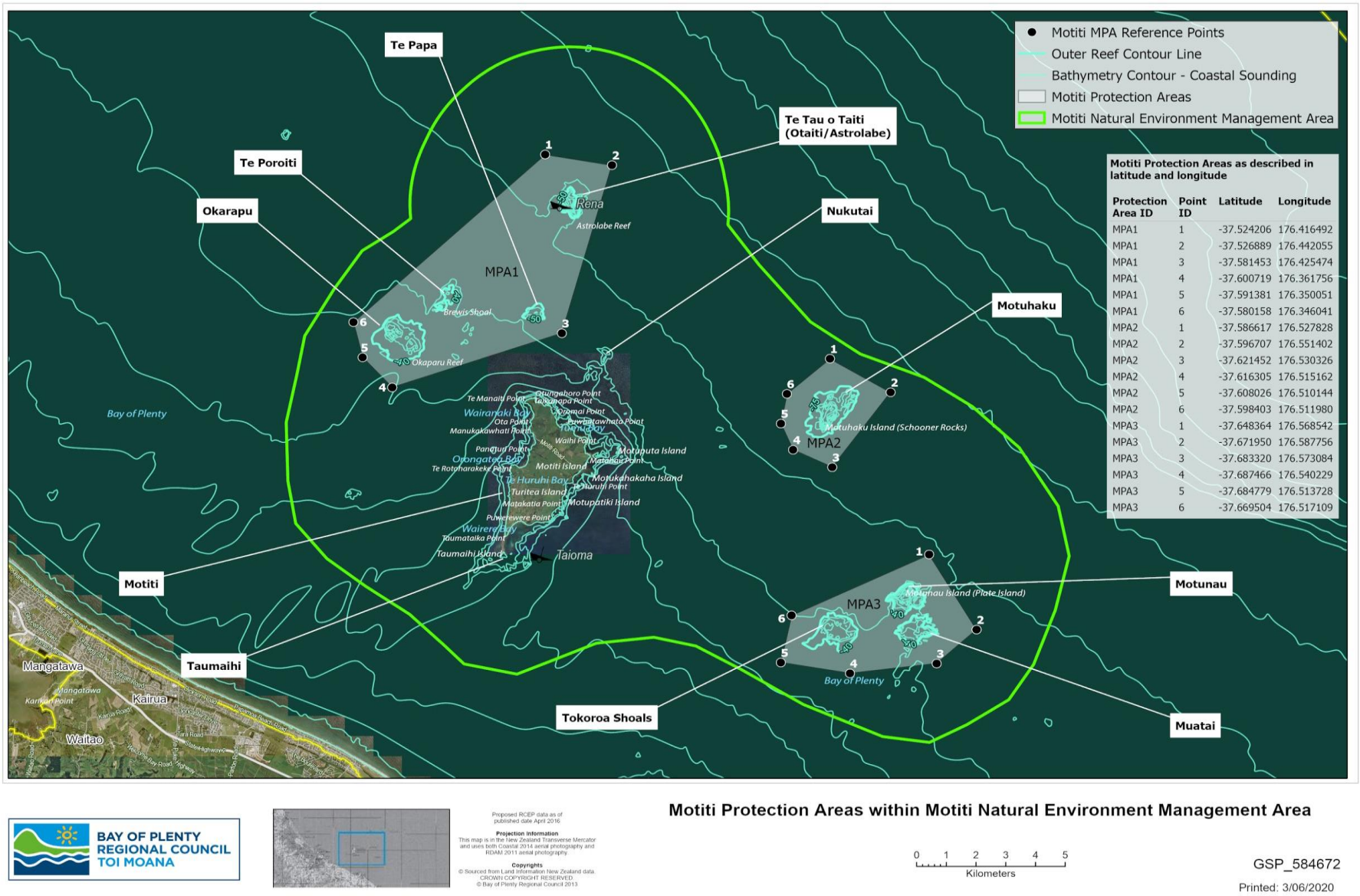

Figure 2. Motiti Protection Areas within Motiti Natural Environment Management Area (Boffa Miskell Limited, 2020).

The reefs required to have no-take protection are grouped into three Motiti Protection Areas (Figure 2). Extensive research on these shallow reef ecosystems has provided the evidence to categorise the main reefs in each MPA as Outstanding Natural Features or Landscapes (ONFLs) under the Regional Coastal Environment Plan – Okarapu reef, Astrolabe reef, Schooner rocks and Plate Island (Figure 3) (BOPRC, 2019; BOPRC, 2020). Motiti Island's margin and associated islands, reefs and shoals have been classified as ONFL 44 because they meet the requirements of Policy 11 in the New Zealand Coastal Policy Statement (NZCPS) 2010 (Department of Conservation, 2010). The key features to note in Policy 11 that are most likely to be useful for the results from this study, are:

To protect indigenous biological diversity in the coastal environment, avoid adverse effects of activities on:

- *indigenous taxa that are listed as threatened or at risk in the New Zealand Threat Classification System lists;*
- *indigenous ecosystems and vegetation types that are threatened in the coastal environment, or are naturally rare.*

If any species or habitats found on the deep reef investigated in this study fall under one of these categories, or any other category under Policy 11 in the NZCPS 2010, then a case may be made by BOPRC or other government agencies to place additional protection over the wider MNEMA through either the RCEP or the Fisheries Act 1996. Any changes would need to be run through a public Plan Change process and include extensive iwi and community consultation before going ahead.

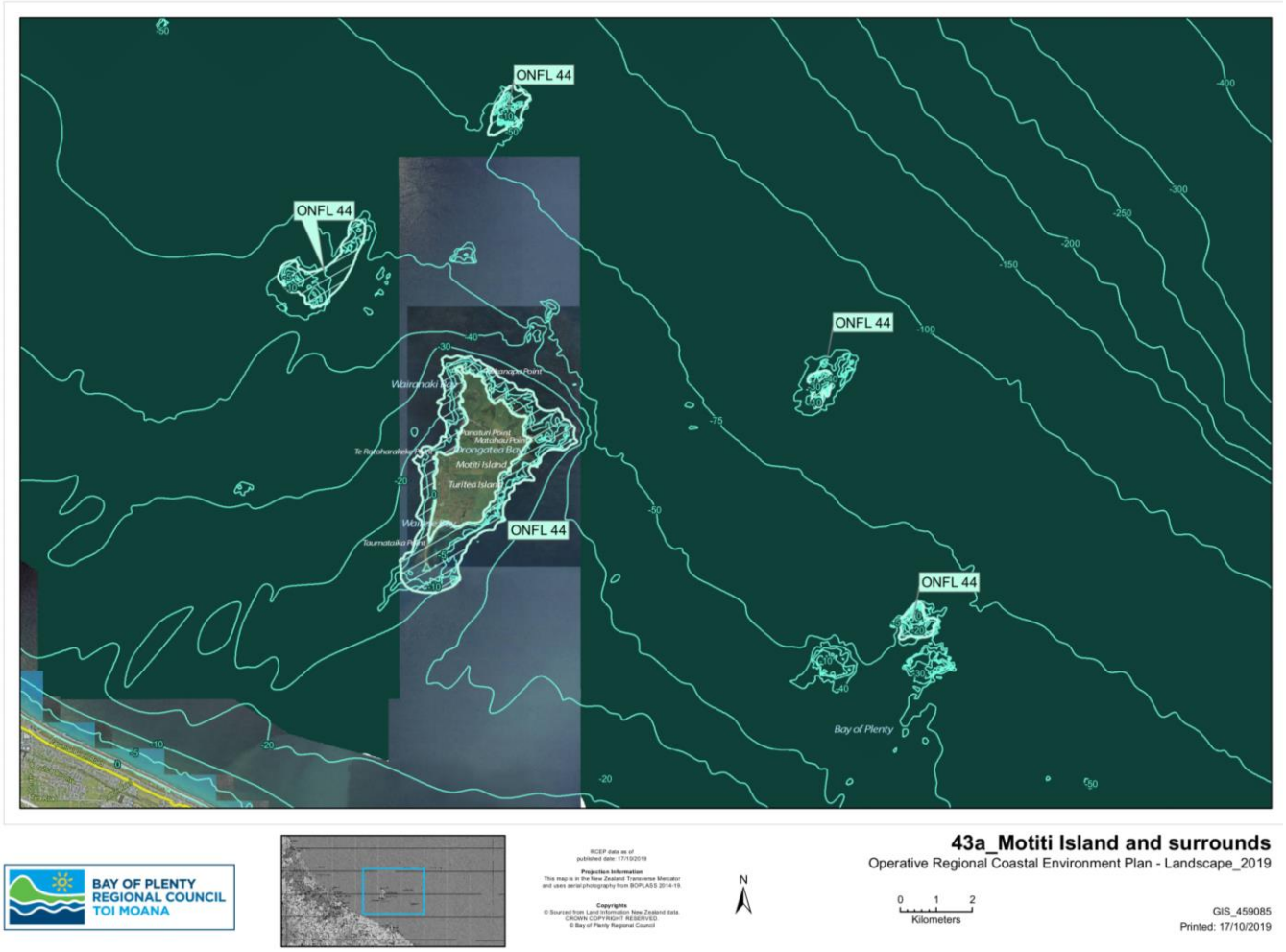

Figure 3. ONFL 44 Map (BOPRC, 2019).

2.2.1 Otaiti/Astrolabe

Otaiti/Astrolabe is the most heavily researched reef in the MNEMA due to the 2011 Rena shipwreck, as monitoring of the after-effects of the oil spill included ecological surveys. The data in the following paragraphs (2.2.1 - 2.2.7) has been sourced from the Rena Physical Environment Reference Report, prepared by Ross et al. (2018) as a condition of BOPRC resource consent RC67891.

Otaiti reef is made up of pinnacles of rock rising from 70m depth to break the surface at mid - low tides. Because the reef rises up from such depths, the distribution of habitat and species on these reefs is highly variable; the main stratifications being depth and surface type. From what is known so far, the shallow and steep sections are mainly composed of bedrock, while the shallow and more flat section have some boulder fields, sand and gravel patches on top of bedrock. As the gradient increases from 40m downwards, the reef surface changes from boulder fields to cobbles, to gravel, to sand and then to seafloor.

Table 2. Otaiti habitat classification from Boffa Miskell Limited (2020).

Depth (m)	Habitat Zone	Description
0 - 5	Shallow mixed algae	Dominated by *Lessonia variegata* and *Carpophyllum flexuosum* and *plumosum*. Subcanopy is fairly dense, containing red and brown algae and a variety of coralline algae.
5.1 - 10	Mixed algae	Dominated by *Carpophyllum flexuosum*. Subcanopy is dense, containing the same species as above.
10.1 - 13	Mixed algae/kelp	Variety of *Carpophyllum*, *Ecklonia radiata* and *Lessonia variegata*. Subcanopy is moderate to sparse, containing red and brown algae.
13.1 - 25	Kelp forest	Dominated by *Ecklonia radiata*, which can be more than 1.4m in height. Subcanopy is moderate to sparse, containing mostly *Zonaria aureomarginata* and crustose coralline algae. Some patches of barren rock, *Evechinus chloroticus* not present at all barren sites.
25.1 - 30	Kelp forest/sponge	Sponges present in the subcanopy of *Ecklonia radiata*.
30.1 - 40	Kelp/sponge transition	Dominated by a variety of sponge species.
40.1 - 55	Deep sponge reef boulders	Dominated by encrusting sponges. *Ecklonia radiata* occur rarely.

The biological communities on vertical and overhanging reef areas at Otaiti are dominated by invertebrates, whereas on flatter surfaces the reef is dominated by canopy--forming macroalgae. There is an abundance of biodiversity on and around Otaiti reef, including "...tarakihi (*Dactylosparus macropterus*), hapuku (*Polyprion oxygeneios*), bass groper (*Polyprion moeone*), kahawai (*Arripis trutta*), trevally (*Araara, Pseudocaranx dentex*), kōheru (*Trachurus novaezelandiae*), scorpion fish (*Matua whaapuku, Scorpaena papillosa*), sea perch (*pūaihakarua, Helocolenus percoides*), banded wrasse (*Notolabrus fuicola*), blue cod (*Rāwaru/Pakirikiri/ Patutuki, Parapercis colias*), butterfish (*Koaea/Mararā/Tarao, Odax pullus*), demoisilles (*Chromis dispilus*), sweep (*hiwihiwi, Scorpis lineolatus*), red and blue moki (Nanua, *Cheilodactylus spectabilis* and Moki, *Latridopsis ciliarus* respectively), pigfish (*Congiopodus leucopaecilus*), black angel fish (*Parma*

alboscapularis), porcupine fish (*Tragulichthys jaculiferus*), snapper (Karati/tāmure, *Pagrus auratus*), blue maomao (Maomao, *Scorpis violacea*), oblique-swimming triplefin (*Obliquichthys maryannae*), spotty (*Notolabrus celidotus*), marblefish (*Aplodactylus etheridgii*), kelpfish (*Parma alboscapularis*), leatherjacket (*Parika scaber*), kingfish (*Seriola lalandi*), shark (species not identified)... sting ray (Whai, *Bathytoshia brevicaudata*), eagle ray (Whai keo, *Myliobatis tenuicaudatus*), octopus (Wheke, *Macroctopus maorum*), fur seal (Kekeno, *Arctocephalus forsteri*)... [and] common dolphin (*Delphinus delphis/capensis*)...” (Boffa Miskell Limited, 2020).

2.2.2 Okarapu Reef

Okarapu reef also consists of pinnacles of rock rising up from 26m to 5m beneath the surface at low tide, at its shallowest point. The only known published scientific report about the ecology of this reef was published by Gregor & Young (2013). Their research revealed that the ecology of Okarapu Reef is very similar to that of Otaiti.

2.2.3 Te Poroiti Reef

Te Poroiti Reef is made up of a series of rock pinnacles, the shallowest of which rises from a maximum depth of 42m, to 6m beneath the surface at low tide. There are no known ecological publications about Te Poroiti, but anecdotal observations from Wilkinson (2016) and Dr Phil Ross speak of hapuklu, terakihi, kingfish, crayfish and sponges inhabiting the reef (Wilkinson, B.W., 2016; anecdotal observations of Dr Phil Ross).

2.2.4 Te Papa Reef (Brewis Shoal)

Te Papa Reef, also known as Brewis Shoal, rises up from 59m at its deepest point, to 33m at its shallowest at low tide. There are also no known scientific publications on the ecology of this reef.

2.2.5 Motukaku Island (Schooner Rocks)

Motukaka Island, also known as Schooner Rocks, rises up from a maximum depth of 77m and breaks the surface at the southern end. The ecology on this reef is comparable to Otaiti and Okarapu.

2.2.6 Motunau (Plate Island)

Motunau, also known as Plate Island, is a reef system consisting of two main reefs: Motunau and Muatai. Motunau has a maximum depth of 58m and rises up to break the surface, while Muatai, just 500m south, has a maximum depth of 50m and rises up to 10m at its shallowest point. The deep rift in between the reefs harbours deep water species that live in shallow water, such as cup sponges, hydroids and bryozoans (Boffa Miskell Limited, 2020). According to multiple sources, hapuku, tarakihi, blue maomao, snapper and kina are known to be present on this reef system (Wilkinson, B.W., 2016; Kahotea, 2016; Wilkinson, A.G., 2016).

2.2.7 Tokoroa Shoal

Tokoroa shoal rises up from a maximum depth of 51m, to just 4m the surface at its shallowest point, at low tide. There are also no known scientific publications on the ecology of this reef.

2.3 Wider Motiti Natural Environment Management Area (MNEMA)

In the Regional Coastal Environment Plan, the MNEMA is classified as an area of significant conservation value (ASCV 25) due to its rich Māori history (BOPRC, 2019). Despite this, little is known about the ecology of the area, outside of what has been described previously in this report - with the exception of the coastal margin of Motiti Island itself.

2.4 Fishing methods in the MNEMA

Trawling, dredging, seining, lining, passive netting and potting are the current fishing methods being employed within the MNEMA, with the highest bottom contact fishing effort for the period 2007 - 2017 being to the south-east and north-east-east of Motiti Island (Boffa Miskell Limited, 2020). As can be seen in Figure 4, the MNEMA is subject to heavy commercial fishing (ENV-2015-134 at [page 969]).

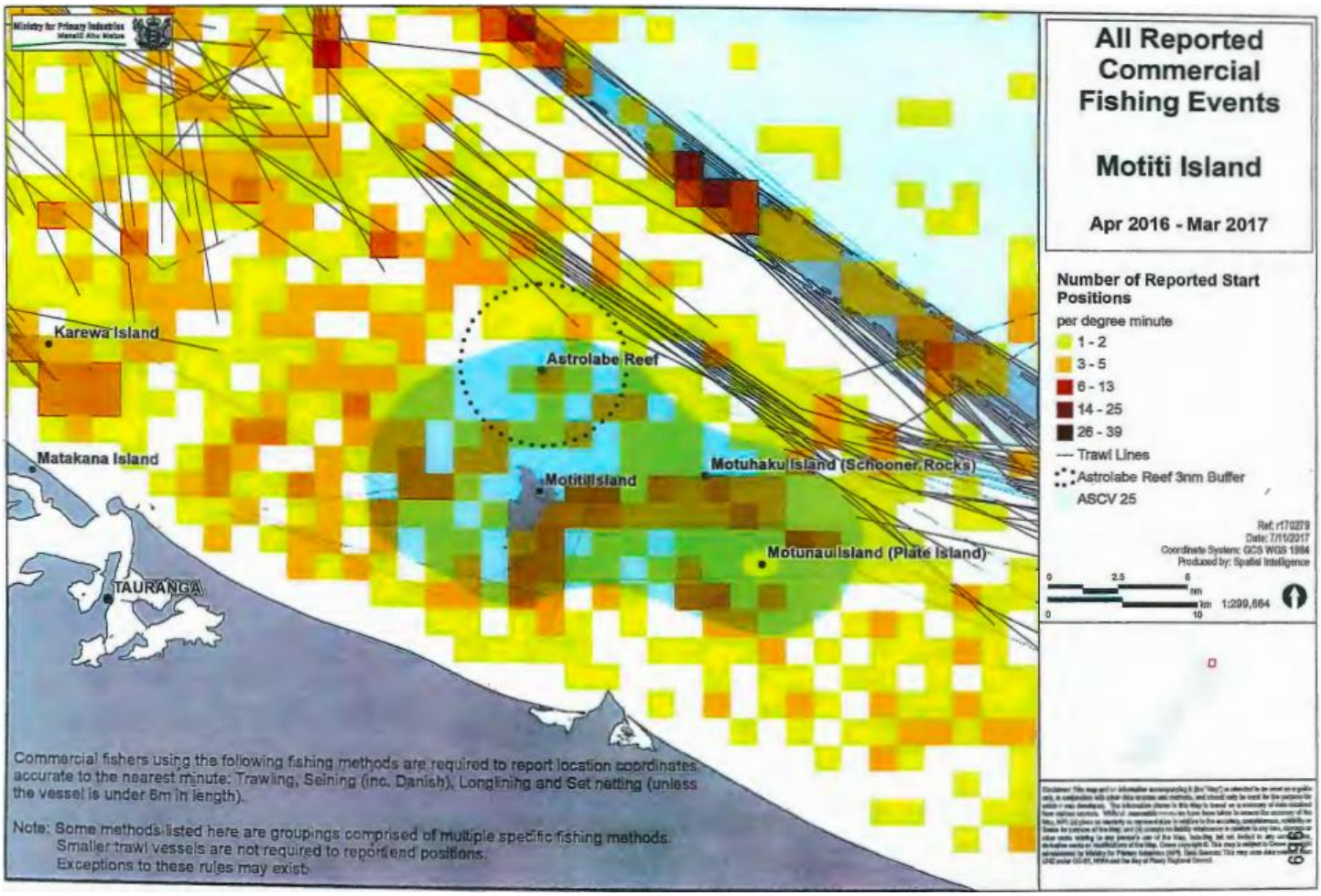

Figure 4. All reported commercial fishing events around Motiti Island for the period 2016 - 2017 (ENV-2015-134 at [page 969]).

2.5 Drop camera

There is very little information on the biodiversity of reefs in the MNEMA below approximately 30m depth because they are deeper than the 30m limit for occupational scientific diving (Boffa Miskell Limited, 2020). The technological advances of surveying and photography equipment such as drop cameras have allowed scientists to bypass the depth and time limitations of diver surveys. Drop cameras can be used to take quick underwater snapshots of an area, while also being very cost-effective and simple. Using a drop camera is also non-destructive in comparison to dredging or fishing survey methods. Due to the depth and variable bathymetry of the reefs chosen for surveying in this study, the nature of the surveying being undertaken, and time constraints, drop camera video transects were deemed the most suitable survey method.

Drop camera surveys have been done by the University of Waikato in the past, so their expertise has contributed significantly to the methods used in this study and the design of the drop camera. The tether attached to the camera is approximately 60m long, so it was lowered to no more than 50m to allow for curve in the cable as it was pulled horizontally through the water by currents. Live feed was supplied to an Atomos Samurai Blade monitor and recorder on board the boat through the tether. The drop camera records in 1080hp but produces low frame resolution when paused, so a GoPro was also attached to the drop camera frame. The GoPro provided high definition still images, which is necessary to identify species in the footage. The drop camera recorded back-up video and provided a live feed. The drop camera on the frame with all attachments weighed no more than 6kg to ensure that minimal stress is placed on the drop camera tether, and so that it could be safely lifted into and out of the water from the boat. The other components of the drop camera are: wooden mounting blocks; hollow steel and plastic garden stake; two dive torches; GoPro Hero 8 Black with waterproof housing; two 1kg lead dive weights; and a hard plastic buoy for pressure resistance at depth (Figure 5).

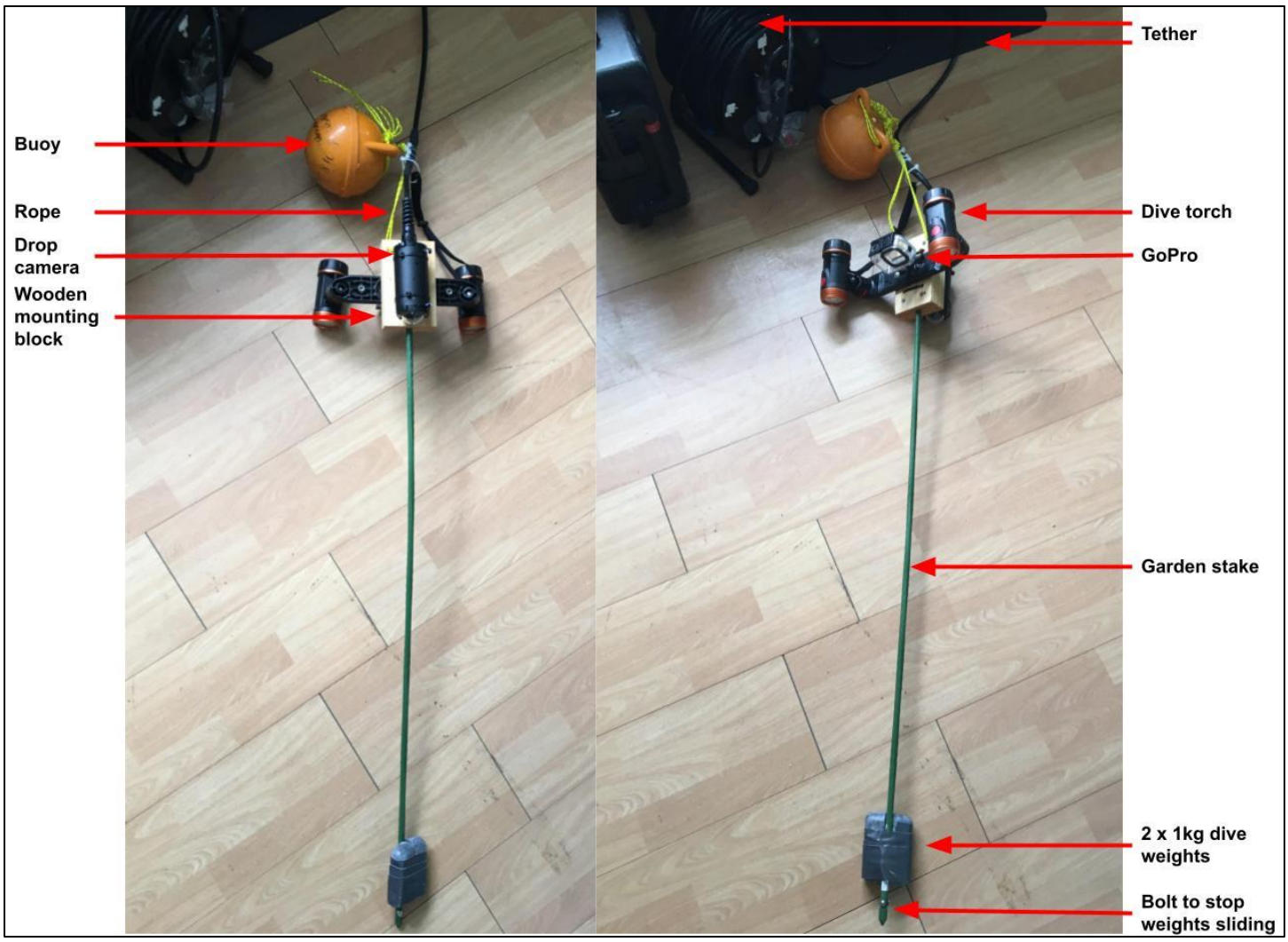

Figure 5. Front and back of drop camera.

Scientific studies in the past have used drop cameras for a range of different purposes in marine habitats, such as observation of epibenthic megafauna (Yesson *et al*., 2016), habitat mapping, fish abundance and fish assemblage information (Easton *et al*., 2015), and macroinvertebrate surveying (Bethoney & Stokesbury, 2018).

3. RATIONALE

The purpose of the Environment Court's directive for the Regional Council to investigate the wider MNEMA area was to allow for classification of these areas within the RCEP. Once the habitats and biodiversity of deeper reefs within the MNEMA are known, then this information can be used by environmental managers to determine whether any further imposition of fishing controls is required; such as changes to the boundaries of no-take areas, addition of no-take areas around newly identified ONFLs, or creation of restricted fishing management areas in the wider MNEMA for recreational fishing only.

4. AIMS

This study aims to investigate the biodiversity of Nukutai Reef, one of the prominent deep reefs within the wider MNEMA (Figure 1), in order to inform and provide evidence for discussions around classification of areas within the Bay of Plenty's RCEP. The data from this study will also contribute to future assessments of any changes in biodiversity over time in the MNEMA.

5. METHOD

Nukutai Reef was the deep reef chosen for surveying with the drop camera because it is deeper than SCUBA diving depths, within the MNEMA but not in one of the MPAs, and has reef in the 40-50 m range which is probably the maximum depth of current drop camera system. Multibeam data of Motiti Island and surrounding reefs does not reach all the way out to the deep reefs, so BOPRC bathymetry data and navigational charts were used to select Nukutai Reef as the survey site, by looking for sharp spikes in depth indicating potential for biogenic habitat. Nukutai Reef is small and deep, rising from approximately 50m to 40m depth and spanning around 160,000 m^2 (Figure 6).

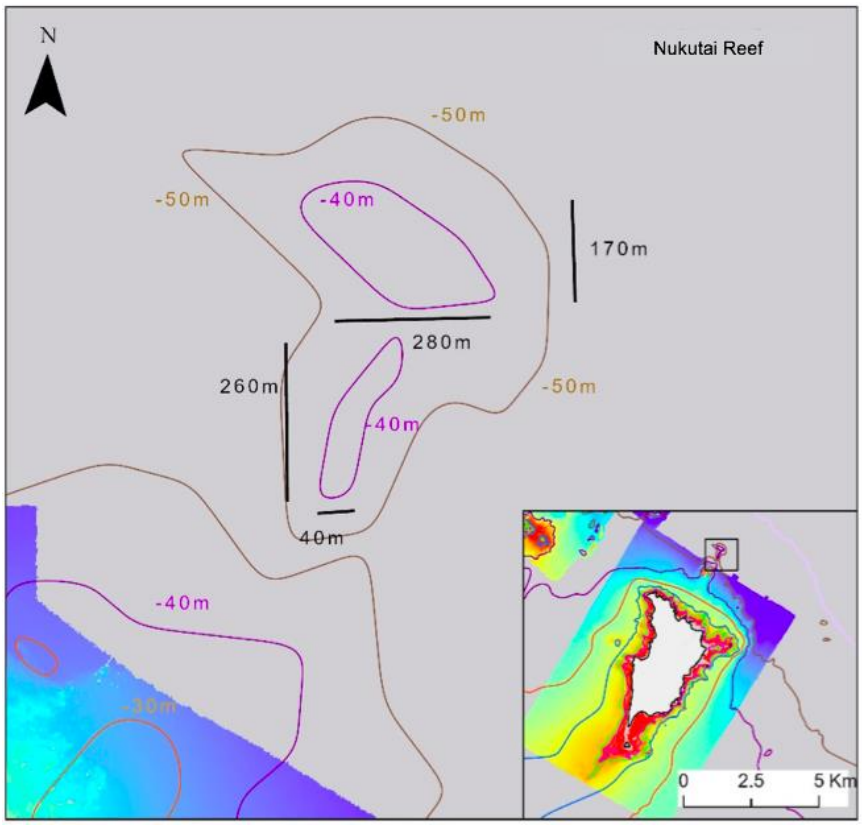

Figure 6. Nukutai Reef size and bathymetry.

Sampling took place in February 2021, from the University of Waikato vessel, Tai Rangahau. Tai Rangahau was chosen due to its large open deck space and shaded cabin area, which provides both space for the drop

camera operation on deck and shelters the live feed monitor inside the cabin (Figure 7). The large deck area also allows space for coiling the tether of the drop camera on deck. Everything apart from personal food and medication needed on the day was supplied by Bay of Plenty Regional Council and the University of Waikato. Each person on board had a role in the operation of the drop camera; one person coiled the tether and managed the depth of the drop camera, one person watched the monitor and told the coiler to move the drop camera up or down in the water, one person recorded notes and one person waited in reserve to step into a role (Figure 7).

Figure 7. Photos from fieldwork on 19/02/2021.

On arrival at Nukutai Reef, it was clear that the maritime chart and bathymetry data was inaccurate. To find the reef, the boat was driven around the area until steep inclines in depth were seen on the sounder. The boat was then stopped, and engines cut to see which way the current was making the boat drift. Once drift direction was determined, the boat was moved to about 30m up-current of the reef and engines were turned off again. The drop camera was lowered, and a video transect recorded as it was towed over the reef behind the drifting boat. The live feed was used to keep the camera just above the seafloor, as the person watching the monitor would tell the person coiling the cable to pull the drop camera up and down as needed, to avoid the camera scraping along the bottom. This was repeated for four transects, each one starting at different points along the up-current side of each reef area. GPS waypoints were created at the beginning and end of each transect to map the surveyed area (Figure 8).

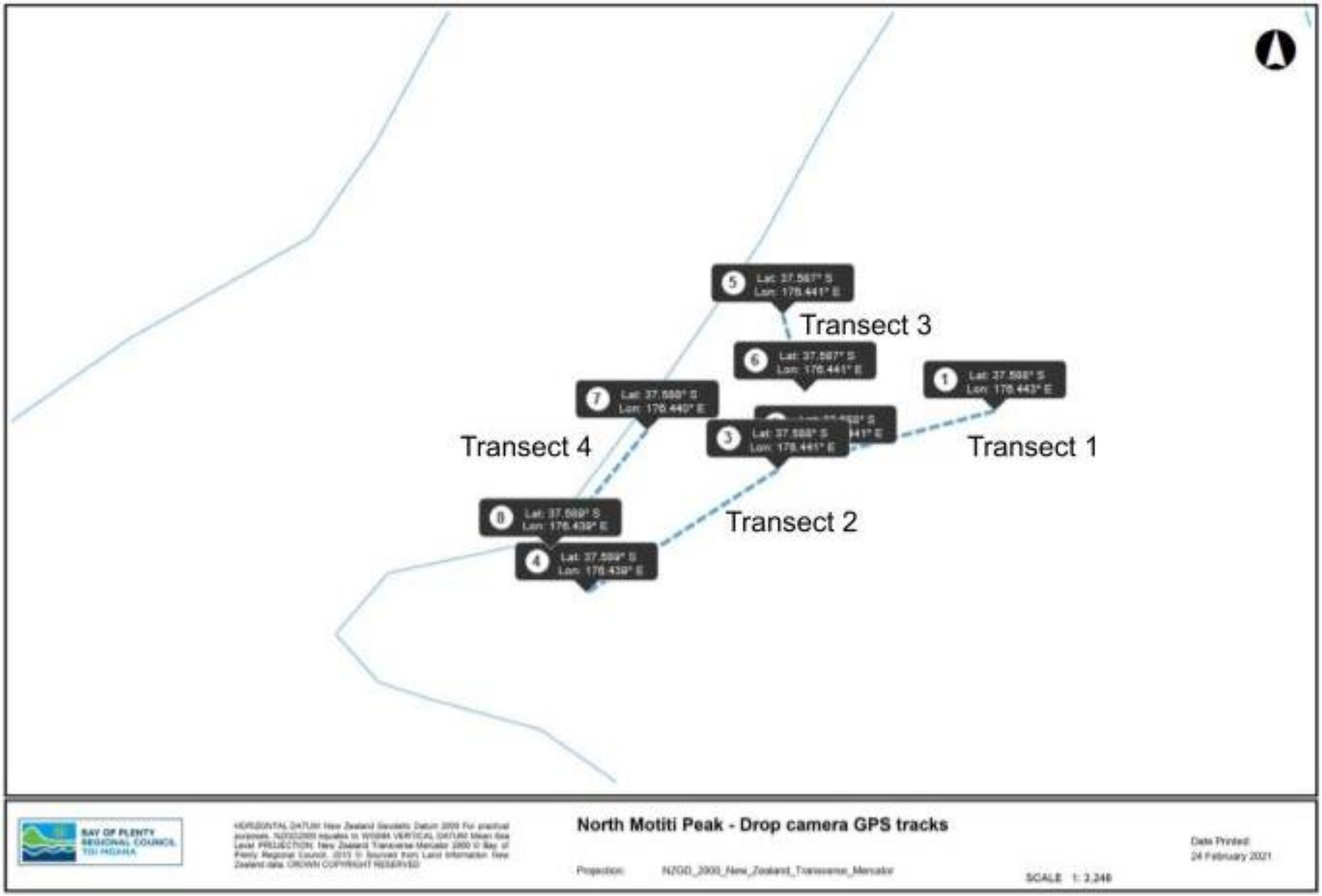

Figure 8. Mapped drop camera video transects.

Analysis of the videos took place in February and March 2021. Due to time constraints, only Transect 1 was analysed (Figure 8). The video transect was watched in real time and a list of species, including possible new species, was compiled. Screenshots were also included to show each species and information about which transect it was first recorded on, with a timestamp for each video file. All identified species were cross-referenced against the New Zealand Threat Classification System lists. Data is stored within the BOPRC Objective at folder ID A1154161.

6. RESULTS

The total species diversity seen across video transect 1 was 99 different species. Images of all the species found in transect 1 can be seen in the ID guides below (Tables 3 - 9). It is important to note that some of the species identifications cannot be confirmed until samples can be taken. It is also important to understand that the species diversity value of 99 does not represent the whole ecosystem on Nukuati Reef or in the MNEMA, only the limited species diversity that could be seen through the lens of the GoPro used. Please refer to Appendices A - G for the raw data.

On analysis of video transect 1, it was with great excitement that two probably new, as well as eight possibly new, sponge species were discovered (Table 4). Two specimens have also been identified that may be new sponge or sea squirt (Ascidian) species (Table 9). Common names have been given to these species for ease of discussion in this report (Please refer to Appendices B and G). New distributions were discovered for twenty one other sponge species, one ascidian and one bryozoan species, as these species have not been recorded in the Bay of Plenty region before now (Tables 10-12). None of the Porifera, Cnidaria, Bryozoan, Echinodermata, or Ascidian species found were on the NZ Threat Classification System lists and the Department of Conservation does not have a list for marine fish. However, ten of the sponge species found are naturally rare or uncommon (Table 10).

The habitat seen throughout the video transect was a large boulder habitat with what looked to be a ~1cm layer of fine deposited sediment covering the top surface of most boulders.

Table 3. MNEMA Fish ID Guide.

FISH of Motiti Natural Environment Management Area, **NZ**

Emma Donald, supervised by Dr Phil Ross
University of Waikato & Bay of Plenty Regional Council **Version 1 03/2021**

Photo order: In sequence of first seen during video transect.
Photos by: University of Waikato, taken by GoPro on a drop camera frame. Produced by: Emma Donald.
Contact: emmapaigedonald@gmail.com. Support from **Prof Chris Battershill**, **University of Waikato** and **Josie Crawshaw, Bay of Plenty Regional Council**.

			
1 Butterfly Perch *Caesioperca lepidoptera*	**2 Blue Cod** *Parapercis colias*	**3 Yellow-black Triplefin** *Forsterygion flavonigrum*	**4 Sea Perch** *Helicolenus percoides*
			
5 Scarlett Wrasse *Pseudolabrus miles*	**6 Leatherjacket** *Parika scaber*	**7 Golden Snapper** *Centroberyx affinis*	**8 Tarakihi** *Nemadactylus macropterus*
			
9 Splendid Perch *Callanthias australis*	**10 Snapper** *Pagrus auratus*	**11 Red Pigfish** *Bodianus unimaculatus*	**12 Goatfish** *Upeneichthys lineatus*
			
13 Red Moki *Cheilodactylus spectabilis*	**14 Slender Roughy** *Optivus elongatus*	**15 Southern bastard red cod** *Pseudophycis barbata*	**16 Halfbanded Perch** *Hypoplectrodes dimidius*
			
17 Blue Mao Mao *Scorpis violacea*	**18 Pink Mao Mao** *Caprodon longimanus*	**19 Oblique-swimming Triplefin** *Obliquichthys maryannae*	**20 Porae** *Nemadactylus douglasii*

Table 4. MNEMA Sponge ID Guide.

SPONGES of Motiti Natural Environment Management Area **New Zealand**

1

Emma Donald, supervised by Dr Phil Ross
University of Waikato & Bay of Plenty Regional Council

Version 1 03/2021

Photo order: In sequence of first seen during video transect.
Photos by: University of Waikato, taken by GoPro on a drop camera frame. Produced by: Emma Donald.
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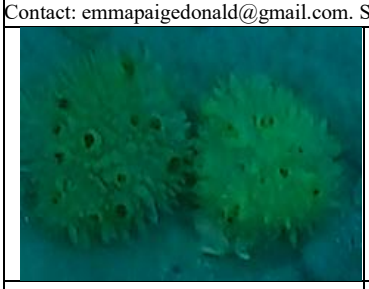
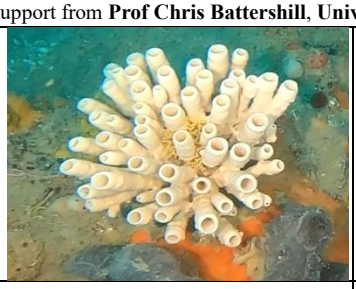


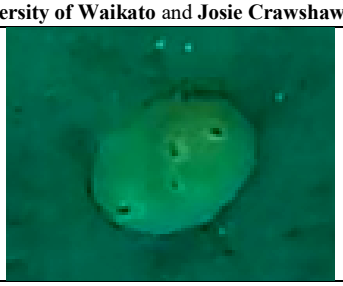
1 ***Polymastia crocea***

POLYMASTIIDAE



2 ***Iophon laevistylis***

ACARNIDAE



3 ***Suberites* sp.**

SUBERITIDAE

4 ***Dendrilla cf. rosea***

DARWINELLIDAE

5 ***Darwinella cf. gardineri***

DARWINELLIDAE

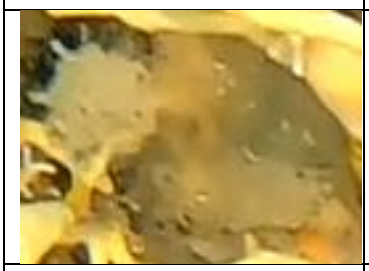
6 ***Xestospongia coralloides***

PETROSIIDAE

7 ***Callyspongia cf. ramosa***

CALLYSPONGIIDAE

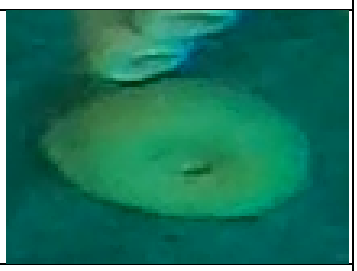
8 ***Clathria cf. macrotoxa* / *cf. Dragmacidon australis***
MICROCIONIDAE / AXINELLIDAE



9 **Possibly new *Haplosclerida* species**
Look at *Haliclona brøndstedi* or *Haliclona venustina*

10 **Calcareous sponge or possibly *Polysyncraton***

11 **Probably new species**
Look at *Haplosclerid callyspongia* and *Homaxinella balfourensis*



12 ***Suberites australiensis***

SUBERITIDAE

13 **Possibly new species**
cf. Suberites australiensis

14 **Possibly new *Aplidium***
But check *Psammocinia perforodorsa*

15 ***cf. Aaptos conferta***

SUBERITIDAE

16 ***Petromica sp.* and possibly *Polymastia echinus***
DESMANTHIDAE / POLYMASTIIDAE

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2

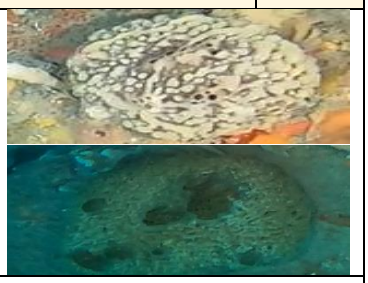
17 ***cf. Hamigera tarangaensis***

HYMEDESMIIDAE

18 ***Ecionemia alata***

ANCORINIDAE

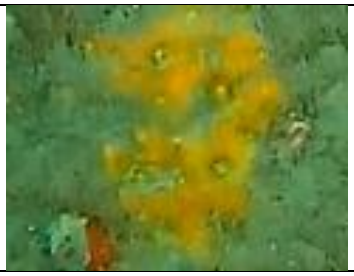
19 ***Polymastia* sp.**
cf. massalis
POLYMASTIIDAE



20 **Polymastia cf. massalis**

POLYMASTIIDAE

21 **Possibly a Choristid or Hadromerida**



22 ***Cliona cf. celata***

CLIONAIDAE

23 ***cf. Steyla plicata* mixture with sponge *cf. Sycozoa sigillinoides***

24 **Probably new species**
For genus, check *Petrosia* or *Xestospongia*

25 ***cf. Raspailia topsenti***
But check *Trachycladus stylifer*
RASPAILIIDAE / TRACHYCLADIDAE

26 ***cf. Tedania battershilli / Clathria* sp. / *Crella* sp.**
TEDANIIDAE / MICROCIONIDAE / CRELLIDAE

27 ***Homaxinella erecta***

SUBERITIDAE

28 ***Pararhaphoxya sinclairi***

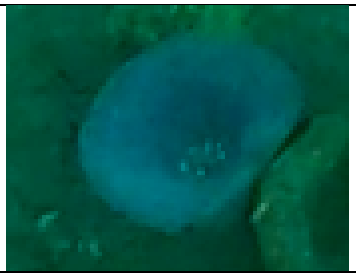
AXINELLIDAE

29 ***cf. Polymastia* sp.**

POLYMASTIIDAE

30 ***Geodina regina***

GEODIIAE



31 ***Psammocinia cf. hawere***

IRCINIIDAE

32 **Possibly new species**
Look at Order Poecilosclerida
MYCALE / CHONDROPSIS / DESMACELLA

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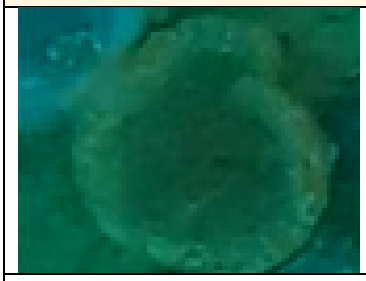
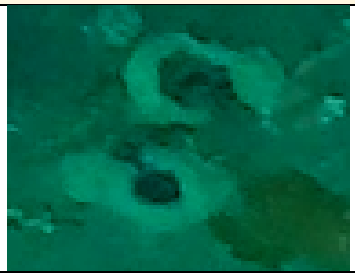
3

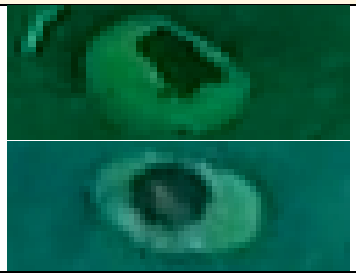


33 ***Stelletta maori***

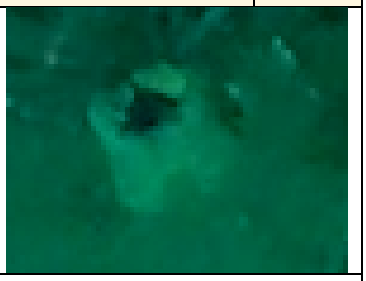
ANCORINIDAE



34 **Unidentified sponge**



35 **Unidentified tiny cup sponge**



36 **Unidentified castle sponge**

37 ***Stelletta crater*** **covered by** ***Desmacella dendyi***

ANCORINIDAE & DESMACELLIDAE

38 ***cf. Asiculites / Petrosia***

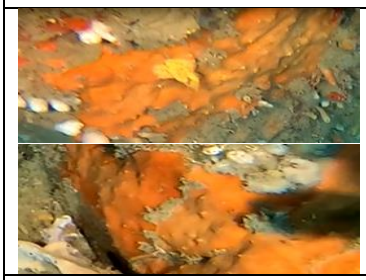
SCLERITODERMIDAE / PETROSIIDAE

39 ***Clathrina*** **sp.**

CLATHRINIDAE

40 ***Desmacidon*** **sp.**

DESMACIDIDAE



41 **Possibly** ***Phorbas anchorata***
But check *Clathria* sp.

HYMEDESMIIDAE / MICROCIONIDAE

42 ***Haplosclerid***
Callyspongia sp. / *Dactylia* sp.

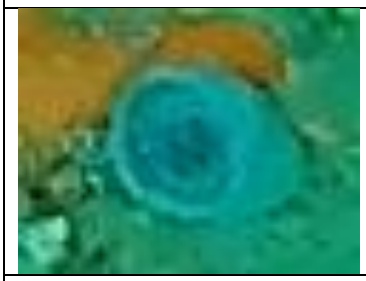
CALLYSPONGIIDAE

43 ***Xestospongia*** **sp.**

PETROSIIDAE

44 **Haplosclerid**
cf. Xestospongia

PETROSIIDAE



45 **Possibly a Choristid**

46 ***Stylopus australis***

HYMEDESMIIDAE

47 ***Chondropsis*** **sp.**

CHONDROPSIDAE

48 ***Cinachyrellla*** **sp.**

TETILLIDAE

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4

49 ***Xestospongia* sp.**

PETROSIIDAE

50 ***Psammocinia* sp.**

IRCINIIDAE

51 **Probably *Taonura cf. marginalis***

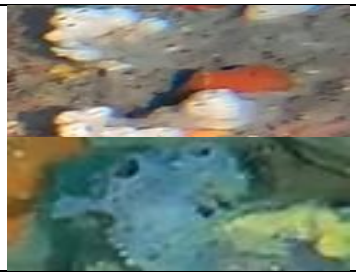
THORECTIDAE

52 ***Desmacidon mammilatum***

DESMACIDIDAE

53 **Unidentified sponge**

54 ***cf. Thorectandra papillosa***



55 ***cf. Thorectandra papillosa***

THORECTIDAE

56 ***Iophon minor***

ACARNIDAE

57 **Possibly new species**
Sponge or *Aplidium* sp.

58 **Possibly new species**
But check *Iophon minor*

59 ***cf. Leucettusa lancifera***
But check *Luecettusa tubulosa*
DESMANTHIDAE

60 ***cf. Chelonaplysilla violacea***

DARWINELLIDAE

61 ***Suberites cf. perfectus***

SUBERITIDAE

62 ***cf. Tetrapocillon novaezealandiae***

GUITARRIDAE

63 ***cf. Trachcladus stylifer***

TRACHYCLADIDAE

64 ***Callyspongia ramosa***

CALLYSPONGIIDAE

SPONGES of Motiti Natural Environment Management Area **New Zealand**

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65 ***cf. Callyspongia latituba***
But check *Iophon laevistylis*
CALLYSPONGIIDAE / ACARNIDAE

66 **Possibly new species**
For genus, check *Clathrina* or *Didemnum*

67 ***Petrosia cf. hebes***
PETROSIIDAE

68 ***Dactylia varia***
But check *Callyspongia ramosa*
CALLYSPONGIIDAE

69 ***cf. Xestospongia* sp.**
But check *Adocia* sp.
PETROSIIDAE / ADOCIIDAE

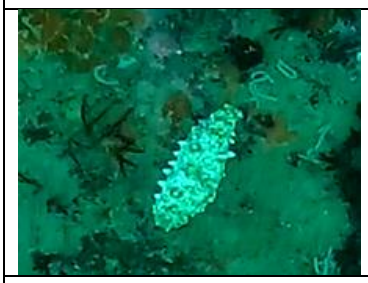
70 ***cf. Polymastia aurantium***
POLYMASTIIDAE

Table 5. MNEMA Echinodermata ID Guide.

ECHINODERMATA of Motiti Natural Environment Management Area, **NZ**

Emma Donald, supervised by Dr Phil Ross
University of Waikato & Bay of Plenty Regional Council **Version 1 03/2021**

Photo order: In sequence of first seen during video transect.
Photos by: University of Waikato, taken by GoPro on a drop camera frame. Produced by: Emma Donald.
Contact: emmapaigedonald@gmail.com. Support from **Prof Chris Battershill**, **University of Waikato** and **Josie Crawshaw, Bay of Plenty Regional Council**.



1 **Australasian Brown Sea Cucumber**
Australostichopus mollis

2 **Feather Star**
Cenolia novaezealandiae

Table 6. MNEMA Hydrozoa ID Guide.

HYDROZOA of Motiti Natural Environment Management Area, **NZ**

Emma Donald, supervised by Dr Phil Ross
University of Waikato & Bay of Plenty Regional Council **Version 1 03/2021**

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1	**Field of unidentified black hydroids**			

Table 7. MNEMA Cnidaria ID Guide.

CNIDARIA of Motiti Natural Environment Management Area, **NZ**

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University of Waikato & Bay of Plenty Regional Council **Version 1 03/2021**

Photo order: In sequence of first seen during video transect.
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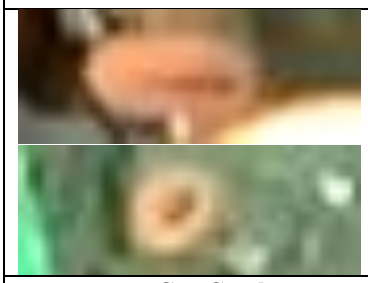				
1	**Cup Coral** *cf. Desmophyllum dianthus*			

Table 8. MNEMA Bryozoa ID Guide.

BRYOZOA of Motiti Natural Environment Management Area, **NZ**

Emma Donald, supervised by Dr Phil Ross
University of Waikato & Bay of Plenty Regional Council **Version 1 03/2021**

Photo order: In sequence of first seen during video transect.
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Contact: emmapaigedonald@gmail.com. Support from **Prof Chris Battershill**, **University of Waikato** and **Josie Crawshaw, Bay of Plenty Regional Council**.

			
1 ***cf. Menipea vectifera*** Living inside *Iophon laevistylis*			

Table 9. MNEMA Ascidian ID Guide.

ASCIDIANS of Motiti Natural Environment Management Area, **NZ**

Emma Donald, supervised by Dr Phil Ross
University of Waikato & Bay of Plenty Regional Council **Version 1 03/2021**

Photo order: In sequence of first seen during video transect.
Photos by: University of Waikato, taken by GoPro on a drop camera frame. Produced by: Emma Donald.
Contact: emmapaigedonald@gmail.com. Support from **Prof Chris Battershill**, **University of Waikato** and **Josie Crawshaw, Bay of Plenty Regional Council**.

			
1 **Possibly new *Aplidium*** But check *Psammocinia perforodorsa*	**2** ***cf. Styela plicata*** STYELIDAE	**3** **Possibly new species** Sponge or *Aplidium* sp.	**4** **Possibly an unidentified Ascidian**

Table 10. Porifera with new distributions and/or that are naturally uncommon or rare, in order of first seen in the video transect (Kelly, 2018; Battershill et al., n.d.; Millar, 1982).

Species	**Previously known distribution**	**Rare or uncommon?**	**Endemic?**
Iophon laevistylis	Poor Knights Islands, Rakitu Island, Little Barrier Island, Colville Channel, offshore Dunedin, Stewart Island and George Sound.	Rare	Yes
Suberites sp.	Found primarily on the north-eastern coast of the North Island, including Cape Reinga, Poor Knights Islands and Leigh.	Uncommon	Yes

Clathria cf. macrotoxa or cf. Dragmacidon australis	***Clathria cf. macrotoxa:*** Found around the Three Kings Islands and Middlesex Bank, Spirits Bay, Bay of Islands, Whangarei Harbour, and down to Little Barrier, Great Barrier and Slipper Islands where it appears to be less common. ***cf. Dragmacidon australis:*** North-eastern North Island from Tutukaka to the Hauraki Gulf, including the offshore islands.	No	Yes for both
Suberites australiensis	Cuvier Island, East Cape, Wellington Harbour, Marlborough Sounds and Cook Strait.	Uncommon	Yes
Possibly *Psammocinia perforodorsa*	Northland and Rodney coasts. Reported from the Taranaki area.	Uncommon	No
cf. Aaptos conferta	Three Kings Islands and Cape Brett, Northland. Also recorded from Kawau Island, Hauraki Gulf and Goat Island Bay, Cape Rodney.	No	No
Petromica sp.	Only known from Goat Island Bay (Leigh) and the Poor Knights Islands.	Rare	Yes
Possibly *Polymastia echinus*	Leigh coast, Takatu, and Great Barrier Island and the Poor Knights Islands.	No	No
cf. Hamigera tarangaensis	Known only from the Poor Knights and the Hen and Chicken Islands.	Uncommon	Yes
Cliona celata	North-eastern coast of the North Island, from North Cape to the Hauraki Gulf, Wellington Harbour, Chatham Island, Banks Peninsula and Foveaux Strait.	No	No
Possibly *Tedania battershilli*	Poor Knights Islands, Tutukaka, Leigh, Cuvier Island, Kapiti Island and Kaikoura.	No	Yes
Homaxinella erecta	Hauraki Gulf, Rodney Coast, Manukau Harbour, and is reported from East Cape.	Uncommon	Yes
Geodia regina	N/A	Uncommon	Yes
Possibly *Phorbas anchorata*	Recorded from Great Barrier Island, Tutukaka Heads and south to Leigh.	No	Yes
Chondropsis sp.	Recorded from Kaikoura, Otago Harbour, and the southeast South Island coast.	No	Yes
Cinachyrella sp.	Spirits Bay and the Leigh coast where it is locally abundant. Elsewhere the distribution is patchy. Reported from Great Barrier Island.	No	Yes

Probably *Taonura cf. marginalis*	Known from only from east of North Cape, Bay of Islands, and Poor Knights Islands. This is a very unusual sponge, rare. If confirmed it is the southern most extension of this species' range by a great deal (C. Battershill, personal communication, March 17, 2021).	Rare	No
cf. Thorectandra papillosa	Tutukaka coast and the Poor Knights Islands.	No	No
Suberites cf. perfectus	Shallow subtidal around Hohoura, Tutukaka, and Rodney from 3–15 m. Outlying records from Mayor Island and Three Kings at around 120 m.	No	No
cf. Tetrapocillon novaezealandiae	Found in intertidal and shallow subtidal waters down to about 20m. Recorded from Barren Arch (Poor Knights Islands), Leigh, Takatu Point, Slipper Island (Bay of Plenty).	No	No
Possibly *Callyspongia cf. latituba*	Throughout New Zealand and on most offshore islands.	No	No
cf. Trachycladus stylifer	Recorded only from North Cape, Spirits Bay, the Poor Knights and the Three Kings Islands.	Rare	Yes

Table 11. Ascidians with new distributions, in order of first seen in the video transect (Page, 2019).

Possibly a *Polysyncraton* species	North Cape, Little Barrier Island, North Auckland, Auckland, Colville Channel and Stewart Island.	No	No
cf. Styela plicata	Previously recorded from the East coast of Whangarei down to Auckland, and the Northern coastline of the South Island.	No	No

Table 12. Bryozoans with new distributions, in order of first seen in the video transect (Gordon & Mills, 2016).

cf. Menipea vectifera	North Cape, Little Barrier Island, North Auckland, Auckland, Colville Channel and Stewart Island.	No	Yes

7. DISCUSSION

The finding of two probable and ten possible new species of Porifera and Ascidians is a significant result, especially for such a small scale study. Already, from this snapshot into the benthic community of Nukutai Reef, it is clear that the biodiversity of the deep reefs within the MNEMA is high. However, it is important to acknowledge that this study is the first investigation and covers only a tiny section of just one deep reef in the MNEMA. Habitat variation and other changing factors around Motiti Island such as exposure, currents, bottom-contact fishing pressure and more, could influence other deep reefs in the MNEMA to have different levels of biodiversity.

Of the suspected new species, four were of particular interest. Sponge specimen 9 (Gravy Sponge) looks to be a *Haplosclerida* species. It most closely resembles *Haliclona brøndstedi* or *Haliclona venustina*, however both of these species have only been known to live in the intertidal and shallow subtidal zones (Kelly, 2018).

Sponge specimen 13 (Tumbleweed Sponge) is of particular interest because it was one of the most abundant sponge specimens throughout the video transect. It does not resemble any species currently known to be in New Zealand waters. It is most likely a new species in the order Haplosclerida, however it does show some resemblance to *Homaxinella balfourensis* (Figure 9). The Tumbleweed sponge's resemblance to *H. balfourensis* is interesting, because it's only known distribution is in Antarctica. The furthest North that *H. balfourensis* has previously been recorded is the Kerguelen Islands (World Register of Marine Species, 2007).

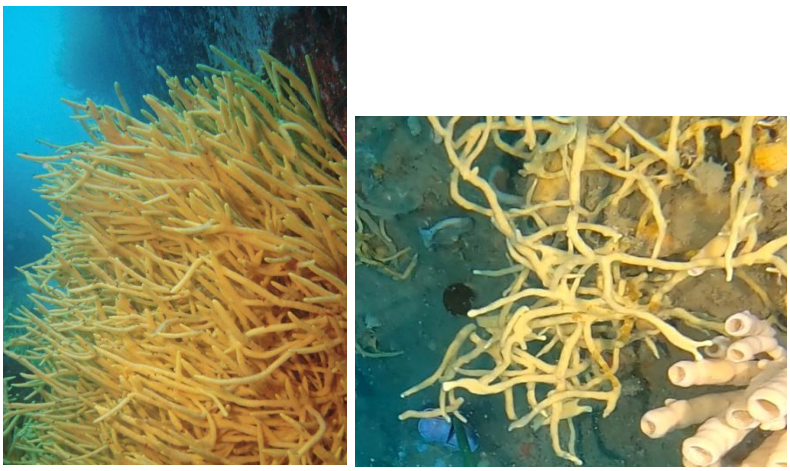

Figure 9. Left: Antarctic species *H. balfourensis* (Cothran, n.d.). Right: Probably new species "Tumbleweed sponge".

Sponge specimen 14/Ascidian specimen 1 (Meringue Sponge/Sea squirt) is another species of interest, again due to its abundance through the video transect. Without a sample or better resolution it is difficult to determine whether it is a sponge or an Ascidian, but it does not closely resemble any known New Zealand species. It is worth checking *Psammocinia perforodorsa* if a sample is taken, as it has slight resemblance and may simply have different morphology due to different ecological conditions.

Sponge specimen 24 (Oyster Mushroom Sponge) is an intriguing find; again, it was abundant throughout the video transect and does not resemble any other species known in New Zealand. For genus, it will most likely fit under *Petrosia* or *Xestospongia*. These types of sponges are usually known from caves and archways on offshore islands in the far north of New Zealand (C. Battershill, personal communication, March 17, 2021), but on Nukutai Reef the Oyster Mushroom Sponge is living in a large boulder habitat under no shelter. The Oyster

Mushroom Sponge seems to be commonly found growing out from the sides of boulders in layered, plate-like structures and does not seem to have any noticeable amount of sediment sitting on it.

As can be seen in Tables 10-12, a large amount of the species seen on Nukutai Reef (25.3%) have not previously been recorded in the Bay of Plenty. 88.2% of the species with new distributions, pending confirmation with samples, have northern affinities, while 11.8% have southern affinities (Figure 10). It has previously been assumed that the East Auckland Current (EAC) and the Wairarapa Eddy (WE) mix in the Bay of Plenty (C. Battershill, personal communication, March 2, 2021). Potential evidence of the WE flowing northwards into the Bay of Plenty was found in a study by Stevens et al. (2019), in which a mid-water counter current was discovered at 200m flowing North-east from the East Cape. Due to the mixed assemblage of northern and southern species seen in this study, for the first time there is evidence of these two major oceanic currents mixing in the Bay of Plenty (pending samples to confirm species). It shows that larvae have drifted into the Bay of Plenty both down from the far North on the EAC and up from the South on the WE. This matches what was seen in the fish assemblage at Nukutai Reef, as it resembles that of the Poor Knights but also has some species with southern affiliations such as the Southern bastard red cod. This may have significant implications for not only the scientific community, but also industries such as aquaculture and fisheries, as it improves on current knowledge of transport mechanisms for larvae dispersal and recruitment around New Zealand.

Figure 10. Simplified illustration of the previously known movement of the EAC and the WE around New Zealand.

One species that was an especially important find was *Taonura cf. marginalis*. This species was seen multiple times in video transect 1, making it probable that it is the same species. This is a very unusual and rare sponge, which has only been recorded once before in New Zealand, quite recently (Kelly, 2018). It known only from east of North Cape, Bay of Islands, and Poor Knights Islands, and has been identified as being very similar to the South Australian species, *Taonura marginalis* (Kelly, 2018). If this species is confirmed, then it will be the southernmost extension of this species' range by a very long way. This is the second record of the *Taonura* genus in New Zealand.

Of the species seen at Nukutai Reef, four of the sponges are known as rare species and six known as uncommon species. This links back to Policy 11 in the NZCPS 2010, and is cause for further investigation into as it could have implications for additional protection over the wider MNEMA in future. With these large implications in mind it is worth questioning the species that we thought were rare or uncommon – it may be possible that the scientific community has not previously been able to look widely enough to find these species more frequently,

and that in fact they may be more common than originally thought. Deeper reefs have previously been thought to be inaccessible due to explorations being too expensive. But the drop camera method employed in this study shows a cost-effective, quick way to get a snapshot of biodiversity and habitat of deep reefs. The limitations of the drop camera method mean that it is not an efficient monitoring tool, since it is such a small snapshot and thus cannot give a representation of a wider area, but it is an ideal method for first investigations.

The drop camera's limitations included its destructiveness, its low resolution images, the slow speed at which is moves through a transect, and its inability to take samples. The drop camera was mildly destructive to the benthos, at time breaking off parts of sponges and visibly aggravating fish. This was due to the downward angle of the camera, so it was not possible to see the area that the drop camera was moving into until it was right up against a boulder. The low resolution images were mainly due to the movement of the camera, and because the screenshots were taken from video files rather than still images – a process that is still being worked on. The slow speed at which the drop camera moves through a transect is dependent on the speed of surface currents in the area. In the case of Nukutai Reef, the currents are relatively slow and so it took just over 20 minutes to complete video transect 1. However, if the current was fast then this set up would not be suitable as the images would be too blurry. One other thing to note for any future drop camera surveys, is to use a rope to pull the weight of the drop camera rather than the live feed cable itself, to avoid putting stress on the live feed connection.

In regards to further investigation of the deep reefs within the MNEMA, this study brings to light the importance of exploring the reefs with an ROV. An ROV has the ability to take much higher resolution images and to be controlled in real-time so it can get closer to specimens and get photos from different angles. More importantly, it can also take samples of specimens of interest, as well as cover a much larger area while causing less damage to the benthos.

8. CONCLUSIONS

The objective of this study was to investigate the biodiversity of Nukutai Reef in order to inform and provide evidence for discussions around classification of areas within the wider MNEMA, under the Bay of Plenty's RCEP. This first snapshot of a deeper reef in the MNEMA showed high levels of biodiversity across an area of large boulder habitat at 40-50m depth. Ten possibly new and two probably new Porifera and Ascidian species were discovered, pending samples to confirm their identification. The mixed assemblage of fish and sponge species with northern and southern affinities provided evidence of the EAC and the WE both having an influence in the Bay of Plenty. Of the species able to be identified in this study, four naturally rare and six naturally uncommon Porifera species were found. This gives cause for further investigation due to the significant implications it may have for additional protection measures in the MNEMA under RCEP, due to Policy 11 in the NZCPS 2010. This study concludes that although a drop camera is a cost-effective and simple way to get a first snapshot of the biodiversity and habit of a deep reef, an ROV is the most suitable method for any further exploration, sampling and monitoring.

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APPENDIX A

Drop camera data for fish at Nukutai Reef.

Fish

Species	Screengrab	Video transect	Time first seen
Butterfly perch (*Caesioperca lepidoptera*)		1, video 1	2:17
Blue cod (*Parapercis colias*)		1, video 1	2:55
Yellow-black triplefin (*Forsterygion flavonigrum*)		1, video 1	3:25
Sea perch (*Helicolenus percoides*)		1, video 1	3:41

Scarlet wrasse (*Pseudolabrus miles*)		1, video 1	3:43
Leatherjacket (*Parika scaber*)		1, video 1	4:09
Golden snapper(*Centroberyx affinis*)	 	1, video 1	4:09
Tarakihi (*Nemadactylus macropterus*)		1, video 1	5:05

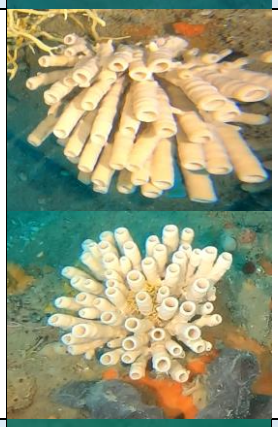
Splendid perch (*Callanthias australis*)		1, video 1	10:54
Snapper (*Pagrus auratus*)		1, video 1	11:05
Red pigfish (*Bodianus unimaculatus*)		1, video 1	12:03

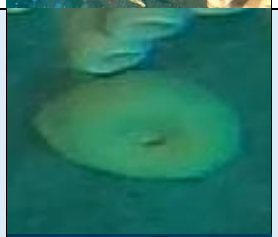
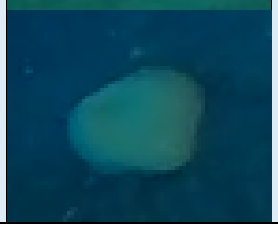
Goatfish (Upeneichthys lineatus)		1, video 1	13:13
Red Moki (*Cheilodactylus spectabilis*)		1, video 1	15:46
Slender roughy (*Optivus elongatus*)		1, video 2	0:10
Bastard red cod (*Pseudophycis barbata*)	  	1, video 2	0:54

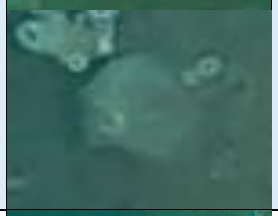
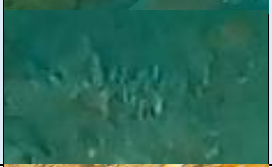
Halfbanded perch (*Hypoplectrodes dimidius*)		2, video 1	3:19
Blue Mao Mao (*Scorpis violacea*)	 	2, video 1	6:38
Pink Mao Mao (*Caprodon longimanus*)		2, video 1	6:35
Oblique-swimming triplefin (*Obliquichthys maryannae*)		2, video 1	12:48
Porae (*Nemadactylus douglasii*)		2, video 1	14:04

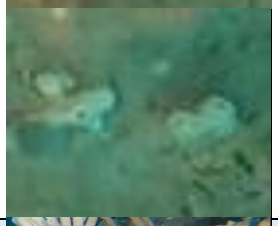
APPENDIX B

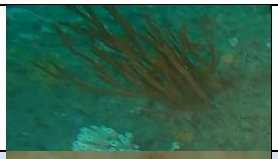
Drop camera data for Porifera at Nukutai Reef.

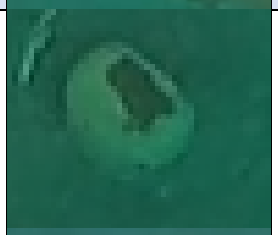
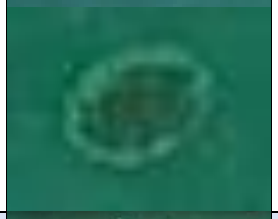
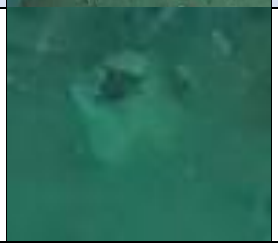
Porifera				
Species	**Screengrab**	**Video transect**	**Time first seen**	**Notes**
Polymastia crocea		1, video 1	2:38	**NIWA Splendid Sponges:** Commonly found on sediment covered rocky reefs and platforms aound Northland and offshore islands down to 50m. Uncommon further south but known from Titahi Bay Wellington. **Porifera ID Guide:** Common around the North Island and all northern offshore islands. Not so common south of Cook Strait although it has been observed in most coastal localities.
Iophon laevistylis		1, video 1	2:44	Rare and endemic (Porifera ID Guide). New distribution. **Porifera ID Guide:** Endemic. Poor Knights Islands, Rakitu Island, Little Barrier Island, Colville Channel, offshore Dunedin, Stewart Island and George Sound.
Suberites sp.		1, video 1	2:46	Uncommon and endemic (NIWA Splendid Sponges & Porifera ID Guide). New distribution. **NIWA Splendid Sponges:** Uncommon, found primarily on the northeastern coast of the North Island, including Cape Reinga, where it has been collected around 50 m, Poor Knights Islands and the Rodney Coast. This species is new to science but remains undescribed. **Porifera ID Guide:** Endemic. Recorded from Leigh and the Poor Knights Islands.
Darwinella cf. gardineri / *Dendrilla cf. rosea*		1, video 1	3:42	
Xestospongia coralloides		1, video 1	5:26	**NIWA Splendid Sponges:** Known from north of Cape Karikari and the Three Kings Islands, the Bay of Plenty and Ranfurly Bank on the east coast. Recently discovered in the north Taranaki Bight on the west coast, from 15–120 m.

Callyspongia cf. ramosa	 	1, video 1	5:30	**NIWA Splendid Sponges:** This is one of the most common sponges in coastal shallow waters around the North Island and is frequently washed up on the beach. Found on walls, large boulders, rocky reefs and reef flats that experience wave surge down to 50 m. Known from the Marlborough Sounds. **Porifera ID Guide:** Endemic. Throughout New Zealand including the offshore islands.
Clathria cf. macrotoxa or cf. Dragmacidon australis		1, video 1	5:22	New distribution for both species. ***Clathria cf. macrotoxa*** NIWA Splendid Sponges: Found around the Three Kings Islands and Middlesex Bank down to 170 m, Spirits Bay, Bay of Islands, Whangarei Harbour, and further south where it appears to be less common. Porifera ID Guide: Endemic. Poor Knights Islands, northeast of Northland, and Little
Possibly new species - *Haplosclerida* (cf. *Haliclona brøndstedi* or *Haliclona venustina)* Common name: Gravy sponge		1, video 1	5:24	If it is one of these species, then it is the first time it has been recorded inhabiting a subtidal area. ***Haliclona brøndstedi*** NIWA Splendid Sponges: Only known to be intertidal ***Haliclona venustina*** NIWA Splendid Sponges: Subtidal specimens found up to 24m deep
Calcareous sponge or possibly *Polysyncraton*		1, video 1	5:24	New distribution if it is *Polysyncraton* . **The Marine Fauna of New Zealand Ascidians:** Polysyncraton species previously recorded in North Cape, Little Barrier Island, North Auckland, Auckland, Colville Channel and Stewart Island.
Probably new species - Look at Haplosclerida of the genus *Callyspongia* and look at *Homaxinella balfourensis* Common name: Tumbleweed sponge		1, video 1	4:58	***Homaxinella balfourensis*** Closest documented distribution is in Antarctica. Farthest North of Antarctica is has been recorded is the Kerguelen Islands.
Suberites australiensis	 	1, video 1	5:10	Uncommon (Porifera ID Guide). New distribution. **Porifera ID Guide:** Endemic. Cuvier Island, East Cape, Wellington Harbour, Marlborough Sounds and Cook Strait.

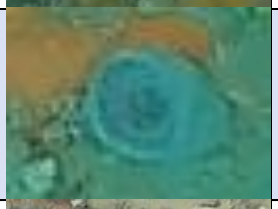
Possibly new species - *cf. Suberites australiensis* Common name: Pork bun sponge		1, video 1	3:09	Uncommon if it is *Suberites australiensis* (Porifera ID Guide). New distribution. ***Suberites australiensis*** Porifera ID Guide: Endemic. Cuvier Island, East Cape, Wellington Harbour, Marlborough Sounds and Cook Strait.
Possibly new *Aplidium,* but check *Psammocinia perforodorsa* Common name: Meringue sponge/sea squirt	  	1, video 1	3:09	Uncommon (NIWA Splendid Sponges), and new distribution if it is *Psammocinia perforodorsa* . ***Psammocinia perforodorsa*** NIWA Splendid Sponges: Uncommon, found on subtital rocky reefs and deeper areas that experience moderate current activity on Northland and Rodney coasts, down to about 30m. Reported from the Taranaki area.
cf. *Aaptos conferta*		1, video 1	2:48	New distribution. **NIWA Splendid Sponges:** down to 20 m on exposed Three Kings Islands and Cape Brett, Northland. Also recorded from Kawau Island, Hauraki Gulf and Goat Island Bay, Cape Rodney
Petromica sp. And possibly *Polymastia echinus*	 	1, video 1	3:32	*Petromica* sp. - Rare and endemic (NIWA Splendid Sponges & Porifera ID Guide). New distribution for both species. ***Petromica* sp.** NIWA Splendid Sponges: Uncommon, and only known from the Rodney Coast and the Poor Knights Islands, from 20–50m. Porifera ID Guide: Endemic. Observed at Goat Island Bay (Leigh) and the Poor Knights Islands. ***Polymastia echinus*** NIWA Splendid Sponges: Known from the Leigh coast where it is locally abundant, Takatu, and Great Barrier Island. Porifera ID Guide: Poor Knights Islands, and northeastern North Island. Likely to be more widespread, as image was taken in Fiordland.
cf. Hamigera tarangaensis		1, video 1	5:26	Uncommon and endemic (Porifera ID Guide). New distribution (Poecilosclerida). **Porifera ID Guide:** Endemic. Known only from the Poor Knights and the Hen and Chicken Islands.

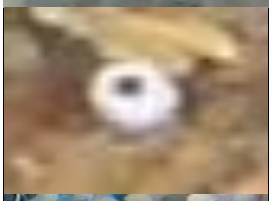
Polymastia cf. massalis		1, video 1	3:55	**NIWA Splendid Sponges:** It is relatively common in open harbours and along rocky coastlines around the west and eastern coastlines of Northland from Three Kings south to Rodney Coast, Hauraki Gulf, Mercury Bay, and White Island in the Bay of Plenty, typically between 6–30 m. Recorded on the Ranfurly Banks at 60 m. The type locality of Polymastia massalis is Port Phillip Heads, South Australia. **Porifera ID Guide:** Throughout northern New Zealand and all offshore islands. Also possibly Port Philip Heads, Australia.
Ecionemia alata		1, video 1	5:38	**NIWA Splendid Sponges:** Very common on coastal rocky reefs and shallow harbours around northern New Zealand down to about 200 m.
Polymastia sp., *cf. massalis*		1, video 1	5:49	See above, although the colour in this specimen is lighter than normal. However, colour is known to be variable in this species (C. Battershill, personal communication, March 17, 2021).
Possibly a Choristid or Hadromerida		1, video 1	5:52	Difficult to identify this speciment further. Possibly Choristid or Hadromerida? (C. Battershill, personal communication, March 17, 2021).
Cliona celata		1, video 1	5:54	New distribution. **NIWA Splendid Sponges:** Very common along the northeastern coast of the North Island, from North Cape to the Hauraki Gulf, Wellington Harbour, Chatham Island, Banks Peninsula and Foveaux Strait down to about 30 m. **Porifera ID Guide:** Known from around New Zealand and all offshore islands. Also from the Arctic, Atlantic coasts of Europe and North America, West Indies, Indian Ocean, Red Sea, Malaysia, Australia and New Guinea.
cf. Styela plicata mixture with sponge *cf. Sycozoa sigillinoides*	 	1, video 1	5:55	New distribution for *Styela plicata* . ***Styela plicata*** NIWA Awesome Ascidians: Previously recorded from the East coast of Whangarei down to Auckland, and the Northern coastline of the South Island. ***cf. Sycozoa sigillinoides*** Sealife Base: Southwest Atlantic, Indo-Pacific and the Antarctic: From Antarctica to sub-Antarctic and Macquarie Islands, Australia, New Zealand and South America. Subtropical to polar (Sea Life Base. (n.d.). *Sycozoa sigillinoides* . https://www.sealifebase.ca/summary/Sycozoa-sigillinoides.html)
Probably new species, for genus check *Petrosia* or *Xestospongia* Common name: Oyster mushroom sponge	 	1, video 1	5:57	These sponges are usually known from inside caves and archways on offshore islands in the far north of New Zealand. An interesting find here in the Bay of Plenty (C. Battershill, personal communication, March 17, 2021).

Raspailia topsenti (*cf. Trachycladus stylifer*)		1, video 1	5:45	**NIWA Splendid Sponges:** Common in sponge gardens and deep reef flats with sediment cover, particularly along the Rodney Coast and Hauraki Gulf. Found elsewhere around New Zealand from North Cape, Three Kings and Poor Knights Islands, along the east coast to Ranfurly Banks off East Cape, Kaikoura, Marlborough Sounds, Mernoo Bank, and Doubtful Sound, Fiordland. **Porifera ID Guide:** Endemic. New Zealand, from the Three Kings Islands to Stewart Island,
cf. Tedania battershilli or *Clathria* sp. Or *Crella* sp.		1, video 1	5:47	New distribution. ***cf. Tedania battershilli*** Porifera ID Guide: Endemic. Recorded from the Poor Knights Islands, Tutukaka, Leigh, Cuvier Island, Kapiti Island and Kaikoura.
Homaxinella erecta	 	1, video 1	5:57	Uncommon and endemic (Porifera ID Guide). New distribution. **NIWA Splendid Sponges:** It is known from the Hauraki Gulf, Rodney Coast, Manukau Harbour, and is reported from East Cape, from 11 to 56 m depth. Porifera ID Guide: Endemic. Northeast North Island and offshore islands.
Pararhaphoxya sinclairi		1, video 1	6:00	**NIWA Splendid Sponges:** Abundant in sponge gardens on low relief rocky reefs on the northeast coast of the North Island, including Three Kings and Poor Knights Islands, North Cape, Great Barrier Island, and Ranfurly Banks off East Cape.
cf. Polymastia sp.		1, video 1	6:39	Again, difficult to identify this specimen further. It has a typical massive morphology of the Polymastiidae, in this case the sponge appears to be covered in a layer of fine sediment (C. Battershill, personal communication, March 17, 2021).
Geodia regina		1, video 1	6:53	Uncommon and endemic (NIWA Splendid Sponges & Porifera ID Guide). **NIWA Splendid Sponges:** Uncommon, found on deep reef flats and in Ecklonia forests in high current areas, and on coastal rocky reefs along the northeastern coastline of the North Island from north of the Three Kings south to the Bay of Plenty, and Mahia Peninsula down to 560 m. **Porifera ID Guide:** Endemic. Northeastern North Island from the Three Kings Islands to Mahia Peninsula.
Psammocinia cf. hawere		1, video 1	7:31	**NIWA Splendid Sponges:** Relatively common on deep open rocky reefs on the northeastern and Northland coast between 15 and 30 m, south to East Cape. Common in the North Taranaki Bight on deep offshore sandy patch reefs and canyons between 170–240 m. **Porifera ID Guide:** Endemic. Northeastern North Island and northern offshore islands
Possibly new species. Look at Order Poecilosclerida. Family *Mycale/Chondropsis/Desmacella*. Common name: Kūmara sponge		1, video 1	5:55	Resolution of this image makes it difficult to discern the Genus/Family. However, it is different to anything else yet seen.

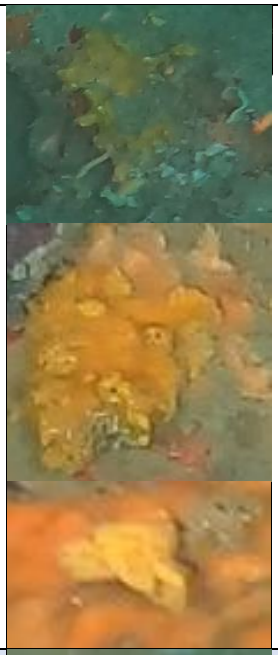
Stelletta maori		1, video 1	7:37	Endemic. **NIWA Splendid Sponges:** Found in the North Island, from Three Kings to the Rodney Coast including Great Barrier Island, Bay of Plenty and Ranfurly Banks off East Cape. Reported from Stewart Island. **Porifera ID Guide:** Endemic. Northeast New Zealand from Cape Karikari to Banks Peninsula. Also offshore islands within this area and the Campbell Plateau
Possibly new species - unidentified sponge Common name: Taco sponge		1, video 1	8:07	Resolution of this image makes it difficult to discern the Genus/Family. However, it is different to anything else yet seen.
Possibly new species - unidentified sponge Common name: Dragon egg sponge	  	1, video 1	9:02	Resolution of this image makes it difficult to discern the Genus/Family. However, it is different to anything else yet seen.
Mixture, possible xestospongia/bryozoan mix		1, video 1	9:46	Resolution of this image makes it difficult to discern the Genus/Family. However, it is different to anything else yet seen.
Possibly new species - unidentified sponge Common name: Castle sponge		1, video 1	10:24	Resolution of this image makes it difficult to discern the Genus/Family. However, it is different to anything else yet seen.

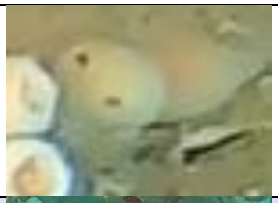
Stelletta crater, covered by *Desmacella dendyi*		1, video 1	12:00	***Stelletta crater*** NIWA Splendid Sponges: Relatively common, distinctive, typically found on shaded deep rocky reef slopes free of sediment and in caves along the northeastern coastline of the North Island, from North Cape and Spirits Bay to Cook Strait. Porifera ID Guide: Endemic. New Zealand and its offshore islands from the Three Kings to Stewart Island. ***Desmacella dendyi*** Porifera ID Guide: Endemic. New Zealand coast and offshore islands including the Chatham Rise.
cf. Aciculites/Petrosia		1, video 1	11:55	Most commonly found offshore on island reef walls, caves along the north east coast. Some recordings from Taranaki also (C. Battershill, personal communication, March 17, 2021).
Clathrina sp.		1, video 1	12:08	Calcareous sponge. Depending on the species, most commonly found along the north island east coast on reef walls (C. Battershill, personal communication, March 17, 2021).
cf. Desmacadon sp.		1, video 1	12:10	North-east NZ, endemic (C. Battershill, personal communication, March 17, 2021).
Possibly *Phorbas anchorata* but check *Clathria sp.*		1, video 1	12:09	New distribution. Difficult to assign this thin to encrusting sponge to a genus. Looks to be a Poecilosclerid. However, this group of orange to red sponges are usually found in the far north/east coast of the North Island. ***Phorbas anchorata*** Porifera ID Guide: Endemic. Recorded from Great Barrier Island, Tutukaka Heads and south to Leigh.
Callyspongia sp./*Dactylia* sp. (Haplosclerid)		1, video 1	12:12	A Haplosclerid sponge but of a growth form that is different enough from the other species listed above to warrant a separate entry.

Xestospongia sp.		1, video 1	12:19	A Haplosclerid sponge/Xestospongia sp. but of a growth form that is different enough from the other species listed above to warrant a separate entry.
Haplosclerid, *cf. Xestospongia*			12:19	A Haplosclerid sponge/Xestospongia sp. but of a growth form that is different enough from the other species listed above to warrant a separate entry.
Possibly a Choristid			12:19	Resolution not adequate to assign this sponge further, but it is different to any seen above.
Polymastia cf. massalis			12:28	Top image: This could be a specimen of *Polymastia massilis* that has recently undergone a fungal infection (causing the pale scaring). Or it could be a different Hadromerid.
Stylopus australis			12:30	**Porifera ID Guide:** Endemic. Cape Maria van Diemen, northeast North Island and offshore islands, south to the Hauraki Gulf.

Chondropsis sp.			12:30	New distribution. **Porifera ID Guide:** Endemic. Recorded from Kaikoura, Otago Harbour, and the southeast South Island coast.
Cinachyrella sp.		1, video 1	12:45	New distribution. Endemic. **NIWA Splendid Sponges:** Found on flat deep reef areas in relatively deep sediments of medium grain size around Spirits Bay and the Leigh coast where it is locally abundant. Elsewhere the distribution is patchy. Reported from Great Barrier Island at 18 m.
Xestospongia sp.			12:45	A Haplosclerid sponge/Xestospongia sp. but of a growth form that is different enough from the other species listed above to warrant a separate entry.
Psammocinia sp.			12:45	Again the identification (light grey sponge in the image) needs verification with a sample, but likely to be a Dictyoceratid sponge. Distribution north island east coast and northern Taranaki.
Probably *Taonura cf. marginalis*	  		12:46	New distribution and maybe only the second record of the genus Taonura for New Zealand. This is a very unusual sponge, rare. If confirmed it is the southern most extension of this species' range by a great deal (C. Battershill, personal communication, March 17, 2021). **NIWA Splendid Sponges:** Known from only from east of North Cape, Bay of Islands, and Poor Knights Islands, ranging from 25–210 m depth.
Desmacidon mammilatum			12:51	**NIWA Splendid Sponges:** Found across a broad range of rocky reef habitats, from the shallow subtidal to deep rocky reefs at the Poor Knights Islands, where they reach spectacular sizes, often with paler yellow-orange Iophon minor (see inset). An uncommon species found off northern New Zealand from Middlesex Bank (108–174 m) to Three Kings Islands, North Cape, Rodney Coast and Hauraki Gulf outer islands, Mahia Peninsula, Ranfuly Banks off East Cape, and Chatham Rise, from about 4–180 m. **Porifera ID Guide:** Endemic. Recorded from Three Kings Islands, North Cape, Porae Reef (Leigh), Takatu Point, Little Barrier Island and Mahia Peninsula.

Unidentified sponge			12:51	Resolution poor, hence difficult to assign.
cf. Thorectandra papillosa	 		12:50	New distribution. Resolution doesn't allow a definitive identification, however the sponge is most likely to be a Thorectid. Usually these are dark grey in colour but can be pale at depth or in caves (C. Battershill, personal communication, March 17, 2021). **Porifera ID Guide:** Tutukaka coast and the Poor Knights Islands.
Iophon minor		1, video 1	12:56	**NIWA Splendid Sponges:** Commonly found along the east coast of Northland and around the offshore islands, Nelson, Kaikoura and Stewart, Chatham and Auckland Islands, from about 10–80 m. **Porifera ID Guide:** Endemic. Throughout New Zealand including the Chathams and Auckland Islands.
Possibly new species - sponge or *Aplidium* sp. Common name: Orange crown sponge/sea squirt	  	1, video 1	12:59	Not seen before. Could be sponge or compound ascidian (an *Aplidium* sp. if the latter).

Possibly new species - But check *Iophon minor* Common name: Pollen sponge		1, video 1	13:25	This specimen is different enough to separate, it could be new (C. Battershill, personal communication, March 17, 2021).
cf. Leucettusa lancifera but check *Luecettusa tubulosa*		1, video 1	13:29	Resolution poor, hence difficult to assign species. ***Leucettusa lancifera*** NIWA Splendid Sponges: Found off the east coast of the North Island, west coast of the South Island including Fiordland, and Cook Strait, down to 50 m. If it is Leucettusa tubulosa, then it is a new distribution for the species. ***Leucettusa tubulosa*** NIWA Splendid Sponges: Recorded from Three Kings, North Cape, Chatham Rise and Fiordland.
cf. Chelonaplysilla violacea		1, video 1	13:36	**NIWA Splendid Sponges:** Relatively common around New Zealand.
Possibly *Petrosia cf. hebes*		1, video 1	13:40	Resolution poor, hence difficult to assign. **NIWA Splendid Sponges:** Relatively common along the northeast coast of the North Island, from Lord Howe Rise to the north of New Zelaand, Three Kings Island south to Chatham Rise, ranging from 4–80 m depth.

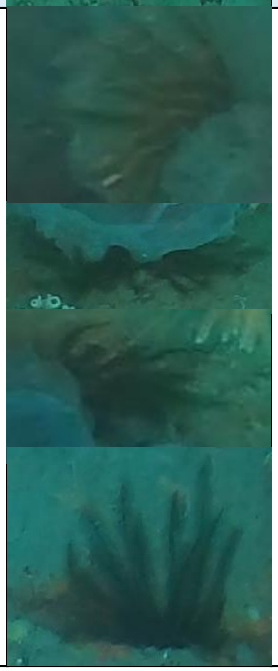
Suberites cf. perfectus		1, video 1	13:35	New distribution if it is *Suberites perfectus* (need a sample to confirm). Resolution poor, hence difficult to assign. Not in a group and not shallow subtidal so may not be *Suberites perfectus* . **NIWA Splendid Sponges:** Relatively common in the shallow subtidal around Hohoura, Tutukaka, and Rodney from 3–15 m. Outlying records from Mayor Island and Three Kings at around 120 m.
cf. Tetrapocillon novaezealandiae		1, video 1	13:46	New distribution. Resolution poor, hence difficult to assign. *Tetrapocillon novaezealandiae* is one of the few jet black sponges in Aotearoa, hence this suggestion, however it is usually found in shallow waters to about 10m (C. Battershill, personal communication, March 17, 2021). **NIWA Splendid Sponges:** Commonly found encrusting on shaded rock surfaces and boulders in intertidal and shallow subtidal waters down to about 20 m, on moderately exposed coastlines along the northeastern section of the North Island including the Hauraki Gulf, Coromandel Peninsula and offshore islands, and the Three Kings Islands. **Porifera ID Guide:** Recorded from Barren Arch (Poor Knights Islands), Leigh, Takatu Point,
cf. Iophon minor but check *Callyspongia cf. ramosa*	 	1, video 1	13:23	Resolution poor, hence difficult to assign.
Callyspongia cf. latituba but check *Iophon laevistylis*	 	1, video 1	14:37	New distribution if it is *Callyspongia cf. latituba* . The mauve colour suggests *Callyspongia latituba* , however, *Iophon laevistylis* could also be mauve if infected with a fungus (C. Battershill, personal communication, March 17, 2021). **NIWA Splendid Sponges:** Very common along the northeastern coastline of the North Island and offshore islands on shallow rock flats, boulder slopes, sandy areas around the bases of reefs, and in macroalgal forests, down to about 20 m. First recorded from North Cape at 140 m, and known from East Cape, Marlborough Sounds and Fiordland, down to 30 m. **Porifera ID Guide:** Throughout New Zealand and on most offshore islands.
Callyspongia ramosa		1, video 1	15:30	White tips to the branches suggests this indivdual is growing fast. Common throughout Aotearoa (C. Battershill, personal communication, March 17, 2021).

cf. Trachycladus stylifer		1, video 1	12:30	Endemic and rare. Should ID prove positive (on collection of a sample), this would represent the southern most extension of this species, normally found at the Three Kings and Poor Knights Is. (C. Battershill, personal communication, March 17, 2021). **NIWA Splendid Sponges:** Restricted in distribution to coral rock, sand and rubble patches on rocky reefs in northern New Zealand, this species was described from east of North Cape at 100 m, and has subsequently been collected from the Three Kings Islands down to 200 m; North Cape, 50–80 m; Spirits Bay, and the Poor Knights Islands around 27–37 m. **Porifera ID Guide:** Recorded only from North Cape, the Poor Knights and the Three Kings Islands.
Possibly new species (*cf. Clathrina* sp. / *cf. Didemnum* sp.) Common name: Guano sponge		1, video 1	15:10	Resolution poor, hence difficult to assign.
Dendrilla cf. rosea		1, video 1	15:12	**Porifera ID Guide:** Common all around the North Island of NZ.
Petrosia cf. hebes		1, video 1	15:15	Resolution poor, hence difficult to assign. **NIWA Splendid Sponges:** Relatively common along the northeast coast of the North Island, from Lord Howe Rise to the north of New Zelaand, Three Kings Island south to Chatham Rise, ranging from 4–80 m depth.
Dactylia varia but check *Callyspongia ramosa*		1, video 1	16:42	**NIWA Splendid Sponges:** Dactylia varia is very common around the coastline of New Zealand and often found on beaches and dredged up from sea beds of sand-shell hash, attached to shells and rubble. Occurs from about 5 m down to about 100 m.
cf. Xestospongia sp. But check *Adocia* sp.		1, video 1	16:42	Need a sample to ID.
Darwinella cf. gardineri		1, video 2	1:09	**NIWA Splendid Sponges:** Common from 10–30m depth around New Zealand, south to Campbell Plateau (160 m). The type locality of this species is Maldives in the western Indian Ocean, and it has since been described from European waters and the southern Red Sea. The New Zealand specimens are highly likely to be endemic, but the genus has few characters on which to differentiate species as they lack mineral spicules. **Porifera ID Guide:** Endemic. New Zealand, northern offshore islands and Stewart Island.
cf. Polymastia aurantium		1, video 2	1:15	Resolution poor, hence difficult to identify. **NIWA Splendid Sponges:** Commonly encrusting the sides of exposed surge channels on exposed west coast beaches, and silty papa rock platforms (mudstone) in the Manukau Harbour (main image). Also common in shallow inshore rocky reefs on Northland coasts and reported from Kaikoura (20 m) and the east coast of the South Island down to 120 m.

APPENDIX C

Drop camera data for Echinodermata at Nukutai Reef.

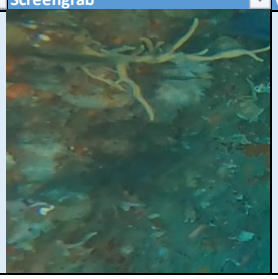
Echinodermata

Species	Screengrab	Video transect	Time first seen	Notes
Australasian brown sea cucumber (*Australostichopus mollis*)		2, video 1	7:34	**NIWA Extraordinary Echinoderms:** Distributed all around New Zealand
Feather star *(Cenolia novaezealandiae)*		1, video 1	2:42	**NIWA Extraordinary Echinoderms:** Found in the north of the North Island, and widespread around Australia and the southwest Pacific

APPENDIX D

Drop camera data for Hydrozoa at Nukutai Reef.

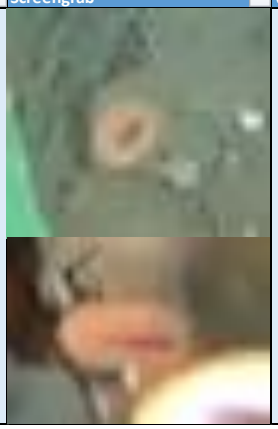
Hydrozoa

Species	Screengrab	Video transect	Time first seen	Notes
Field of black hydroids		1, video 1	12:15	There are good assemblages of turfing bryozoa and hydroids on this reef.

APPENDIX E

Drop camera data for Cnidaria at Nukutai Reef.

Cnidaria

Species	Screengrab	Video transect	Time first seen	Notes
cf. Desmophyllum dianthus		1, video 1	12:39	Cup coral found around NZ (C. Battershill, personal communication, March 17, 2021).

APPENDIX F

Drop camera data for Bryozoa at Nukutai Reef.

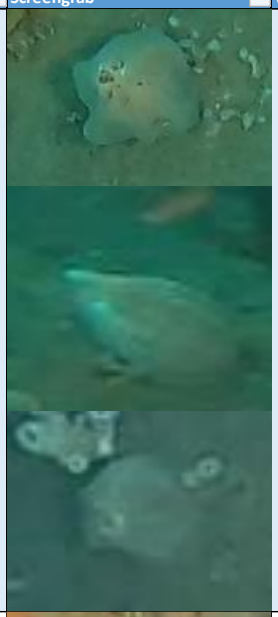
Bryozoa

Species	Screengrab	Video transect	Time first seen	Notes
cf. Menipea vectifera living inside *Iophon laevistylis*		1, video 1	13:36	New distribution **NIWA Bountiful Bryozoans:** Only occasionally found, but it can be common in those areas. Endemic, occurring at the Three Kings Islands, Cook Strait and Fiordland.

APPENDIX G

Drop camera data for Ascidians at Nukutai Reef.

Ascidians

Species	Screengrab	Video transect	Time first seen	Notes
Possibly new *Aplidium*, but check *Psammocinia perforodorsa* Common name: Meringue sponge/sea squirt		1, video 1	3:09	
cf. Styela plicata		1, video 1	13:42	Resolution poor, hence difficult to assign. **NIWA Awesome Ascidians:** Previously recorded from the East coast of Whangarei down to Auckland, and the Northern coastline of the South Island.
Possibly new species - sponge or *Aplidium* sp. Common name: Orange crown sponge/sea squirt		1, video 1	12:59	Not seen before. Could be sponge or compund ascidian (an *Aplidium sp* . if the latter).
Possibly an Ascidian		1, video 1	16:53	Resolution poor, hence difficult to assign.