

Rapid Ecological Assessment of Sponge and Associated Marine Communities Post Dredging in Tauranga Harbour Entrance



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1 Executive Summary

A rapid ecological assessment targeting sponge and associated benthic marine communities was conducted along the eastern side of the Tauranga Harbour entrance channel adjacent to the northern shoreline of Mauao on 13th December 2016. Surveys were conducted to provide qualitative observations on health and survival of hard bottom benthic communities (primarily sponge and algal populations) post Port of Tauranga dredging operations carried out in 2015 -2016. Sampling was stratified by depth (15-20m, 10-15m, 5-10m) with a roving diver technique (RDT) and photo-quadrats were utilised to provide a rapid assessment of substrate and epifauna found in the study area.

Composition of the benthos was similar at all three depth ranges. The slope ranged from 20° to 75°, and was comprised of bedrock and boulders interspersed with medium to coarse sand. No evidence of extensive burying was observed during the survey.

In general the species composition was diverse, with old growth invertebrate fauna and large sponge colonies. There were no un-colonised, exposed hard surfaces observed during this survey. Those hard surfaces left exposed to the water column appeared healthy and diverse with living organisms that could not have established and grown to the observed size in the period since dredging started. The large sponge sizes observed appeared to be typical of a high current, limited light environment, climax community.

Overall the area's diversity and community structure appears healthy, comparable and little changed to the pre-dredge environment surveyed in Warren et al. (2015).

2 Introduction

Tauranga Harbour is a large tidal estuarine environment located on the north east coast of the North Island of New Zealand in the Western Bay of Plenty (Figure 1). Covering an area of 210km², it extends over 30km from the eastern areas of Rangataua Bay to Otawhiwhi in the west.

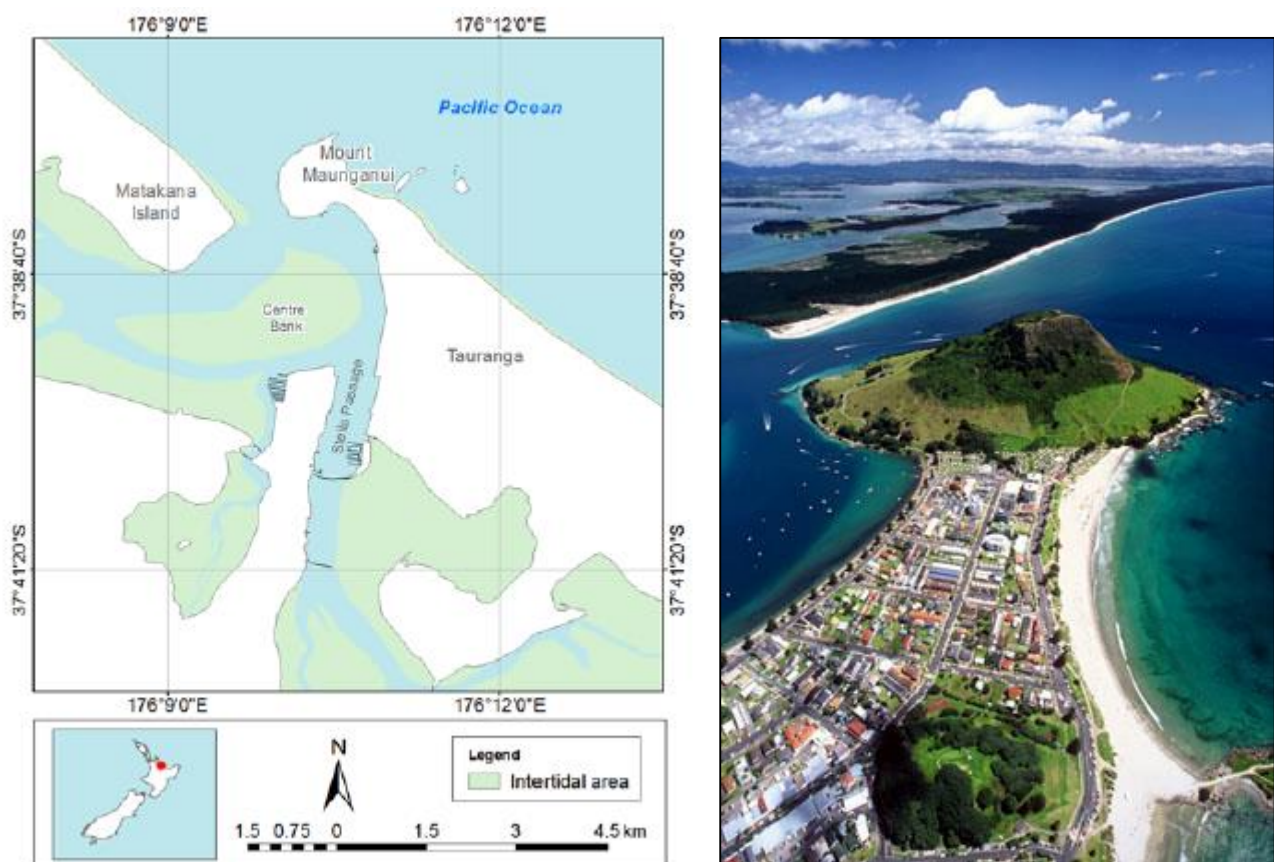


Figure 1 Tauranga Harbour Entrance (Cussioli et al, 2015, BOPRC, 2015)

The harbour has two entrances at opposing ends of Matakana Island, a long, narrow, sand barrier island that stretches over 20km from Mt Maunganui to Bowentown. The Tauranga Entrance forms a channel between the south eastern end of Matakana Island and the volcanic tombolo Mauao, this area is heavy with boat traffic being the entrance to the Port of Tauranga. Tidal flow is strong and currents ranging from 4 – 7 knots are generated through the entrance.

Throughout New Zealand, dredging operations have been used to deepen, extend and maintain shipping channels. Dredging of the Tauranga Harbour has been carried out since 1968 to maintain and improve shipping approaches by deepening and extending channels (Healey et al, 1998). In 1992 areas of the entrance channel were deepened from 10m to 14.1m. Since then maintenance dredging has continued due to increased sedimentation rates, Kruger and Healy (2006) report that 110,500m³ of sediment is dredged annually to maintain the required depth.

On the 3rd of March 2013 the Minister for Conservation granted consent to the Port of Tauranga to undertake further dredging operations to widen the shipping channels within Tauranga Harbour. Dredging commenced in 2015 and continued through to August 2016, limits were set on volume of material removed to achieve the required depth of up to 17.4 metres in some areas of the shipping channel (BOPRC, 2010).

Large quantities of sediment can be produced by dredging which eventually are deposited on the seabed. Suspended sediments are transported by currents before deposition, their dispersal is determined by volume and frequency of dredging as well as local hydrodynamics (Cussoli, Bryan, Pilditch & De Lange, 2015). Suspended sediments can have negative impacts on marine benthic communities. High concentrations of suspended sediments can reduce feeding efficiency in filter feeding bivalves. Sponges are an important component of hard bottom benthic communities and as sessile suspension feeders can be adversely affected by changes in sediment levels. Filtering apparatus and pumping activity in marine sponges can be impaired by ingested sediment which can reduce respiration, growth and reproductive success (Bell et al, 2015). Decreased light penetration through high levels of suspended sediment can also impair photosynthetic capabilities affecting algal and seagrass populations (Cussoli et al, 2015).

Rapid ecological assessments can be useful for assessing habitat condition and identifying sessile encrusting organisms. Photographic quadrats can be used to provide scale and images analysed later for in depth species identification and assessment of condition (Kingsford & Battershill, 1998).

This study aims utilise a rapid ecological assessment to provide a description of the current condition of sponge and algal populations in an area of the Tauranga Harbour that has been impacted by dredging. This information will be used in conjunction with turbidity data supplied by the Port of Tauranga to rationalise and recommend turbidity standards for proposed dredging of the Whangarei Harbour.

3 Methods

The survey was undertaken on behalf of Refining New Zealand as an independent rapid ecological assessment of the hard bottom benthic communities (primarily sponge and algal populations) post dredging within the Tauranga Harbour entrance.

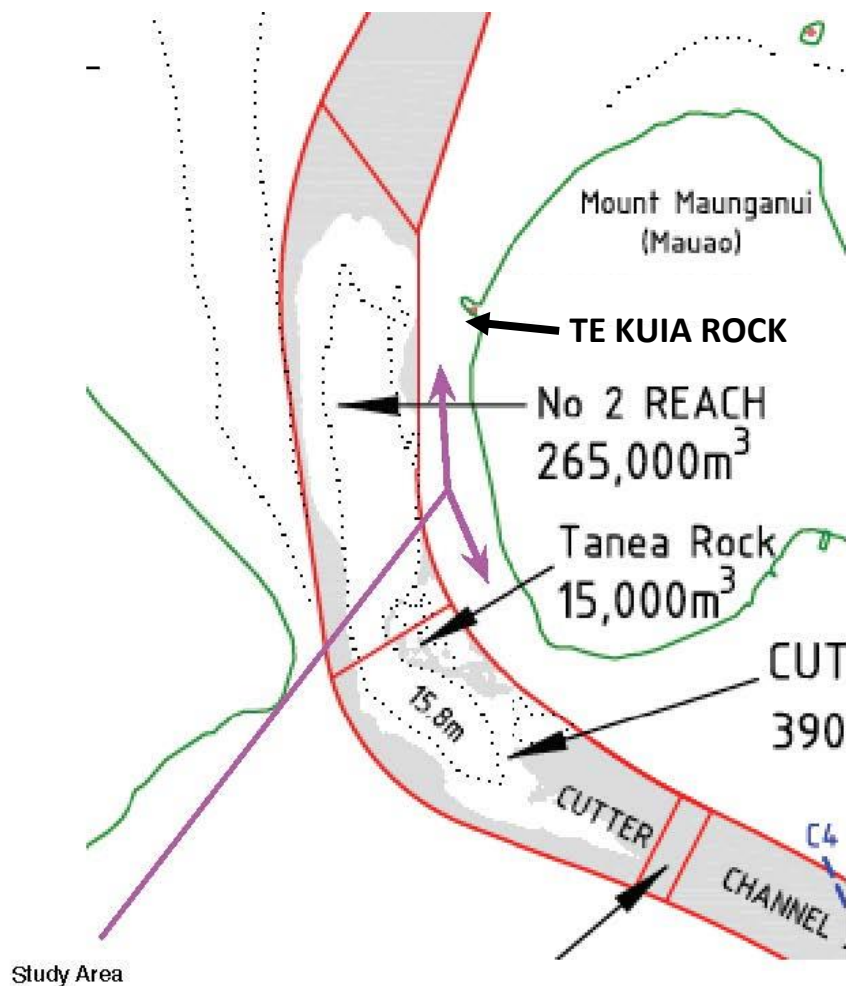


Figure 2. Survey site location identified by Brian T. Coffey and Associates Limited.

Three depth bands were monitored: 20-15m, 15-10m and 10-5m

Diving was conducted on a high slack tide to give optimum visibility and diving conditions.

The descent took place at the northern end of the prescribed survey area (GPS: 37° 37.912 S, 176° 09.920 E) and divers followed the channel bank which ran approximately south-east.

Divers quickly descended as a pair to the first depth band (Depth band 1), locating boulders along the edge of the steep channel bank. A 0.25m² (500mm x 500mm) square quadrat was used as a focal area and if needed, a quantitative measure. A Canon G12 camera inside a water proof housing with associated twin strobes (DS160 and DS51 Ikelite) was used to capture the images.

One diver operated the camera whilst the other diver provided in-water diver supervision and noted general qualitative observations on the benthos.

Ten photo quadrats were obtained from each of the three depth bands and additional photos were taken to compensate for poor image quality due to environmental factors.

Once images were taken in the first depth band the divers moved to “depth band 2” and repeated the process. This was repeated for “depth band 3”. The divers then completed a safety stop at 5m for 3 minutes, and surfaced in the shallows to board the awaiting dive tender.

The images and qualitative recordings were subsequently used to provide a guide to the condition of the hard bottom benthic community in the study area.

4 Results & Discussion

4.1 Interpretation of photographic quadrats

The following is a detailed description of the three depth bands surveyed with a representative image from that area. All the images from each depth band are shown in Appendix 1.

Depth band 1: 15-20 meters

In Tauranga Harbour a diver could expect to find 5 meter visibility on average near the entrance, although this can vary between 0-20 meter depending on rainfall, and recent wave action. At the 15-20 meter depth band light penetration is extremely variable but low, allowing filtering communities such as sponges to dominate. There were no macrophytes present except *Ulva sp.* (sea lettuce) which had drifted and settled. The photos show a high diversity of sponges with encrusting to globose morphology. The strong current limits the extent to which any organism can grow out into the water column from its point of attachment. Also present were brittle stars, a moderate diversity of hydrozoan colonies, colonial and solitary tunicates, *Coscinasterias calamaria* (11 arm starfish), *Patiriella regularis* (cushion starfish), and predatory gastropods. Interestingly, no deposit feeding gastropods were noted, as would expect to be found in a depositional environment. Egg ribbons of hydroid and sponge grazing, nudibranch gastropods

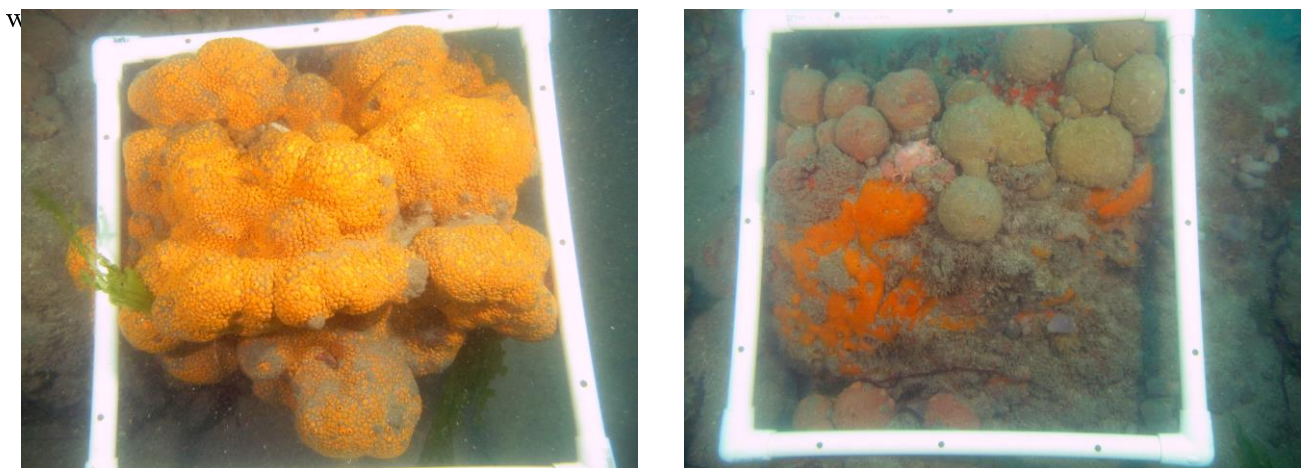


Figure 3. Sponges found in Depth band 1: 15-20m

Depth Band 2: 10 – 15 meters

This depth band was very similar to depth band 1 with the appearance of large aggregations of *Anthothoe albocincta* (white striped anemones), and a small variation in diversity of sponges as can be seen in the photos. The average slope is slightly less than depth band 1 with a bit more patchiness and space between hard surfaces. Some small palmate red algae were present as well as *Ulva sp.* that had drifted and settled.

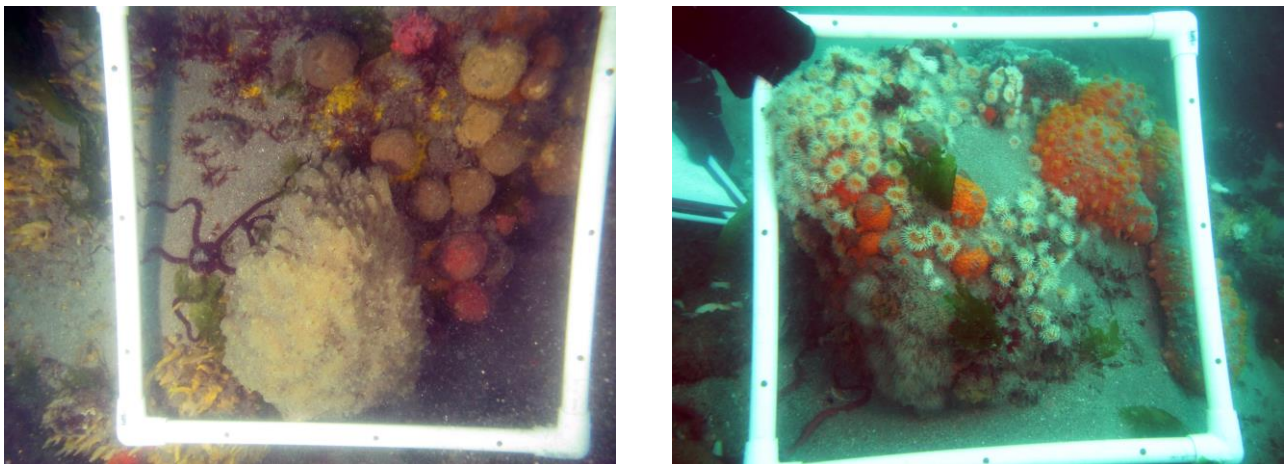


Figure 3. Sponges and White striped anemones found in depth band 2: 10-15m

Depth Band 3: 5 – 10 meters

This depth band has a higher light exposure and allows some successful competition by macrophytes. The faunal community is again, sponge and anemone dominated but at roughly 9 meters depth brown algae starts to appear with both *Undaria pinnatifida* and *Ecklonia radiata* present. Small palmate red algae are more common as well as green algae, *Ulva sp.* Some of the *Paphies australis* (pipi) shell wrack that was more common previous to dredging operations appears in the depositional edges of hard surfaces.

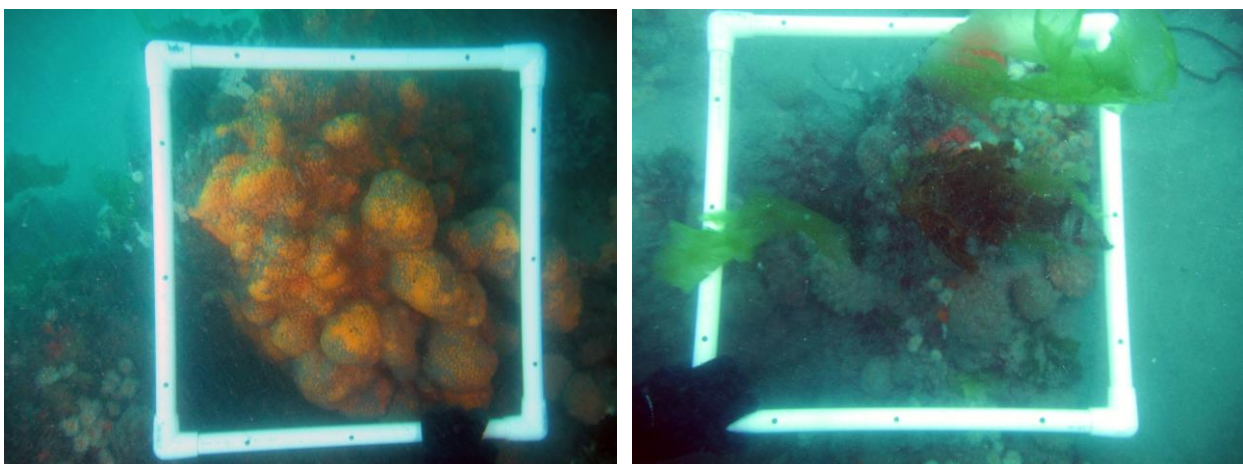


Figure 4. Sponges and *Undaria pinnatifida* found in Depth band 3: 5-10m

5 Conclusion

This rapid ecological assessment used a combination of photographic quadrats and general observations with a roving diver technique to identify and assess the condition of benthic assemblages impacted by dredging activity. *Porifera* and algal populations were used as indicator species being sensitive to high concentrations of suspended and settled sediments and resulting decreased light penetration.

Overall the area's diversity and community structure appears comparable and little changed to the pre dredge environment surveyed in Warren et al. (2015). No evidence of extensive burying was observed.

There were no un-colonised, exposed hard surfaces observed during this survey. In general the species composition was diverse, with old growth invertebrate fauna and large sponge colonies. Growth rates will differ between sponge species and variability in growth can be caused by many different factors such as size, age, damage and environmental conditions (Ayling 1983; Handley et al. 2003). However growth rates are in general relatively slow with reported rates ranging from 0.2mm to 0.5cm year⁻¹ (Ruppert et al, 2004; Murray et al, 2008). Those hard surfaces left exposed to the water column appeared healthy and diverse with sponges that could not have established and grown to the observed size in the period since dredging started. The large sponge sizes observed appeared to be typical of a high current, limited light environment, climax community.

6 References

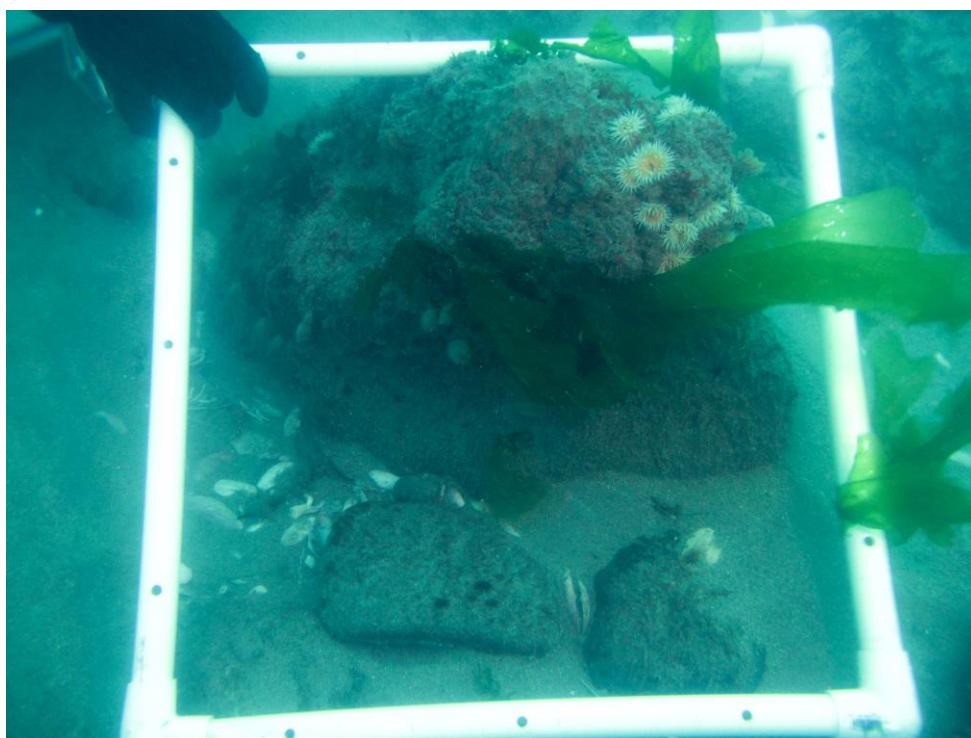
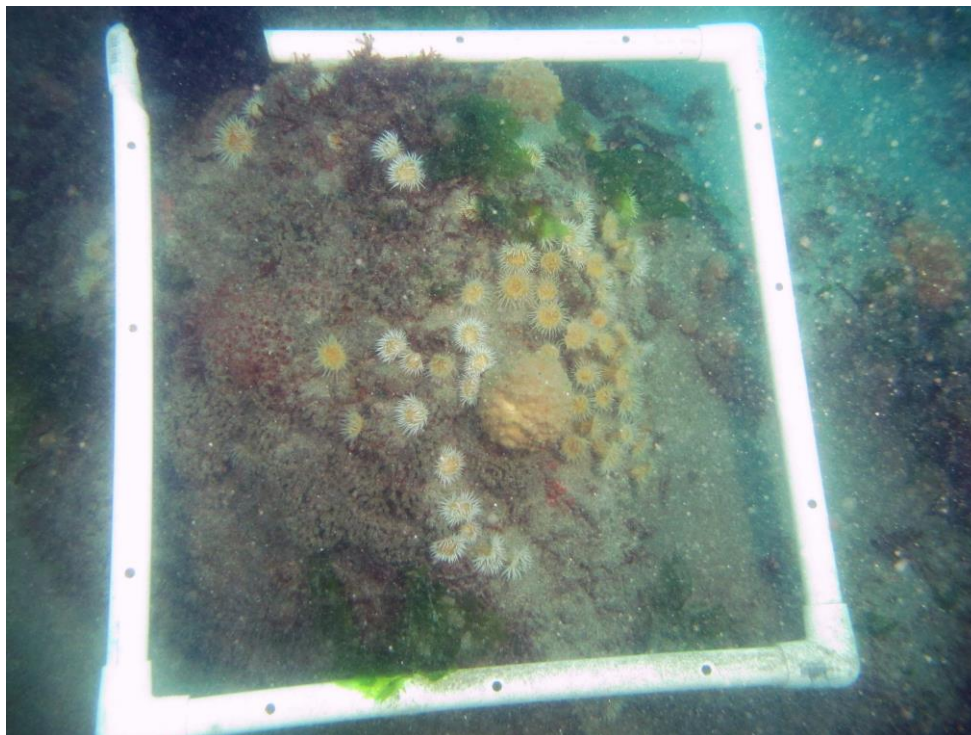
- Ayling A.L., (1983). Growth and regeneration rates in thinly encrusting demospongiae from temperate waters. *Biology Bulletin* 165:343–352
- Bay of Plenty Regional Council (2010) Conditions for Coastal Consent No. 65806 – retrieved from www.boprc.govt.nz/media/28877/Consents-100603-PortofTgaConditions65806.pdf
- Bell, J., McGrath, E., Biggerstaff, A., Bates, T., Bennett, H., Marlow, J. & Shaffer, M. (2015). Sediment impacts on marine sponges. *Marine Pollution Bulletin* 94, 5–13
- Cussioli, M., Bryan, K., Pilditch, C., & Lange, W. Dispersal of dredging plumes in Tauranga Harbour, New Zealand: A field study. *Australasian Coasts & Ports Conference 2015 15 - 18 September 2015*, Auckland, New Zealand
- Handley, S., Kelly, S., Kelly, M. (2003) Non-destructive video image analysis method for measuring growth in sponge farming; preliminary results from the New Zealand bath-sponge *Spongia* (Heterofibria) *manipulatus*. *New Zealand Journal of Marine and Freshwater Research* 37:613–621
- Healy, T.; Thompson, G.; Mathew, J.; Pilditch, C., and Tian, F., (1998). Assessment of Environmental Effects: Maintenance Dredging and Disposal. A report for the Port of Tauranga Ltd. Tauranga, New Zealand: Port of Tauranga Ltd., 170p.
- Kingsford, M. & Battershill, C. (1998). *Studying temperate marine environments: a handbook for ecologists*. Christchurch, New Zealand: Canterbury University Press.
- Kruger, J.C. and Healy, T.R., (2006). Mapping the morphology of a dredged ebb tidal delta, Tauranga Harbour, New Zealand. *Journal of Coastal Research*, 22(3), 720–727.
- Murray, S.E., Blum, J.E., Pawlik, J.R., (2008). Redwood of the reef: growth and age of the giant barrel sponge *Xestospongia muta* in the Florida Keys. *Marine Biology* 155:159–171
- Park, S.G. (1991). Bay of Plenty regional council coastal overview report. BOPRC.

Ruppert, E., Fox, & R.S., Barnes, R.D., (2004). *Invertebrate Zoology: A functional evolutionary approach* (7th edition). California, USA: Brooks/Cole.

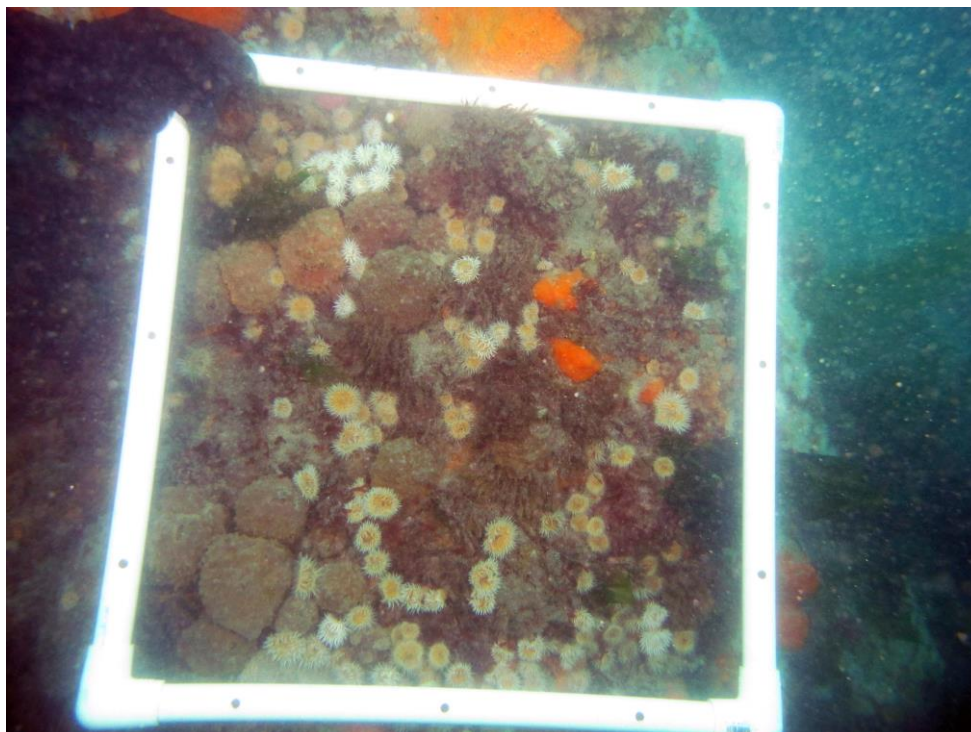
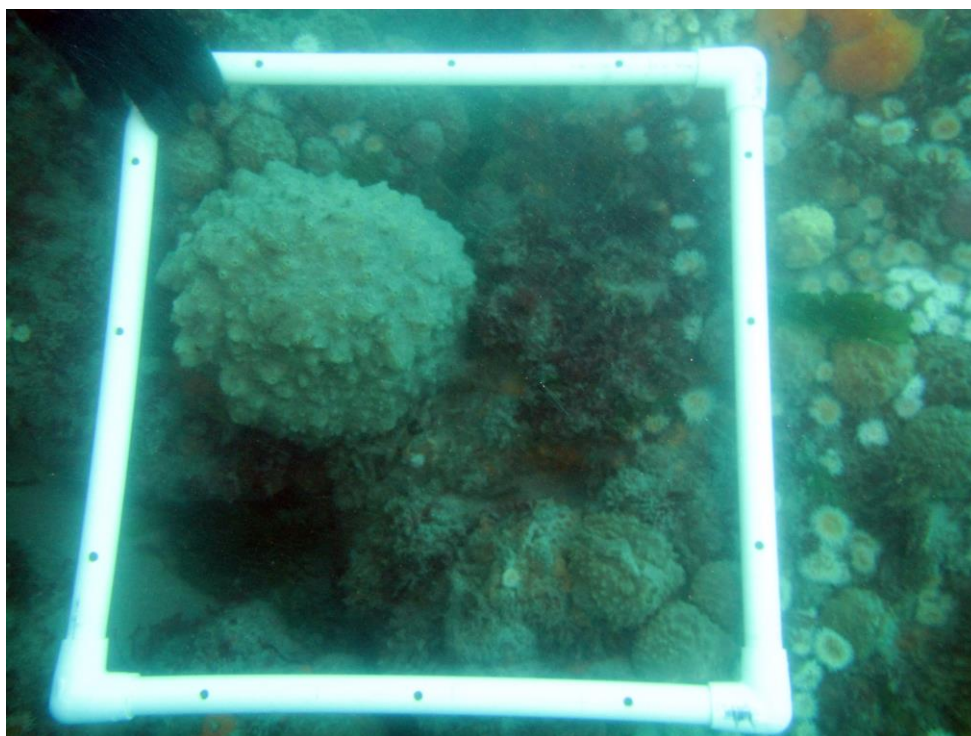
Warren, P., Sharp, D. & Guccione, D. (2015) Tanea Shelf Rapid Ecological Assessment 2015. Client Report August 2015. Report Number 2015-01-TS. Bay of Plenty Polytechnic: School of Applied Science. Tauranga.

7 Appendix 1

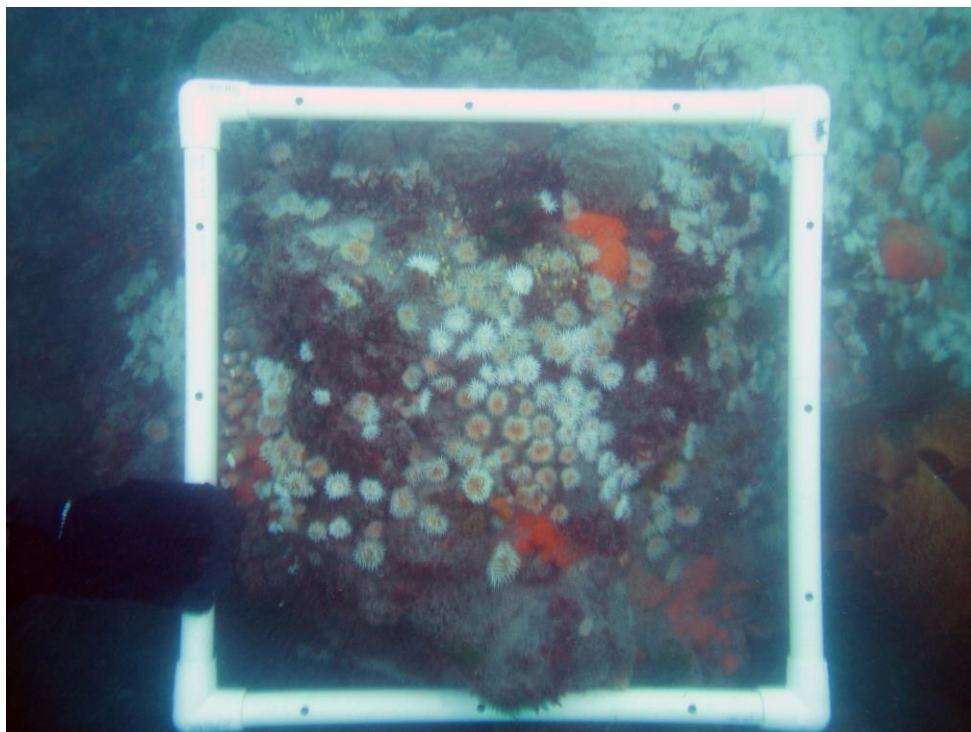
Depth band 3.) 5-10m



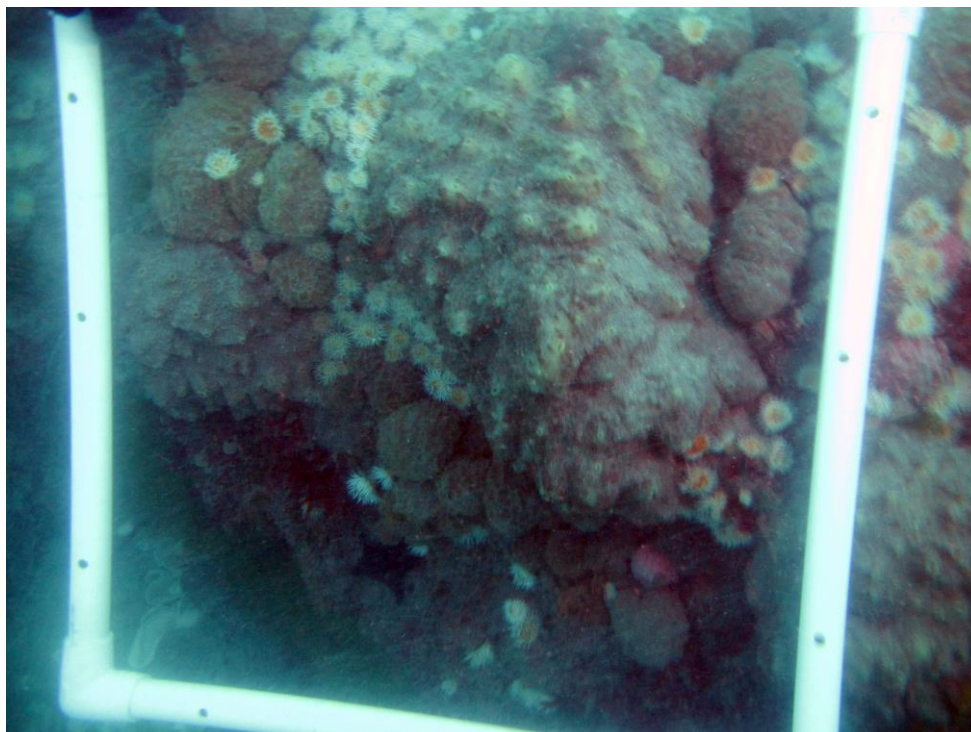
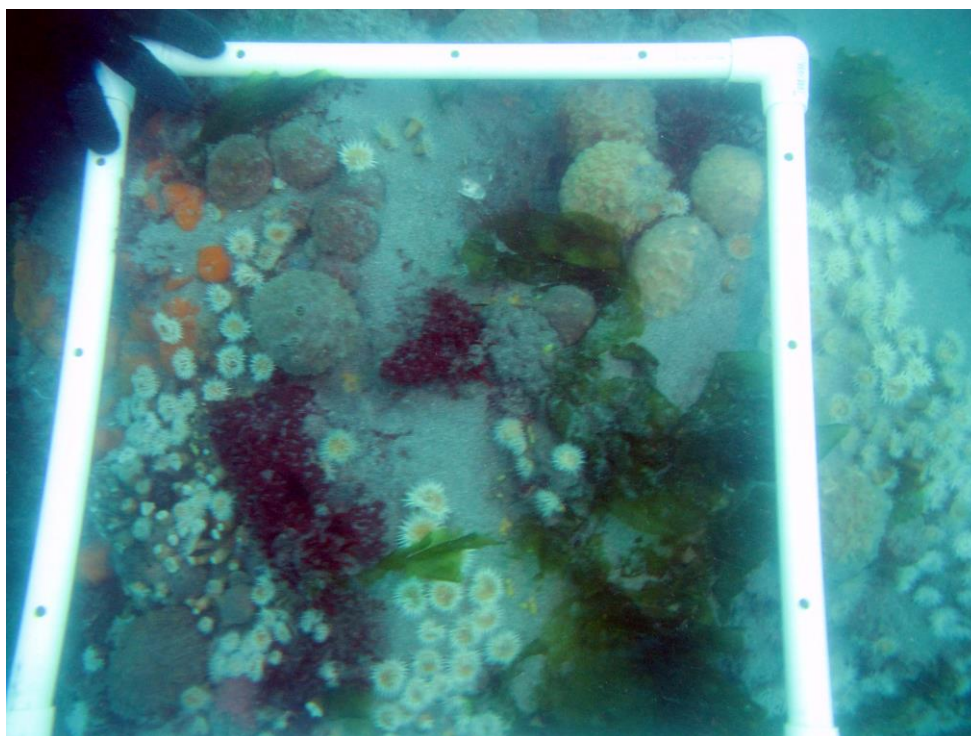
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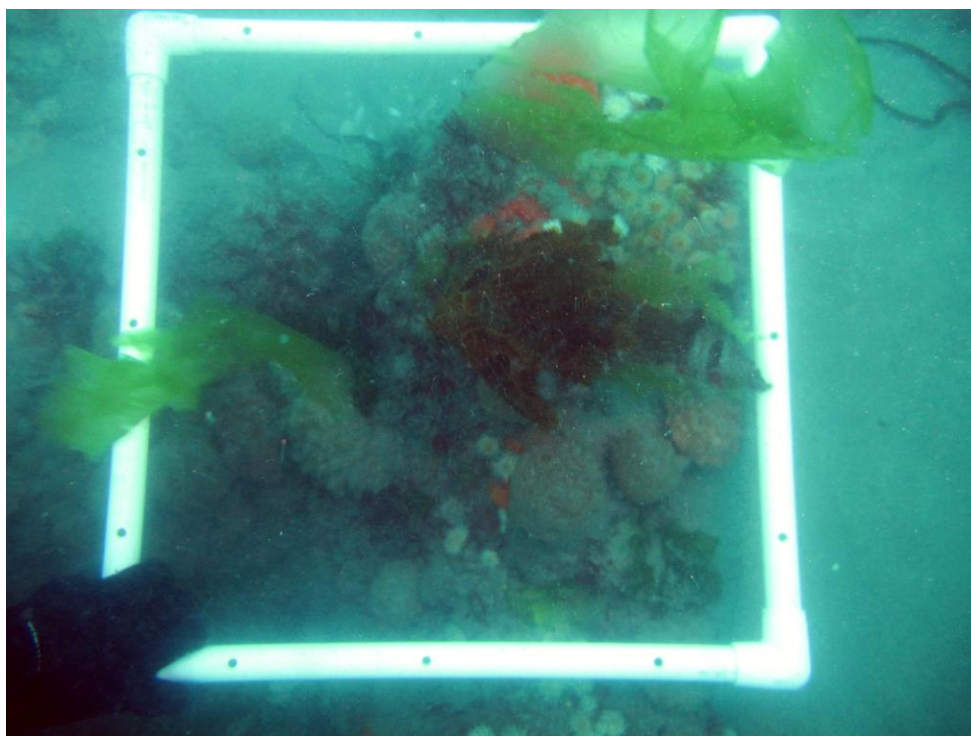
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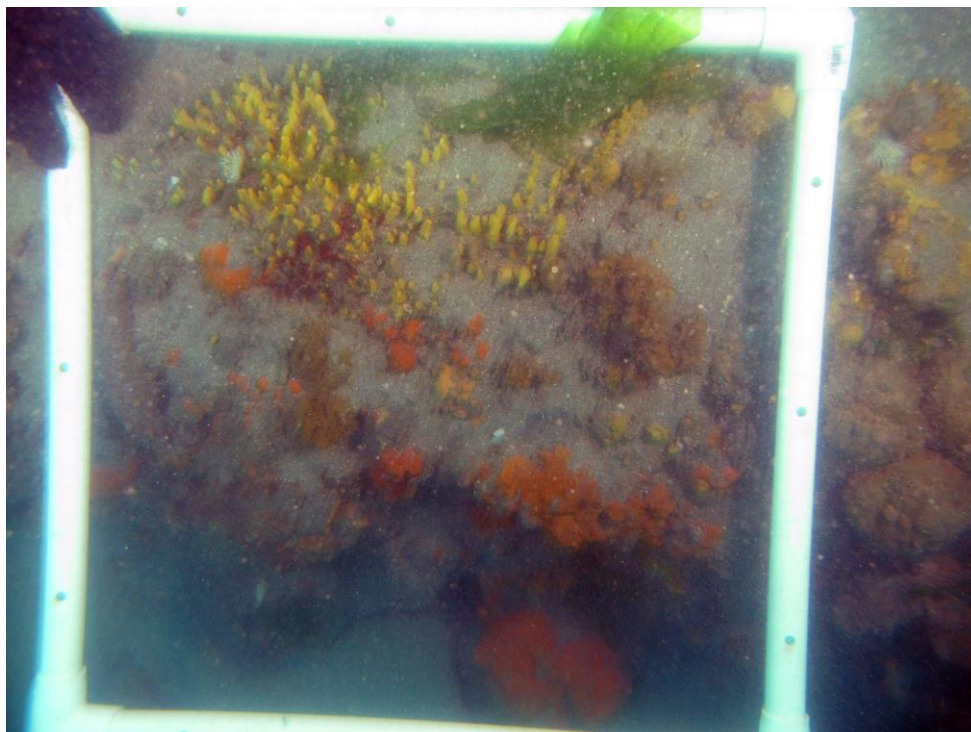
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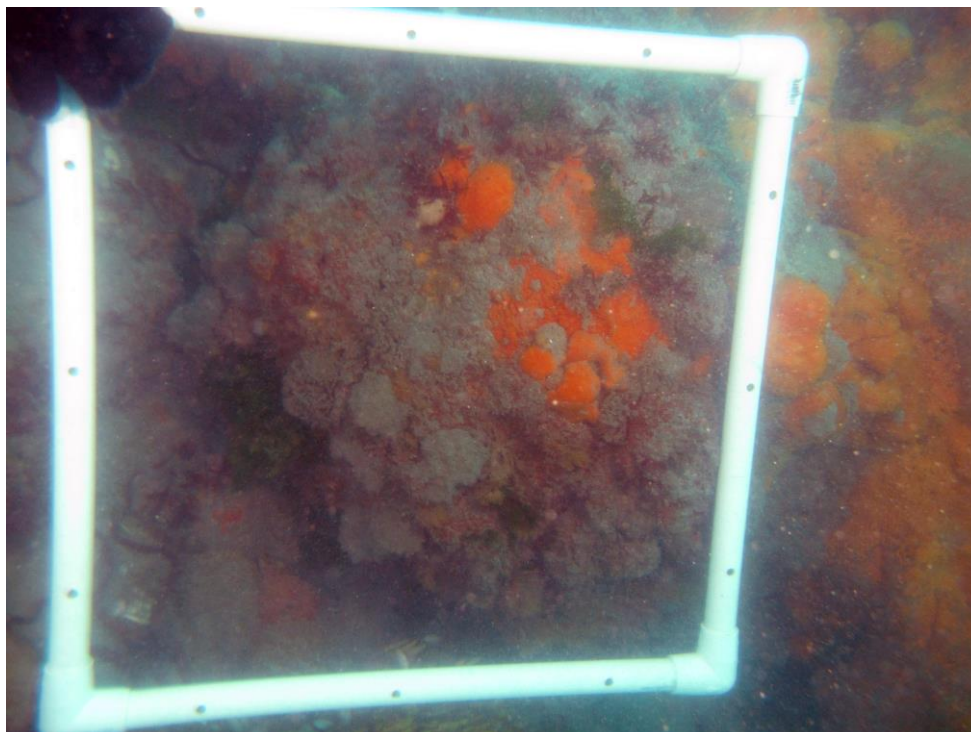
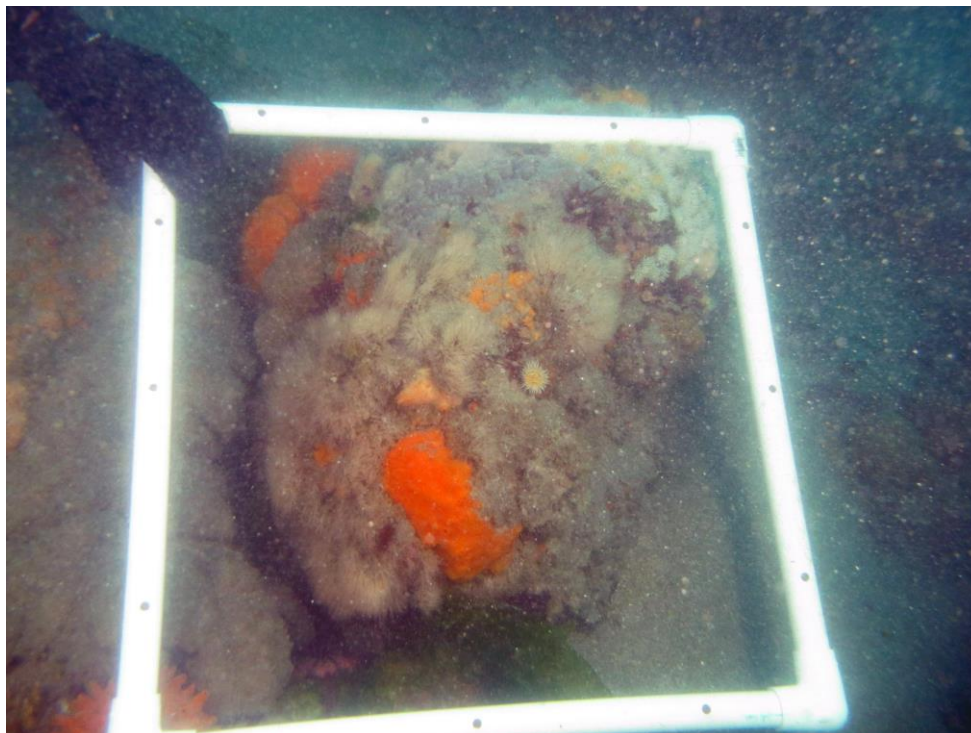
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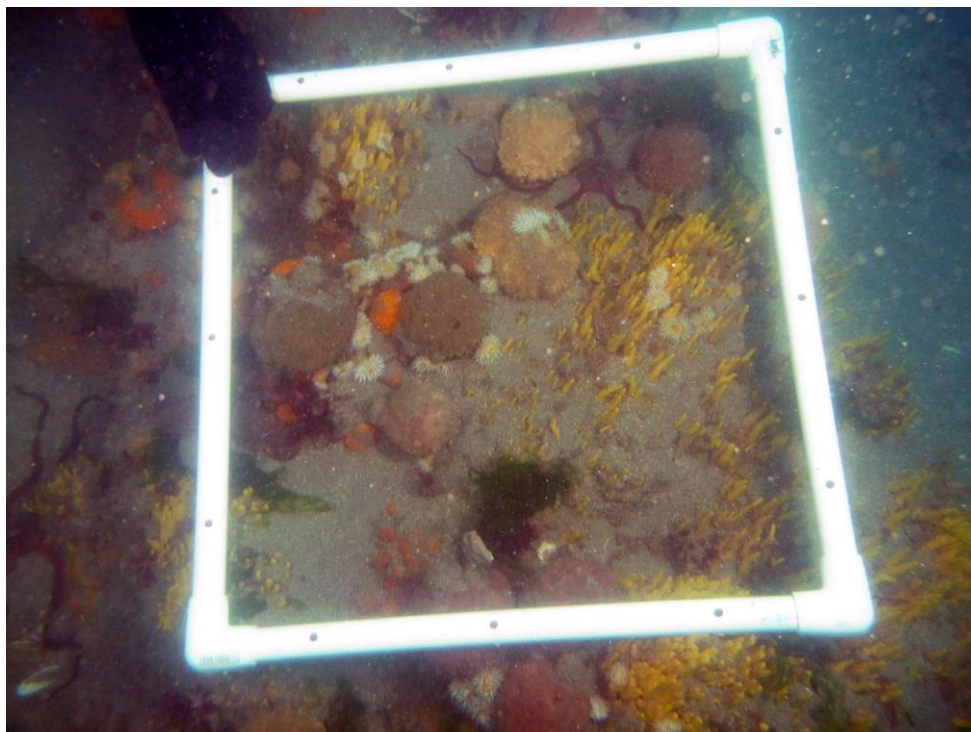
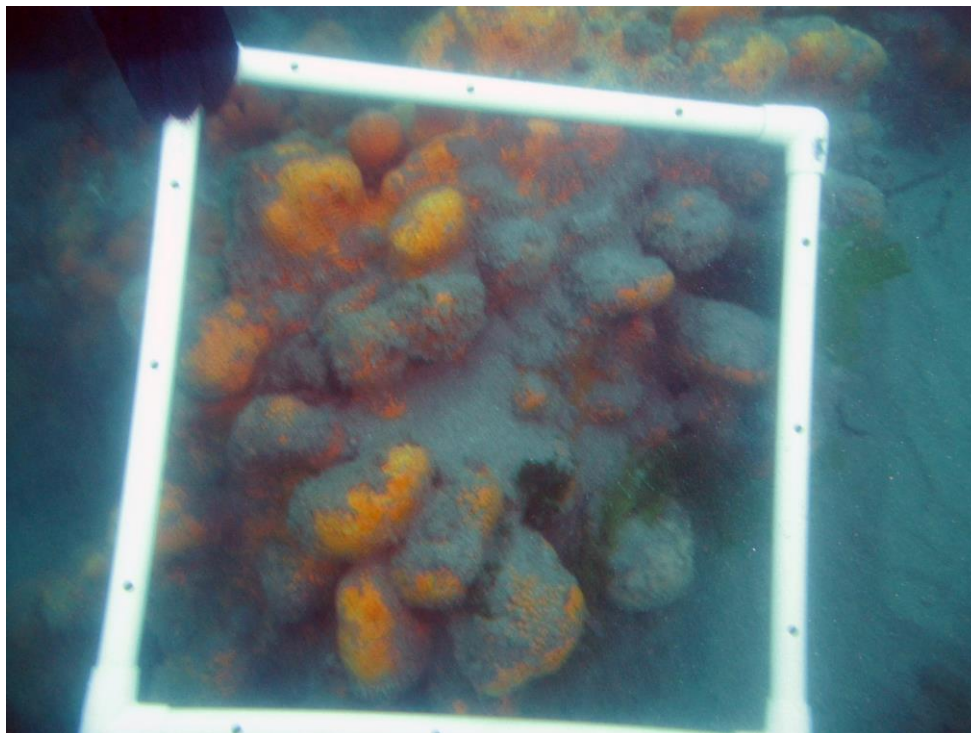
Depth band 2.) 10-15m



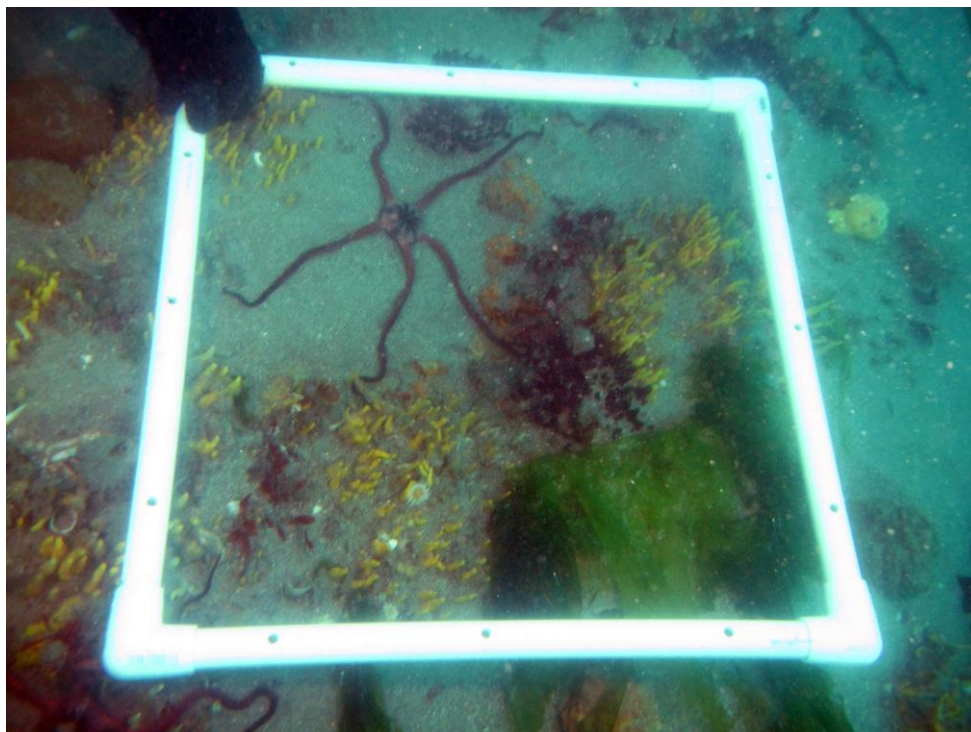
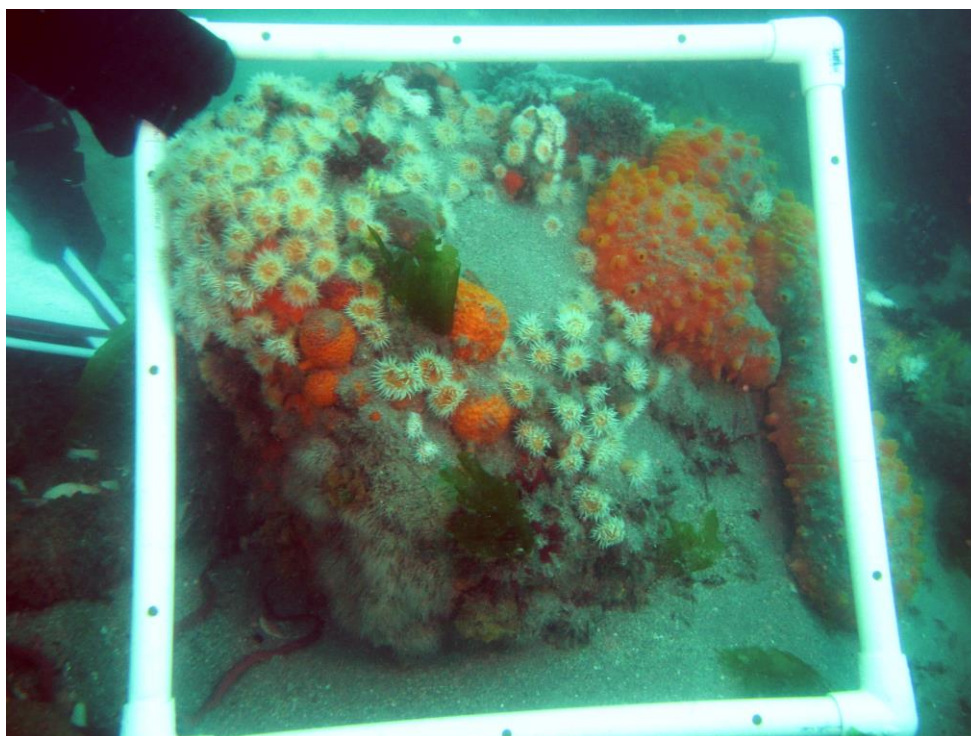
Depth band 2.) 10-15m



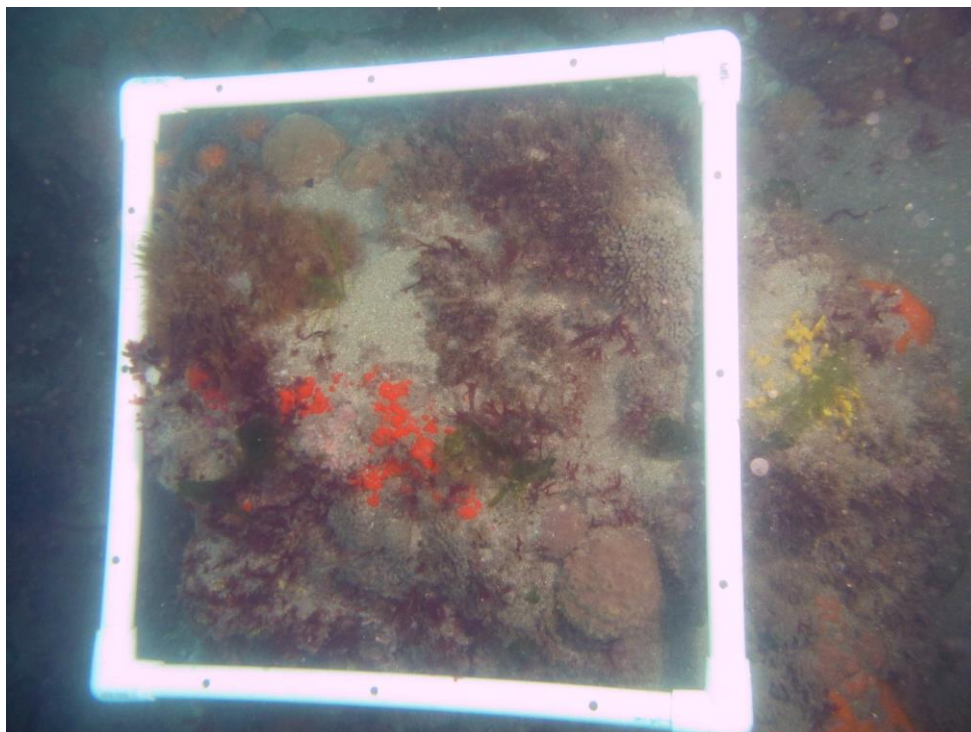
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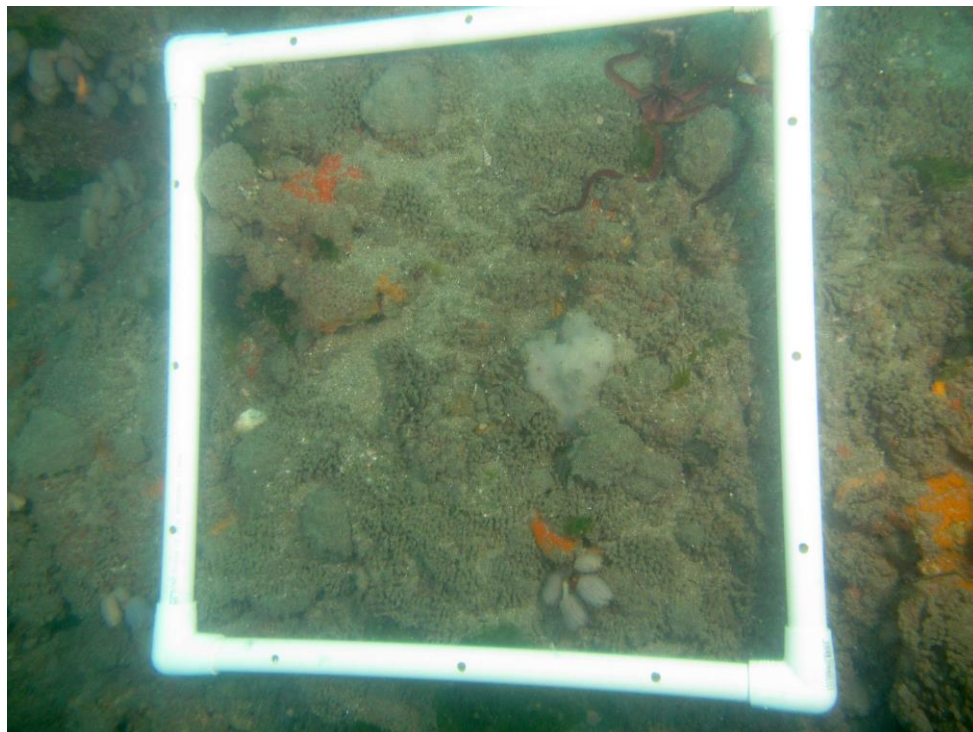
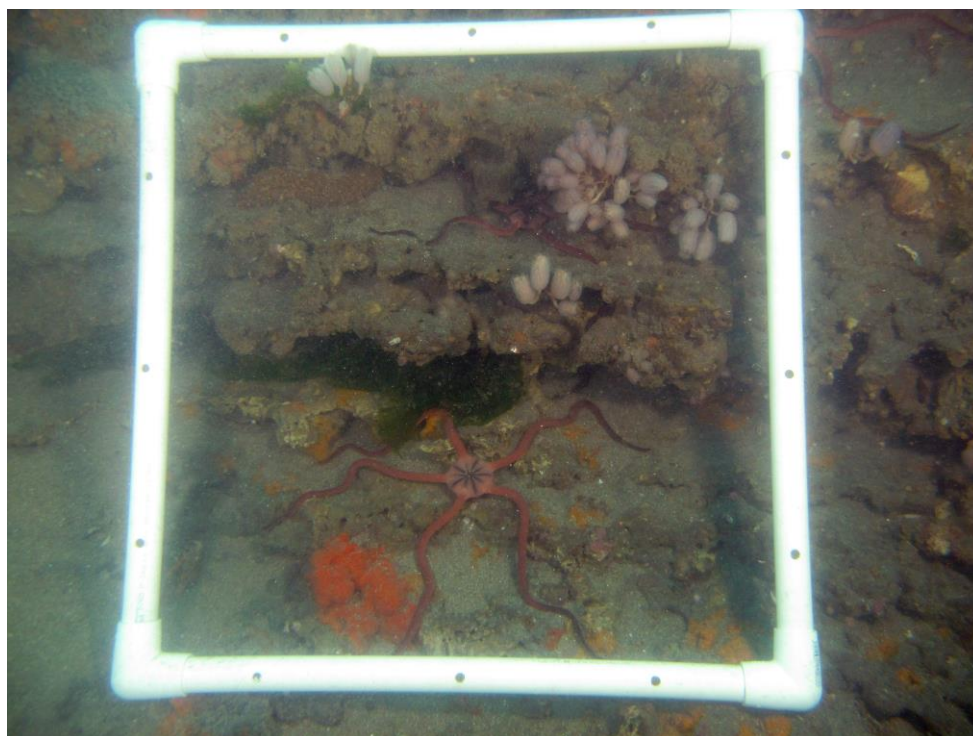
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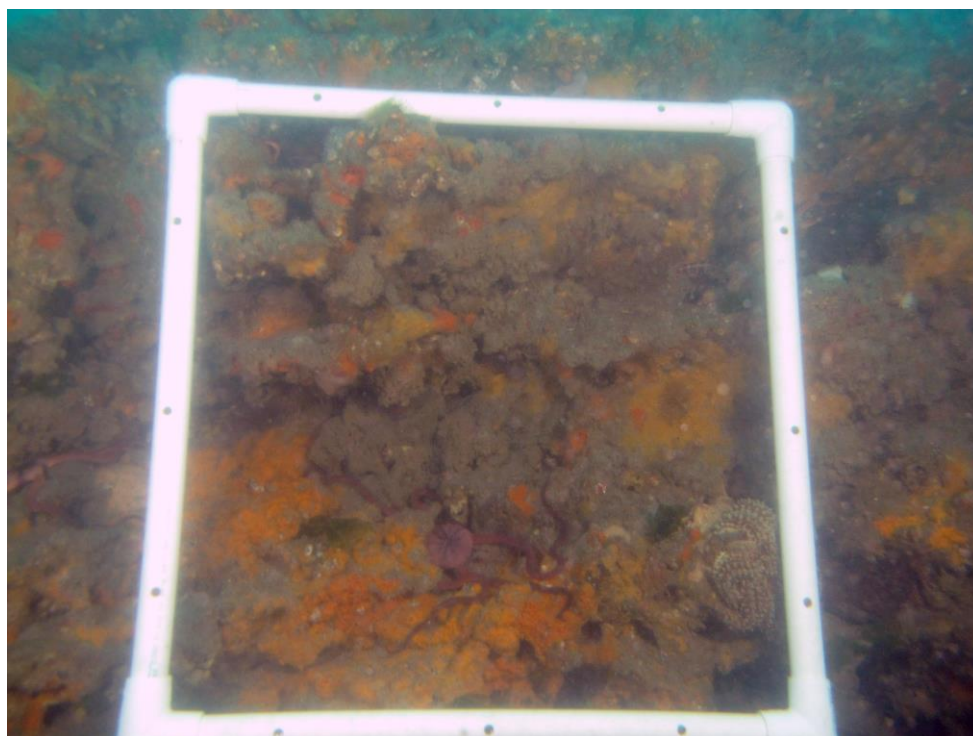
Depth band 2.) 10-15m



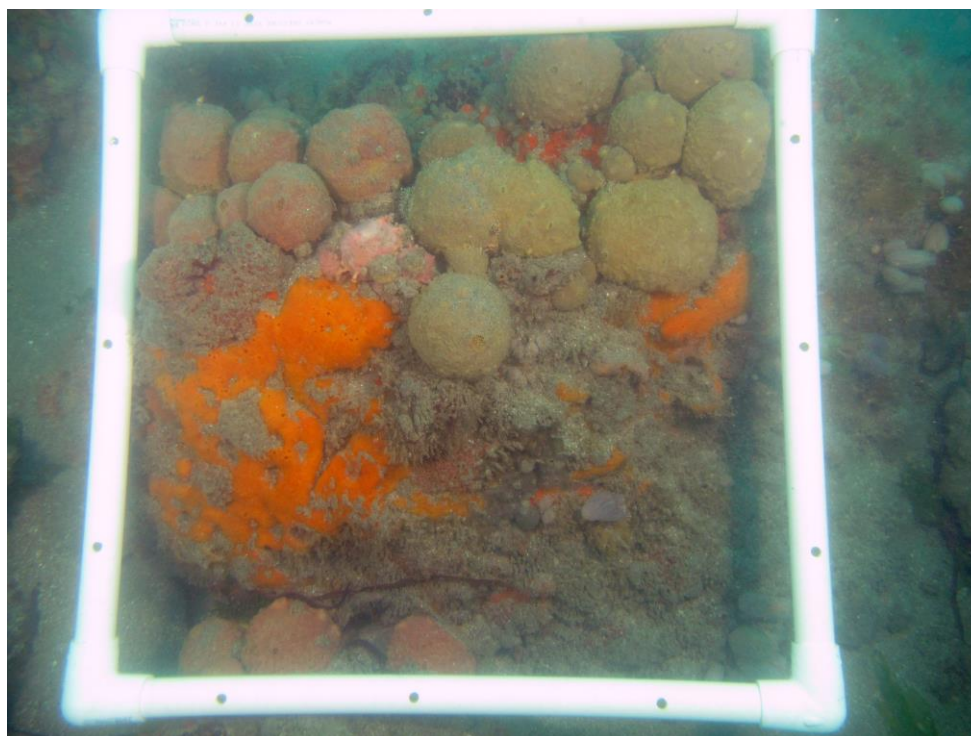
Depth band 1.) 15-20m



Depth band 1.) 15-20m



Depth band 1.) 15-20m



Depth band 1.) 15-20m

