

Monitoring of subtidal reef biota off Motuotau Island in relation to dredge spoil dumping by the Port of Tauranga Ltd

2014-2018

ERI Report no. 118



Prepared for the Port of Tauranga Ltd by

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Cover image:

Construction diver Glen Ladkin installing survey marker pins at Motuotau in 2014

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Executive Summary

Background

- Dredge spoils generated from the development and maintenance of the Port of Tauranga is disposed of on the inner shelf off Mt Maunganui.
- Major channel deepening and widening programmes were undertaken in 1992 and 2015/16. Maintenance dredging is undertaken more regularly.
- Since 1990, monitoring has been conducted to determine if the dumping of dredge spoils was affecting subtidal reef communities around Motuotau Island, as island off Mt Maunganui beach and inshore of the dredge spoils disposal area.
- Three sites at Motuotau have been monitored since 1990. A site to the east of Motuotau has been monitored as a control site and two sites to the north-east and north-west of Motuotau have been monitored as impact sites.
- Monitoring has consisted of photographic monitoring of permanent transects close to the reef-sand boundary to record (a) changes in the elevation of the seabed relative to the rocky reef, and (b) changes in the biological community over time.
- Monitoring has taken place in 1990, 1991, 1993, 1995, 1998, 2001, 2006, 2009 and 2012.
- One of the difficulties of the monitoring programs was that the marker pins, which are cemented onto the reef, would often be dislodged between surveys and would need to be reinstated prior to each new survey taking place. This made it difficult to be sure that the same section of reef was monitored on each occasion and that the measurement of changes in seabed height was accurate.
- In 2013, a decision was made to reinstate marker pins for the permanent transects. In January 2014, holes were drilled into the reef and stainless steel rods were secured in these holes using epoxy cement. It is unlikely that these marker pins will ever be dislodged from the reef.
- At the same time, the monitoring methodology was reviewed and a number of changes recommended. Most significantly, it was decided that the reef being monitored as a control site did not really constitute a control against the effects of dredge spoil dumping and subsequently all three sites would be considered as impact sites.
- Monitoring took place in January and May 2014, November 2015 and April 2018 and is reported on here.

Findings

- Marker pins were reinstated in January 2014 and four and a half years later remain solidly in place.
- In general terms, the reefs around Motuotau appear to be healthy and in a state that is comparable to other reefs of similar depth, aspect and exposure along the Bay of Plenty coastline.
- The 2014, 2015 and 2018 surveys did not record any major changes in the biological communities of the reefs around Motuotau.
- Measurements of the distance between the bottom marker pin at each site and the reef-sand boundary indicate that the reefs are not being inundated by dredge spoils. Seabed

heights have fluctuated by as much as 30 cm since 2014 and this is not thought to be outside the scale of fluctuations that would naturally occur given the aspect and energy environment of the surveyed reefs.

- Photographic surveys continue to prove useful in capturing information about the diversity of subtidal reef communities. Although there is some evidence of minor changes in these communities over time this is to be expected. There is also evidence of stability in these communities with a number of sponges on these transects having been present for several decades.

Introduction

(For full introduction see Grace 1997)

In order to maintain usable and safe shipping channels to the Port of Tauranga, it is necessary to periodically dredge several million tonnes of estuarine seafloor sediment from the entrance and main shipping channel of Tauranga Harbour. The dredged material is deposited on the inner continental shelf, offshore of Mt Maunganui, in accordance with conditions outlined in the Port of Tauranga's resource consents. Major dredging programmes were undertaken in 1992 and most recently in 2015/2016. Dredging is conducted periodically to maintain the depth of the shipping channel.

In 1990 a monitoring programme was established to identify any possible impacts of dredge spoil dumping on nearby subtidal rocky reef communities. Three monitoring sites were established around Motuotau Island. A site to the east of Motuotau has been monitored as a control site and two sites to the north-east and north-west of Motuotau have been monitored as impact sites. Surveys conducted in 1990 and 1991 were undertaken prior to the large scale dredging programme of 1992. Subsequent surveys were conducted in 1993, 1995, 1998, 2001, 2003, 2006, 2009 and 2012. Monitoring has consisted of photographic monitoring of permanent transects close to the reef-sand boundary to record (a) changes in the elevation of the seabed relative to the rocky reef, and (b) changes in the biological assemblages (invertebrates and algae) over time. Seabed elevation was considered a good indication of whether dredge spoils were being transported inshore and smothering coastal reefs. Biological communities at these site were considered to provide an indication of ecological health of reef communities. This was based on the premise that for an organism to exist in an area all its ecological requirements must be met. If a change in the environment occurs, a subsequent shift in the biological community should result. Because sessile benthic organisms (plants and animals attached to the sea floor) cannot migrate to more favourable areas, the density and composition of this group is considered a good measure of recent environmental conditions.

One of the weaknesses of the monitoring programs was that the marker pins, which up until now have been cemented into shallow crevices in the reef, would often be dislodged and be missing from the reef. Typically, at least four or five marker pins would need to be reinstated each survey. This was time consuming and made it difficult to ensure that the exact same section of reef was being monitored on each occasion. It also made it impossible to accurately measure changes in seabed elevation over time. In 2013, the decision was made to more securely reinstate the survey marker pins. In January 2014, holes were drilled into the reef surface and stainless steel rods were cemented into these holes. Given the methods used it is unlikely that these marker pins will ever be dislodged from the reef. At the same time, the monitoring methodology was reviewed and a number of changes recommended. Most significantly, it was decided that the reef to the east of Motuotau that was being monitored as a control site did not constitute a control site and subsequently all three sites would be considered as impact sites.

This report presents the results of surveys conducted in 2014 during and after the reinstatement of the survey pins, in 2015 at the beginning of the 2015/2016 capital dredging programme, and in 2018, almost two years after the completion of this major dredging operation. It serves as an addition to and comparison with previous reports (Grace 1997, Keeley and Pilditch 1998, Keeley and Pilditch 2001, Ross and Pilditch 2006, Ross and Pilditch

2009). The survey provides a quantitative assessment of seabed elevation at survey sites and a qualitative assessment of changes in biological communities at these sites over time.

Methods

Establishment of sites

(For details on initial establishment of sites please refer to Grace (1997)).

Site location and reinstatement of marker pins

The three sites (figure 1) were located by GPS (see site information below for GPS positions). At each site a shot line was dropped from the dive vessel when the distance to the site waypoint was less than 3 m. Using this method we were always able to drop our shot weight within 5 m of the top pin of each transect.

In January 2014, all marker pins were replaced. University of Waikato (UoW) divers familiar with the sites and pin locations were able to identify a number of existing marker pins and these were replaced. Where old pins were not relocated, UoW divers determined the positioning of replacement pins. Commercial divers working on surface air supply from the Port Vessel “the Edward G” used a pneumatic drill to bore holes into the reef surface to a depth of 15 cm. Stainless steel rods were then secured in these holes using epoxy cement. Approximately 30 cm of stainless rod was left protruding from each hole. Each transect was photographed and surveys were subsequently conducted in May 2014, November 2015 and April 2018.

Photographic surveys

At each site, a survey tape was run from the shallowest to deepest marker pin and then down to the reef-sand interface. Video or still images were then recorded across the entire length of each transect. In 2018, still images were stitched together in a photo mosaic to provide an image of the entire length of the transect.

Measurement of seabed elevation relative to reef

The distance from the bottom (deepest) pin to the reef-sand boundary was recorded at each site. This measurement was taken to be the shortest distance between the marker pin and the reef-sand boundary.

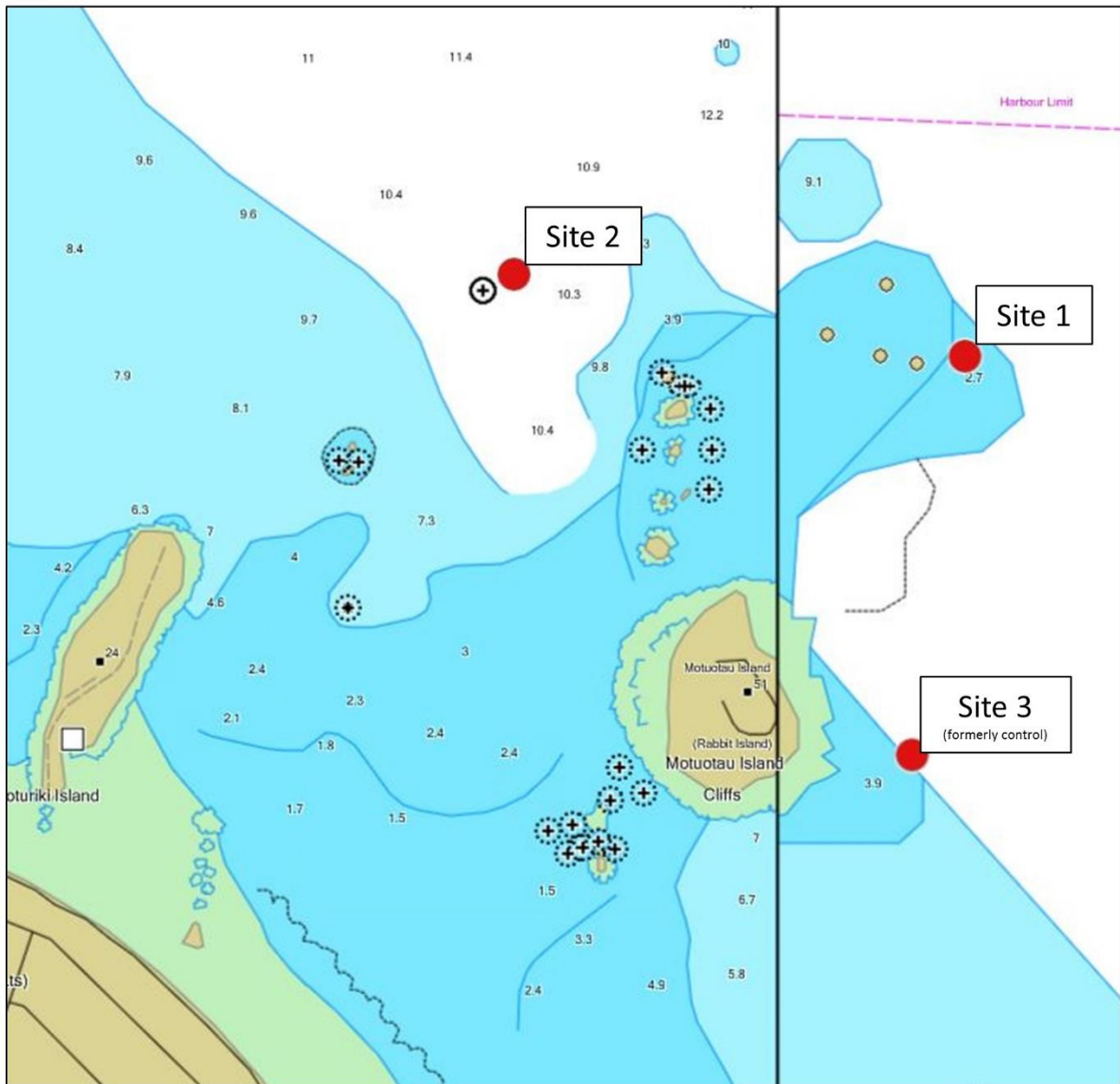


Figure 1. Chart showing Motuotau and the locations of the three survey reefs (red circles)

Site 1

One of a group of submerged high rocks seaward of a prominent shallow submerged reef to the southeast of the reef northeast of Motuotau island.

Coordinates

Maketu F coordinates:	714654N	276266E
WGS-83 Lat. Long.:	37° 37' 37.681S	176° 11' 51.129E
Chart Lat. Long.:	37° 37.74S	176° 11.87E
Metric grid:	6392224N	2792464E
NZMS 260 U14:	925922	

Site 2

On the seaward edge of a patch of rock, locally known as Charlie's Reef, outcropping on the sandy seafloor, northeast of Wedding Cake Rock.

Coordinates

Maketu F coordinates:	714760N	275690E
WGS-83 Lat. Long.:	37° 37' 34.189S	176° 11' 27.652E
Chart Lat. Long.:	37° 37.68S	176° 11.49E
Metric grid:	6392355N	2791909E
NZMS 260 U14:	919924	

Site 3 (formerly called Control site)

Outer edge of a small submerged patch reef southeast of Motuotau island.

Coordinates

Maketu F coordinates:	714130N	276200E
WGS- 1983 Lat. Long.:	37° 37' 54.671S	176° 11' 48.376E
Chart Lat. Long.:	37° 37.93S	176° 11.70E
Metric grid:	6391881N	2792202E
NZMS 260 U14:	922919	

Results

Seabed elevation

Variations in seabed elevation are presented in table 1 and in figure 2. At site 1, the distance to the reef-sand boundary varied between 0.2 m and 0.09 m with no trend of either increasing or decreasing seabed elevation at this site. At site 2, the distance to the reef-sand boundary varied between 1.2 m and 1.0 m. Again, there was no trend of either increasing or decreasing seabed elevation at this site. At site 3, formerly the control site, distance to the reef-sand boundary varied between 1.1 and 0.8 m. Since May 2014 the pin to boundary distance has decreased by 0.3m indicating a small increase in seabed elevation at this site. The increase in seabed elevation recorded at site 3 and the variation recorded at sites 1 and 2 are within the scale of fluctuations that would naturally occur given the reef aspect and energy environment. Images showing the positions of the bottom pins at the three sites are shown in figures 3-5.

Table 1. Tape distance (m) from the bottom marker pin to the reef-sand boundary for four survey conducted between 2014 and 2018. For site locations refer to figure 1.

Survey date	Site 1	Site 2	Site 3
15-Jan-14	0.15	1.1	1
13-May-14	0.11	1	1.1
11-Nov-15	0.09	1.2	1
5-Apr-18	0.2	1.05	0.8

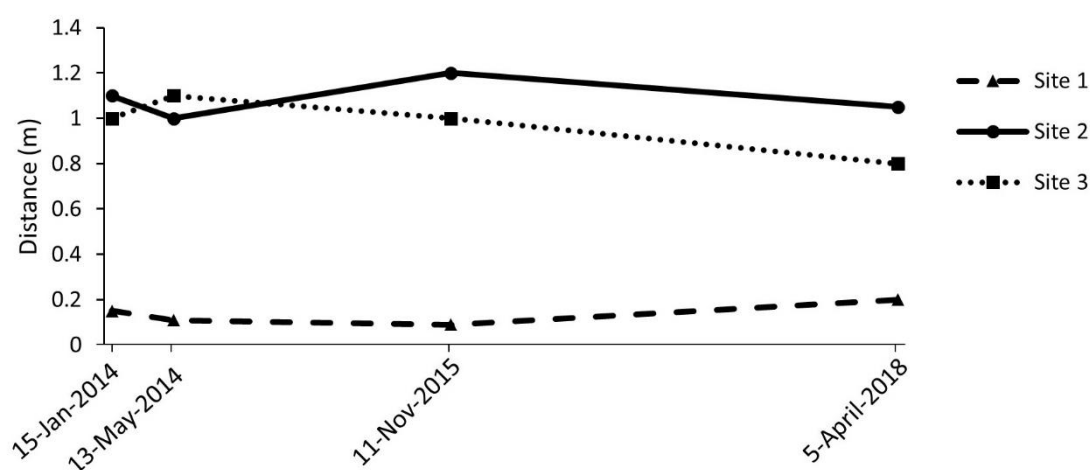


Figure 2. Tape distance (m) from the bottom marker pin to the reef-sand boundary over time. For site locations refer to figure 1.

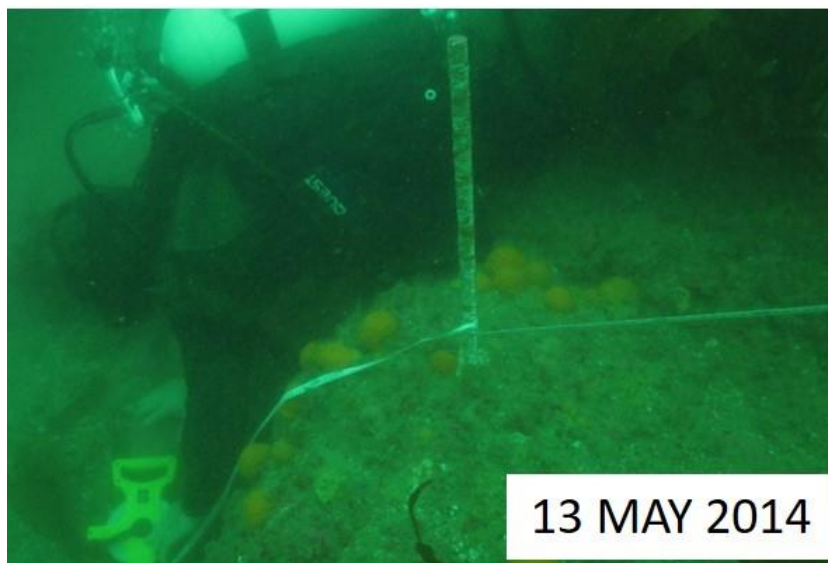
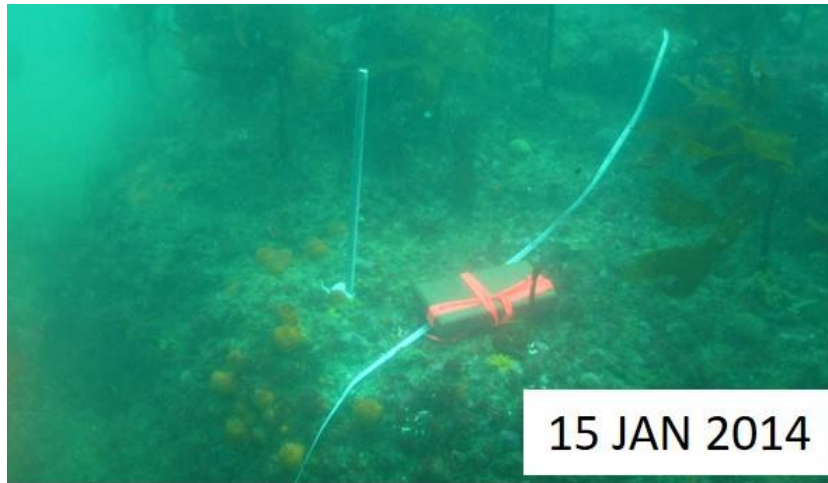


Figure 3. Images of the bottom pin at site 1 in January and May 2014 and April 2018. Visibility during the 2018 survey was very limited and only close up photos were able to be taken.

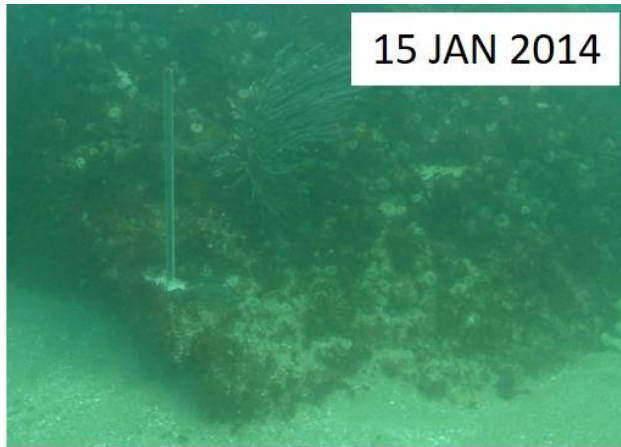


Figure 4. Images of the bottom pin at site 2 in January and May 2014 and April 2018. Visibility during the 2018 survey was very limited and only close up photos were able to be taken.

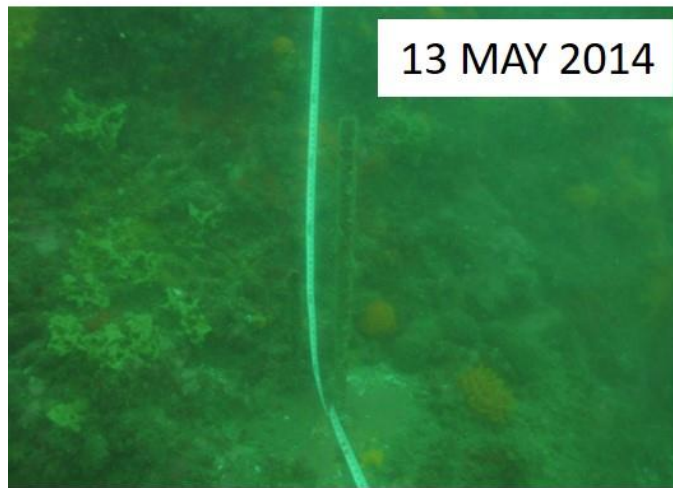


Figure 5. Images of the bottom pin at site 2 in January and May 2014 and April 2018. Visibility during the 2018 survey was very limited and only close up photos were able to be taken.

Biological diversity

Biodiversity was high at all sites (figures 7-9) and is similar to that described in previous monitoring reports. Although there is evidence of minor changes in the composition of the reef benthic communities over time this level of variation is to be expected (Shears and Babcock 2003; Shears and Ross 2010). The most striking change in reef biology was recorded at site 3 which was previously monitored as a control site. In 2018 an abundance of mussels (*Perna canaliculus*, figures 6 and 9) was recorded through the middle and upper sections of this transect. This observation coincides with reports of greater than usual mussel spat recruitment to aquaculture farms offshore of Opotiki. Another change to occur between 2015 and 2018 surveys was the disappearance of a large finger sponge at site 2 adjacent to the bottom marker pin (figure 4). A piece of nylon sack was found wound around the base of this site marker pin and it is possible that under heavy swell conditions that this piece of debris may have swept the reef clear of nearby biota projecting far above the reef surface. Alternatively, it is possible that seabed height may have risen and then fallen in such a way that sponges on the lower section of reef perished. Lastly, at site 2, the abundance of sea anemones has been lower since 2015 than in previous years (figure 10).

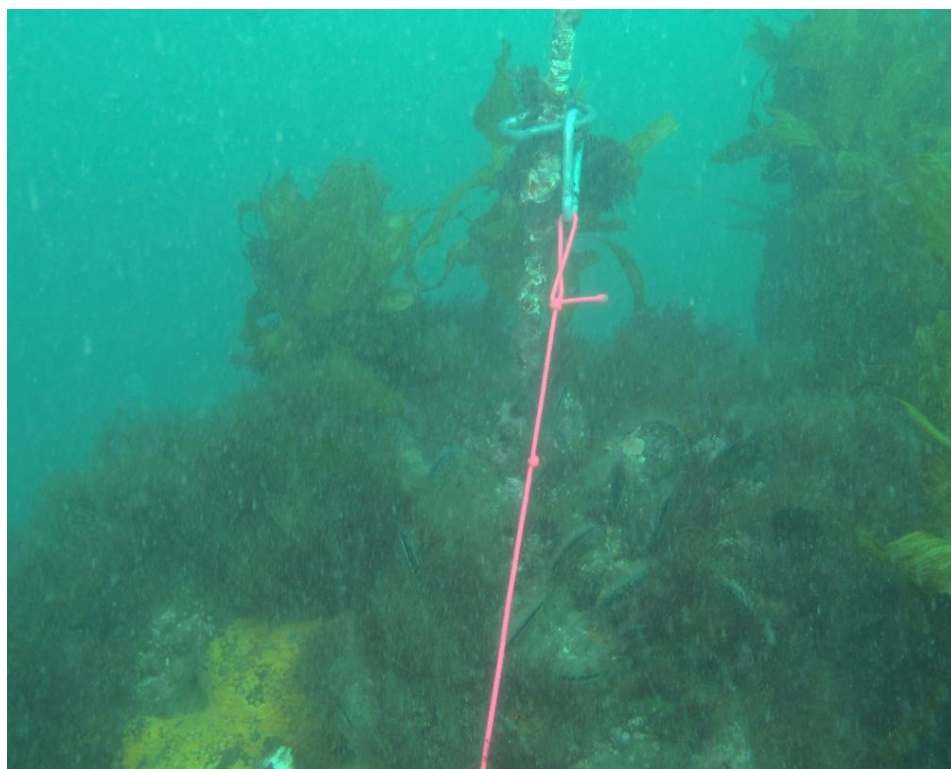


Figure 6. Mussels (*Perna canaliculus*) were recorded in high numbers at site 3 in 2018 and are shown here attached to the reef around the base of the uppermost marker pin.

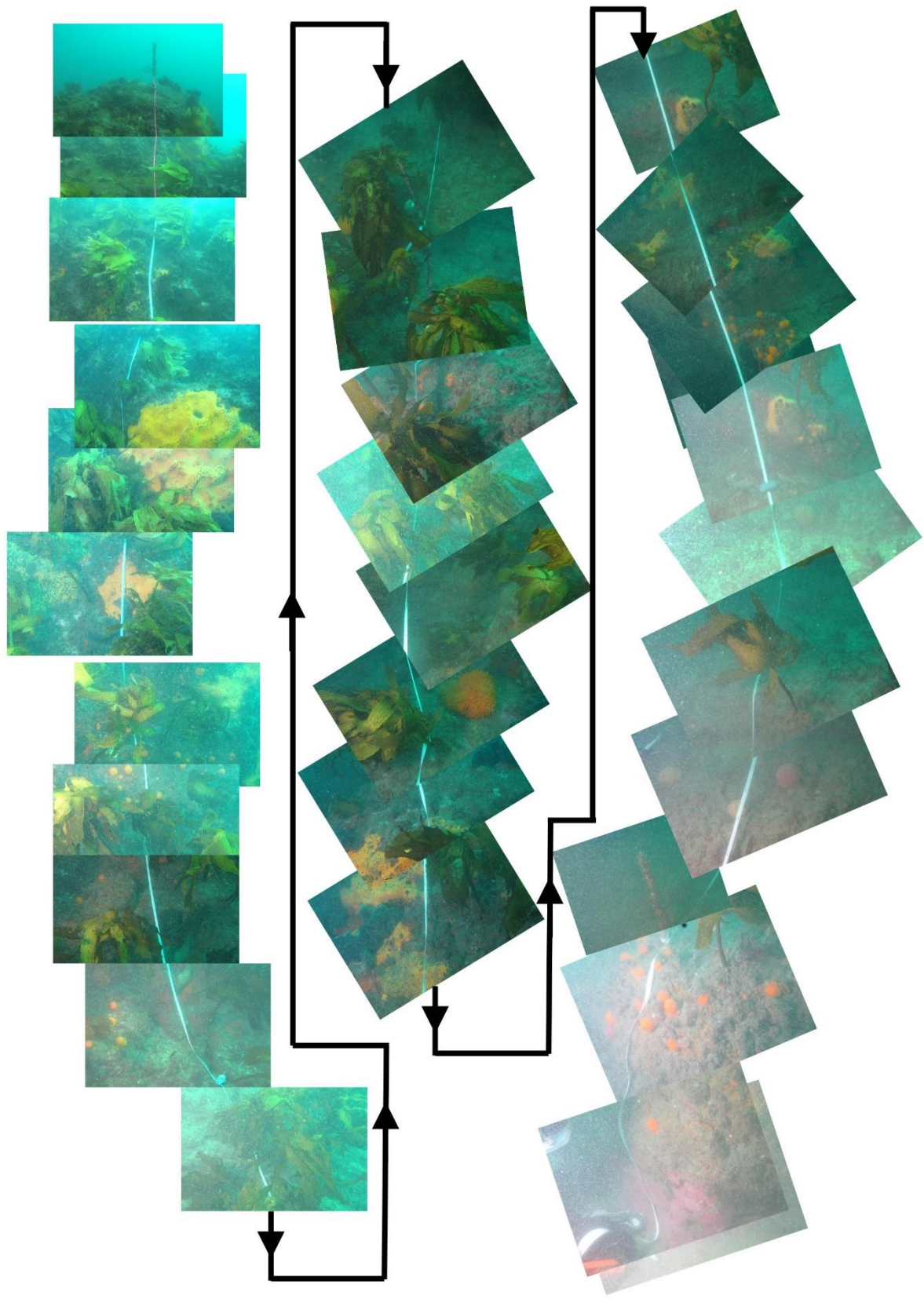


Figure 7. Photo mosaic of the permanent transect at site 1 in April 2018.

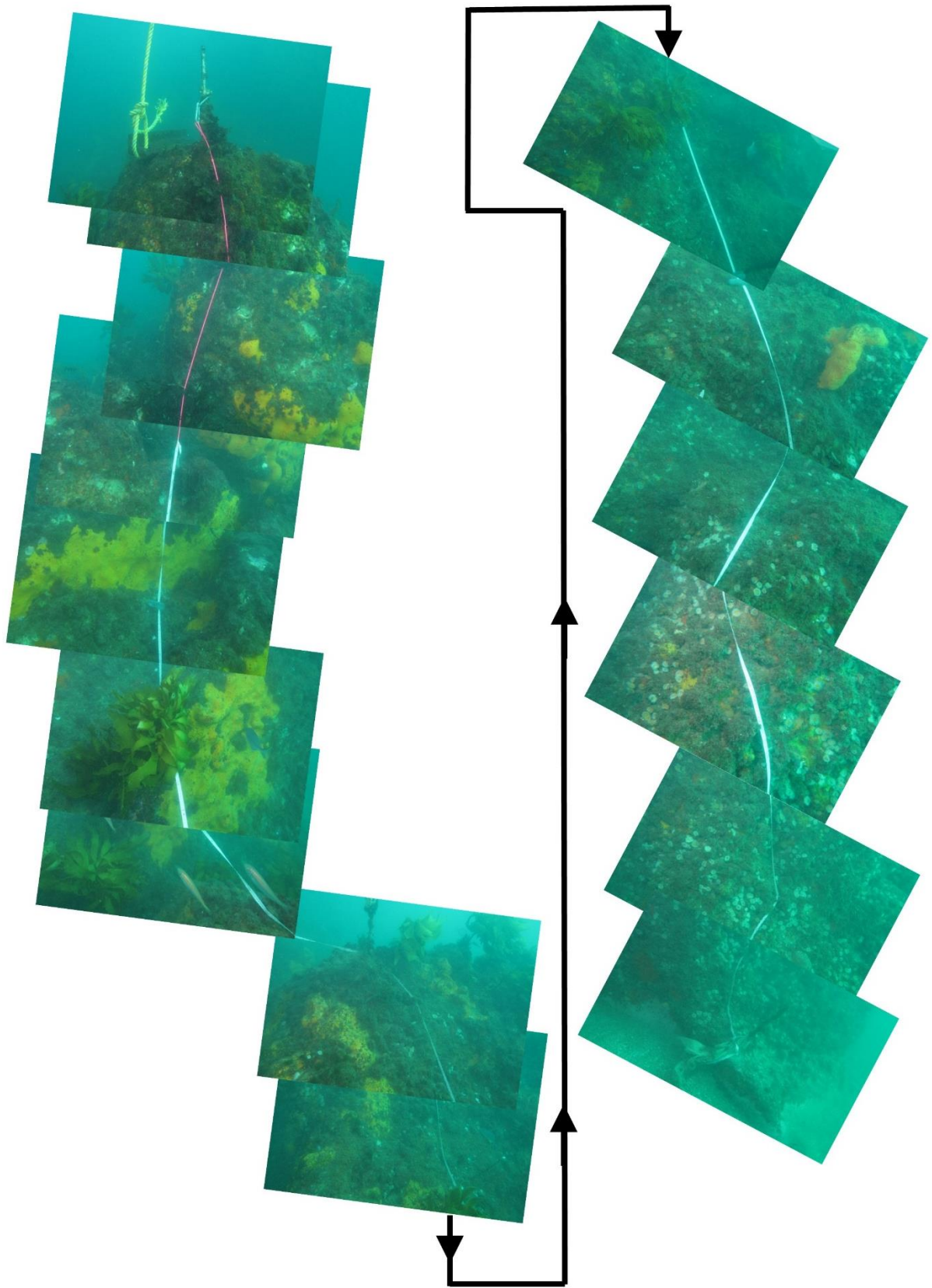


Figure 8. Photo mosaic of the permanent transect at site 2 in April 2018.

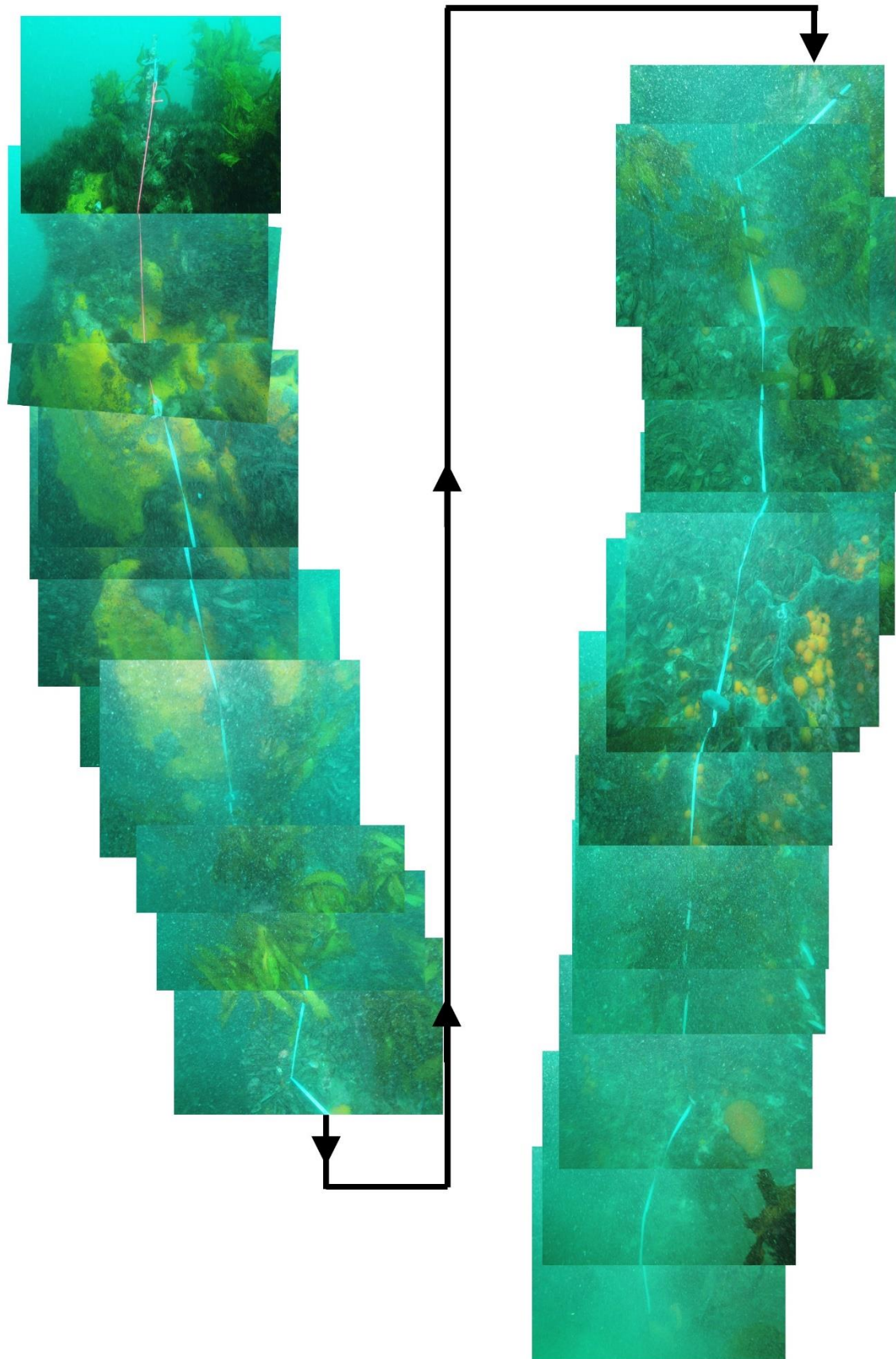


Figure 9. Photo mosaic of the permanent transect at site 3 in April 2018.

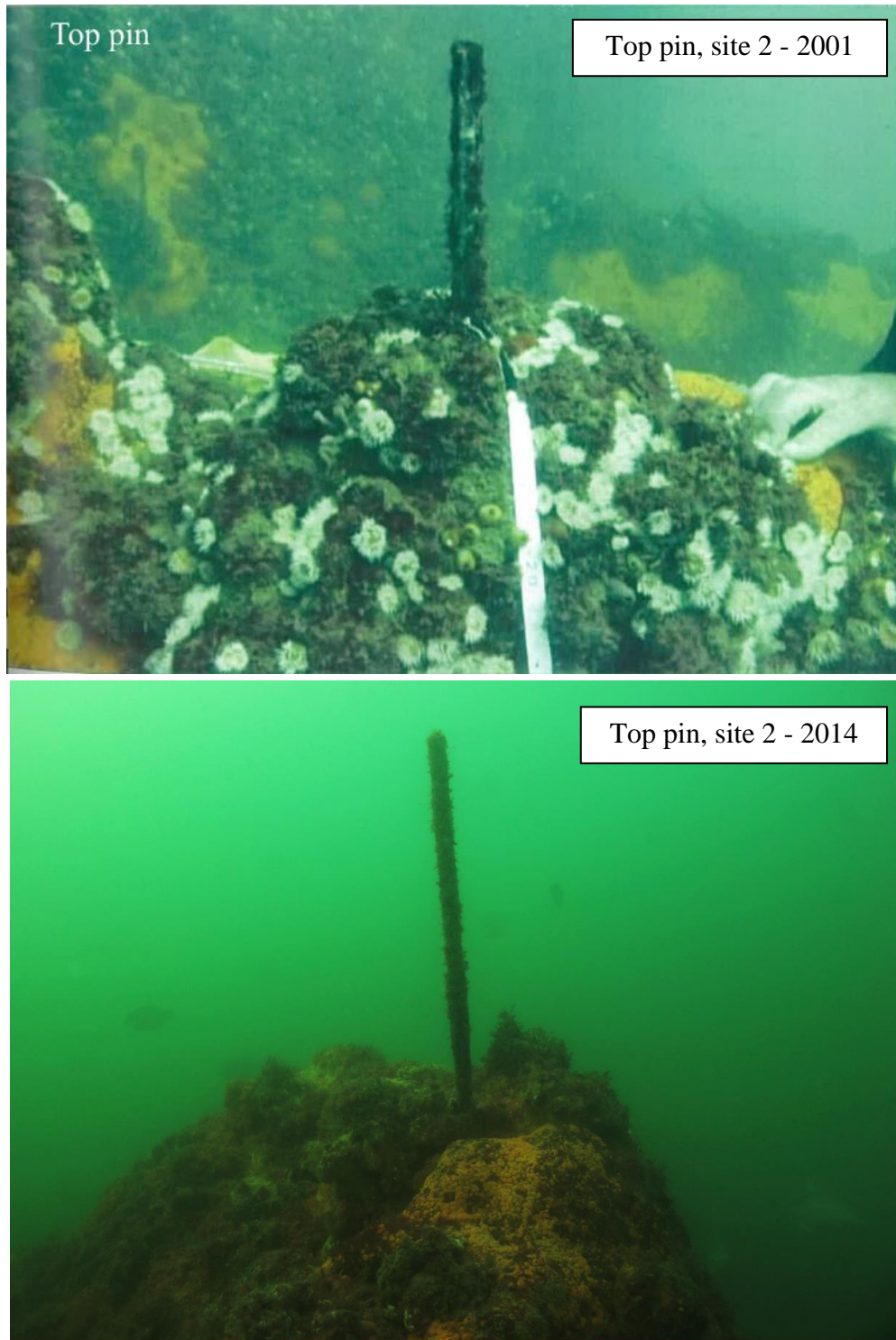
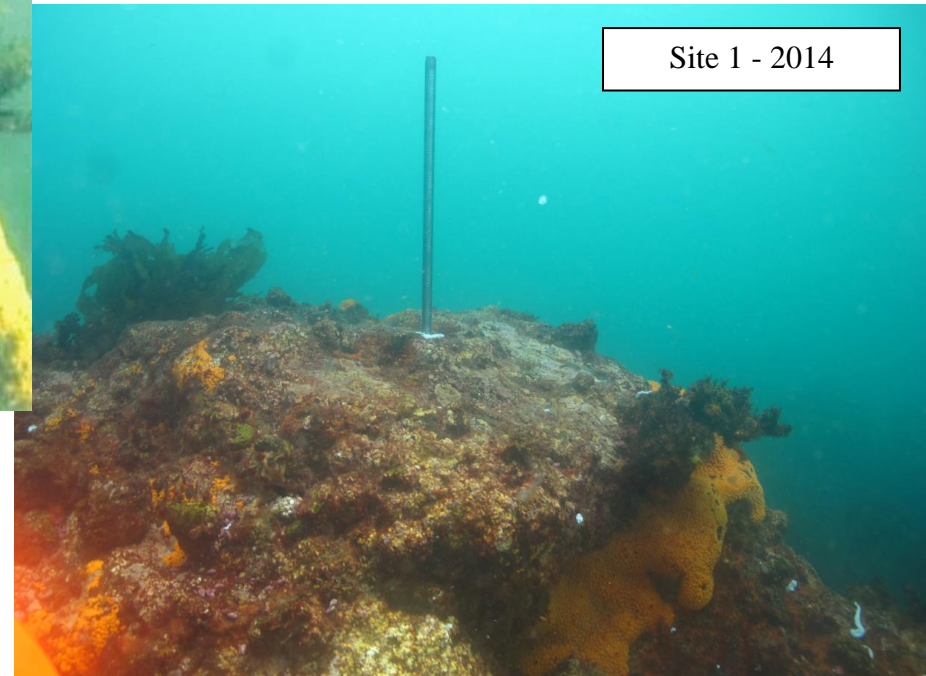
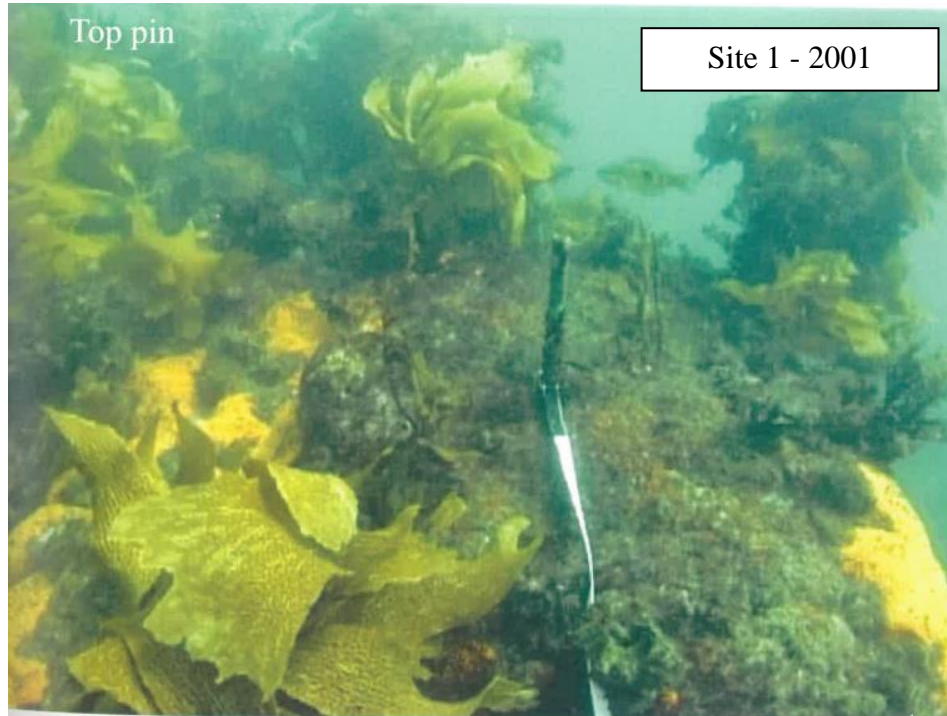
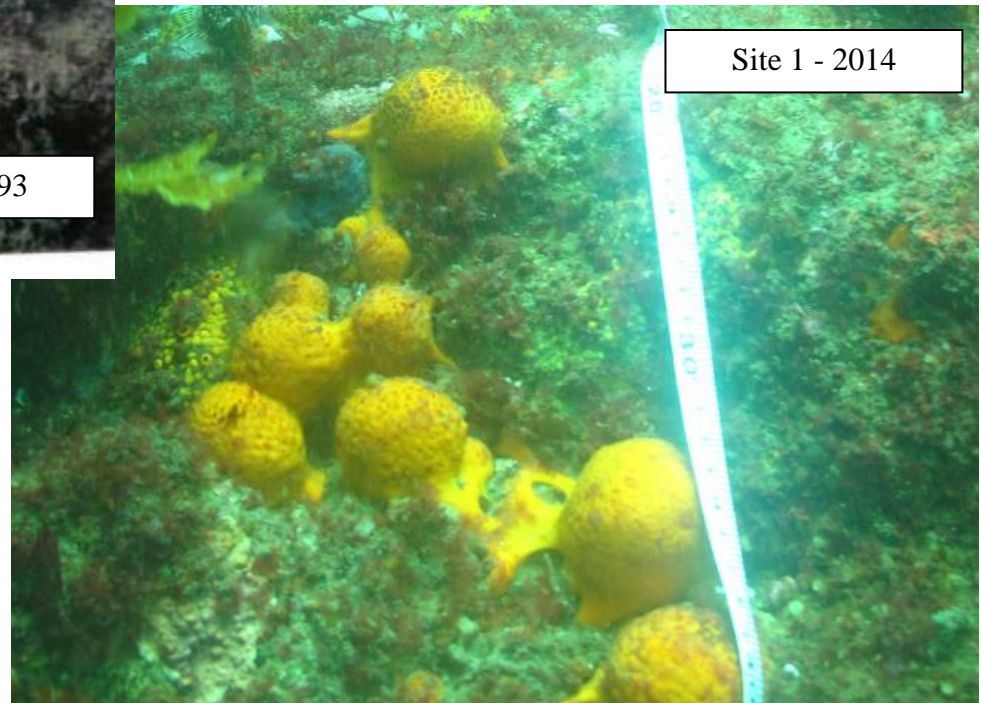
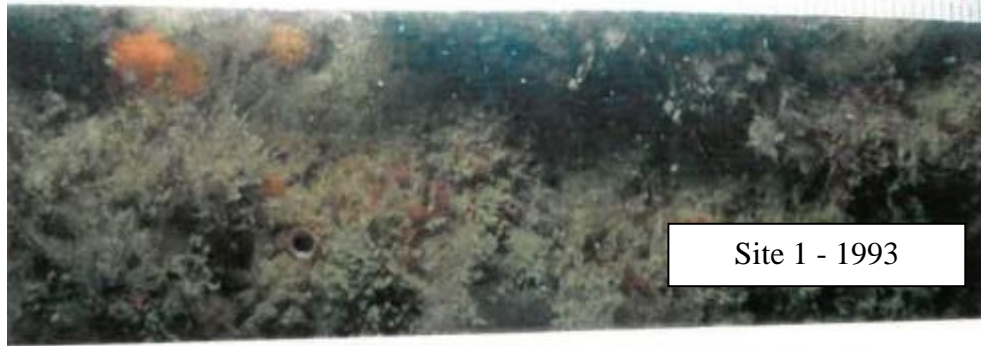


Figure 10. The top marker pins at site 2 in 2001 and 2014. Image comparison shows the decrease in abundance of *Actinotox* anemones that has been observed at this site.

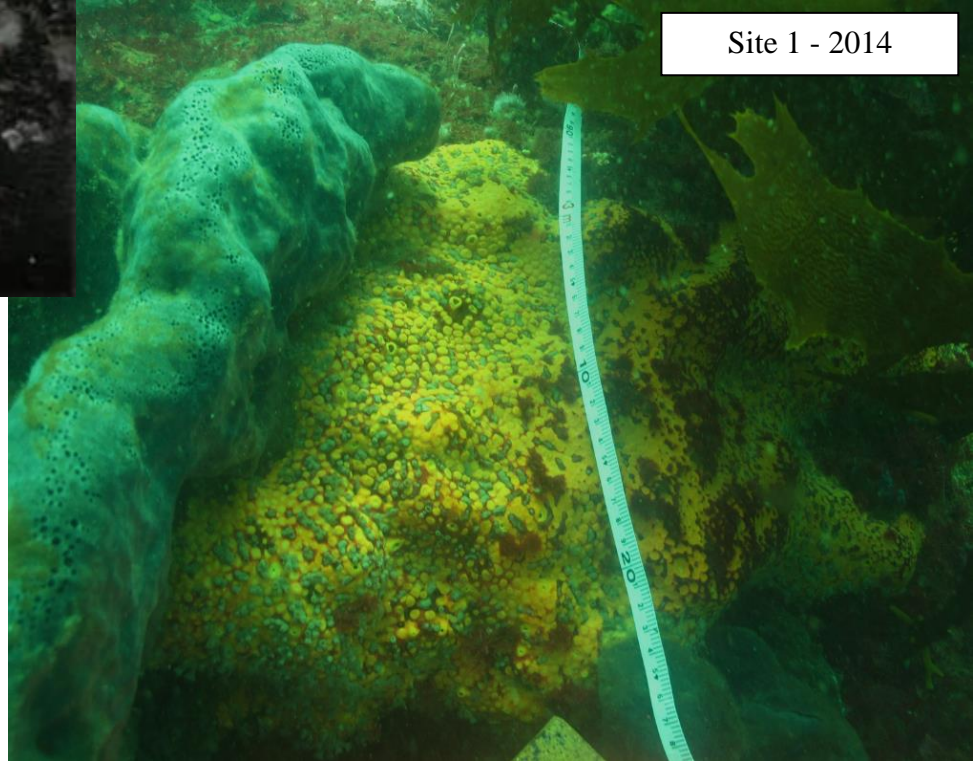
Site 1 – photo comparisons





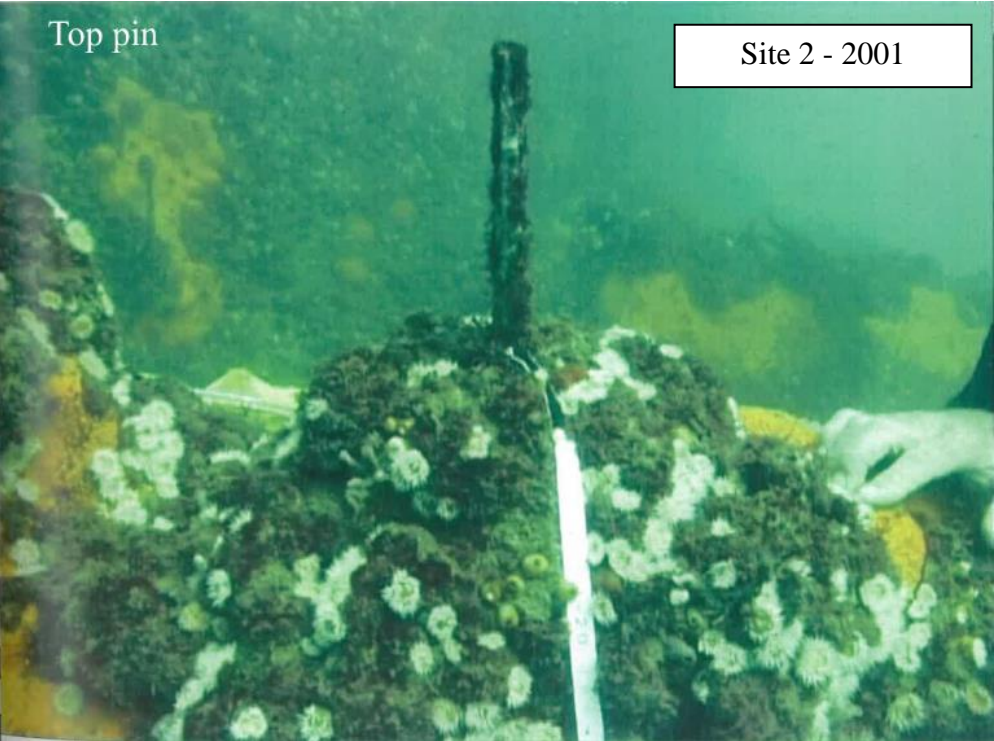


Site 1 - 1998



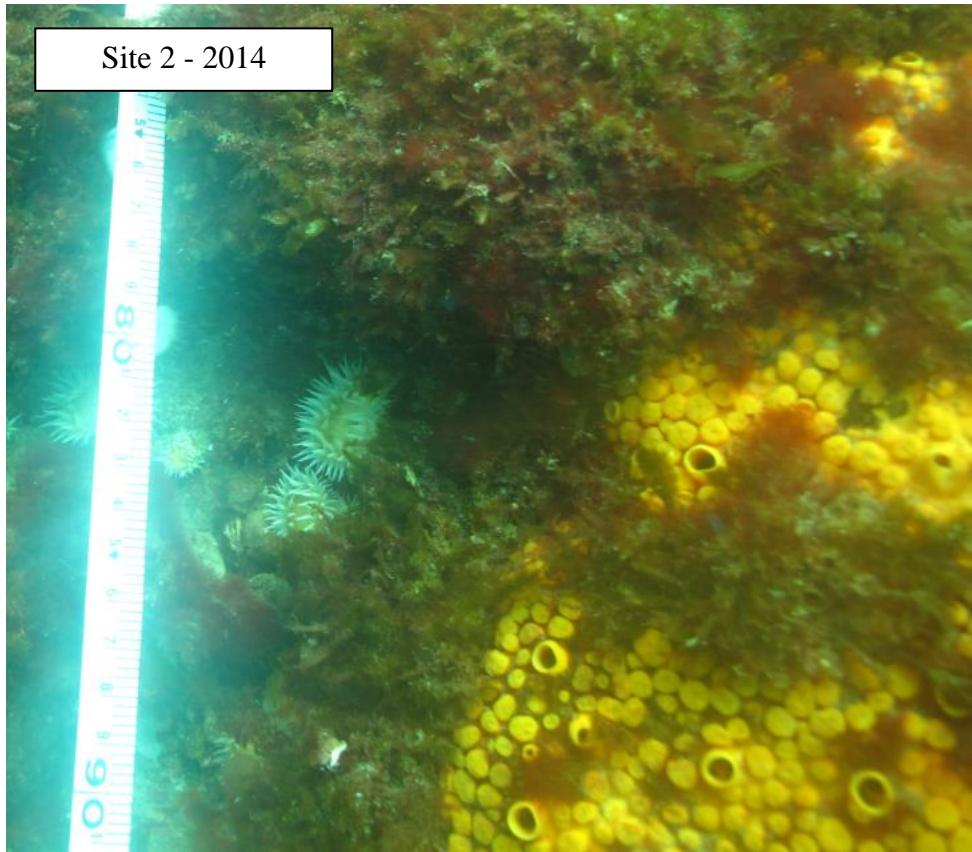
Site 1 - 2014

Site 2 – photo comparisons

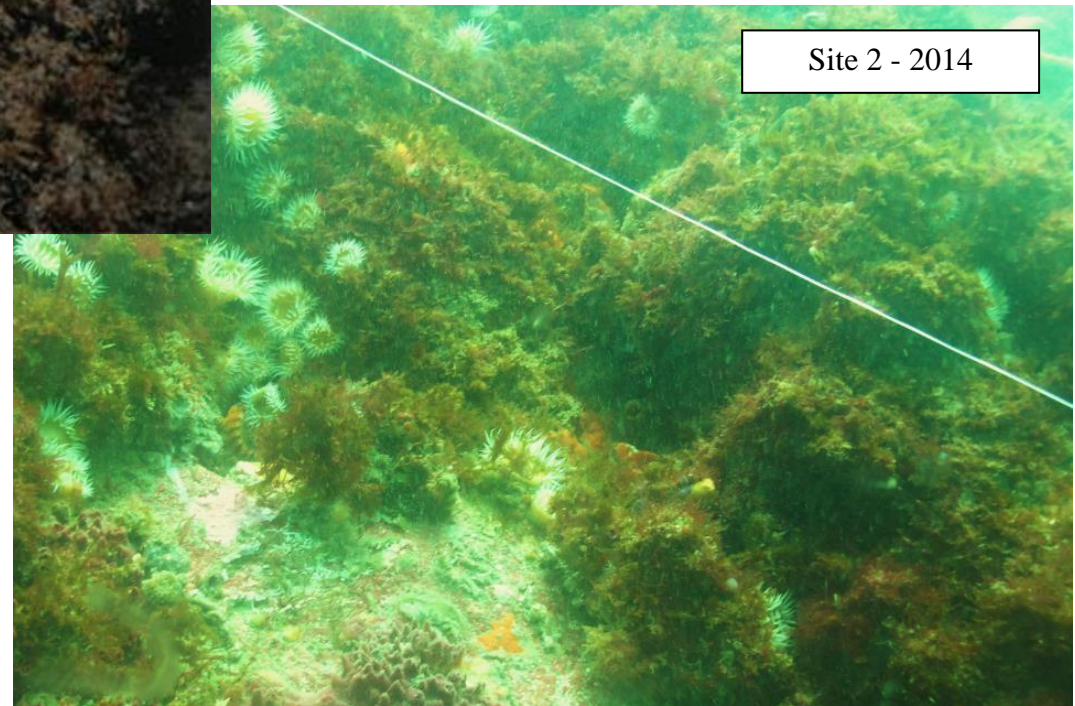
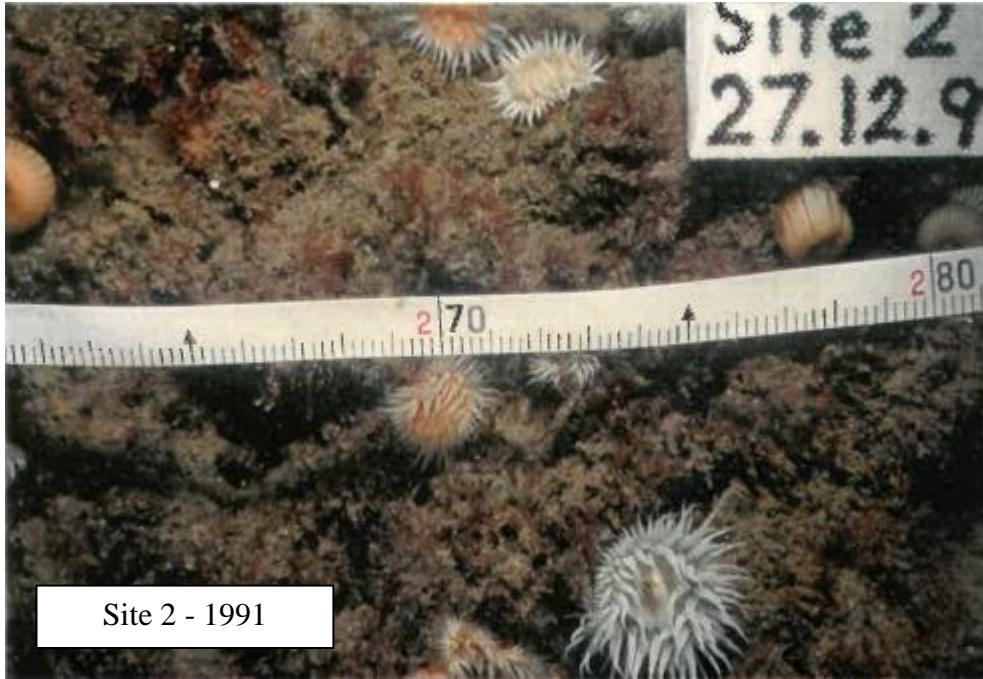




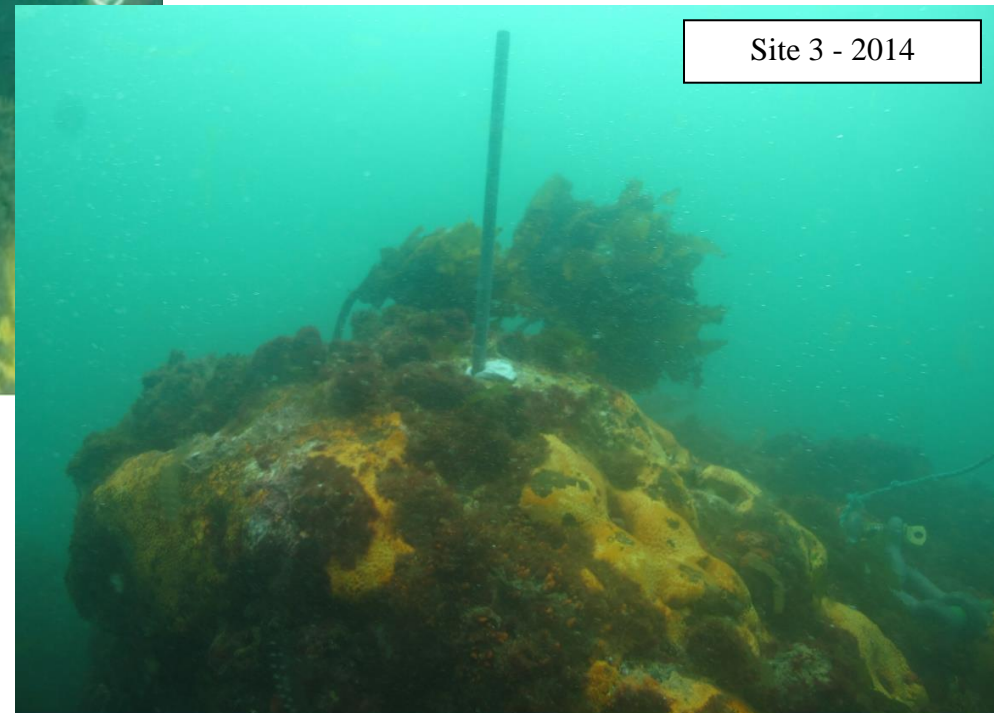
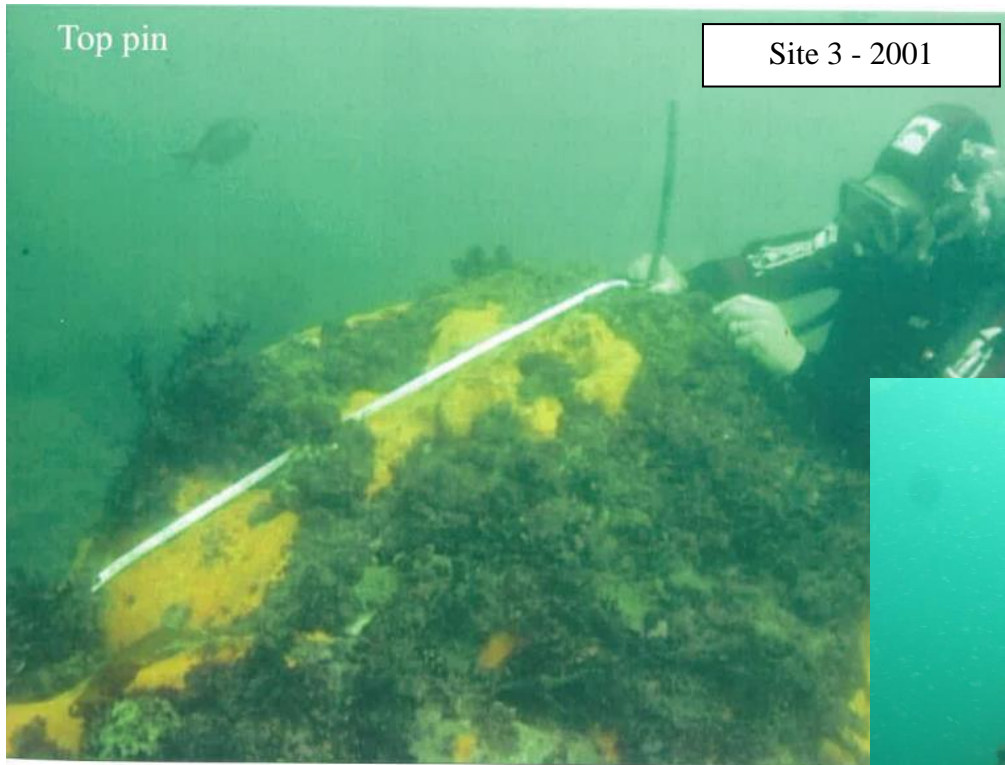
Site 2 - 1991



Site 2 - 2014



Site 3 – photo comparisons

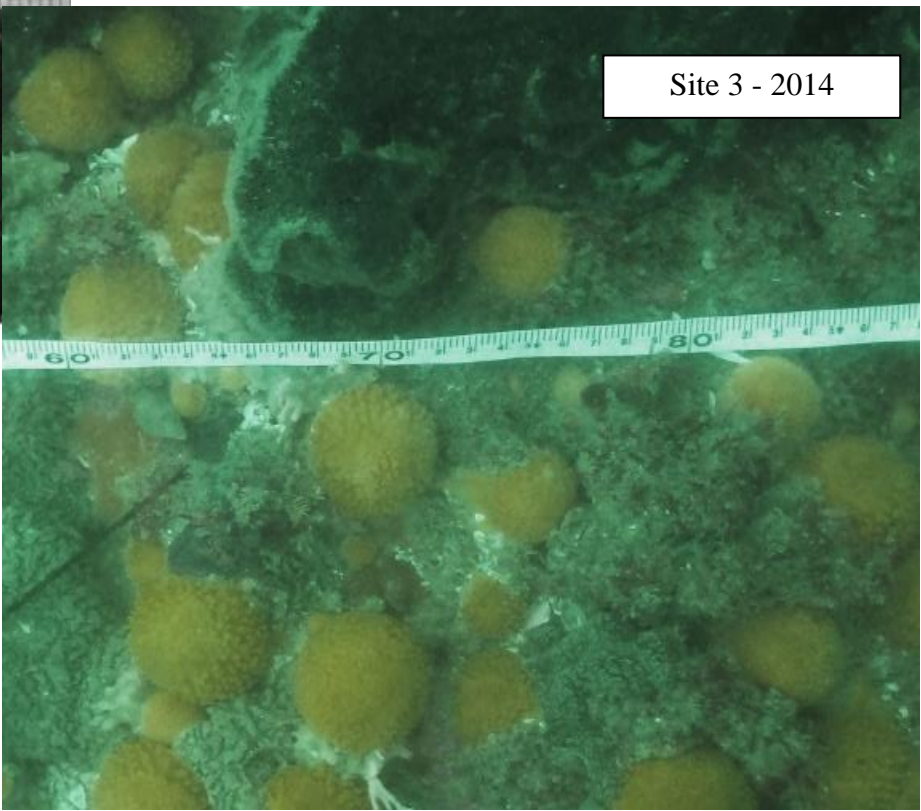
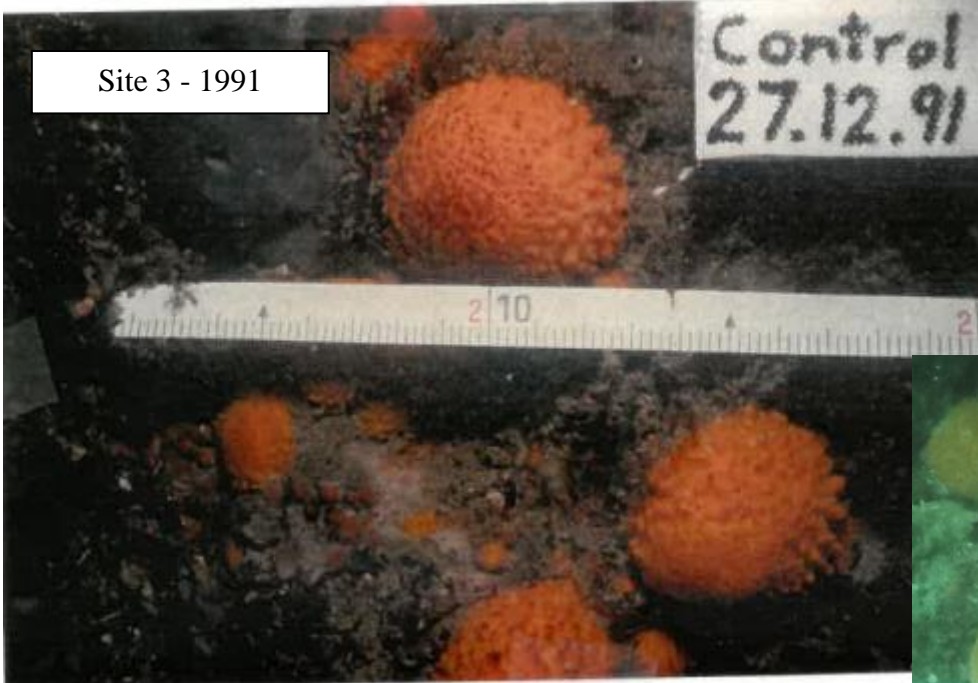




Site 3 - 1991



Site 3 - 2014



Discussion

Measurements of the distance between the bottom marker pin at each site and the reef-sand boundary indicate some fluctuation in the elevation of the seabed at all sites. At sites 1 and 2 measurements since 2014 indicate both the rise and fall of the reef-sand boundary. At site 3, formerly monitored as a control site, the seabed has risen over two successive surveys, but only by 30 cm. The levels of fluctuation observed for the 2014-2018 period are similar or less than the changes previously reported for the Motuotau reefs (Ross and Pilditch 2009). Greater fluctuations in seabed elevation are known to occur in this area (P. Ross *pers. obs.*) but may not be captured by this approximately bi-annual monitoring programme. The data presented here indicate that the reefs around Motuotau are not being inundated by the dredge spoils dumped offshore of Mt Maunganui.

Photographic surveys continue to prove useful in capturing information about the diversity of subtidal reef communities. Surveys between 2014 and 2018 have provided no evidence of environmental degradation at any of the monitoring sites. There have been some minor changes to the biological assemblages of the surveyed reefs, including an increase in the abundance of mussels at site 3 and a decrease in abundance of anemones at site 1. This level of temporal variation in biological diversity can occur naturally as a function of variable recruitment, competition and oceanographic conditions and is no cause for concern (Bertness et al. 2001; Shears and Babcock 2003; Nybakken and Bertness 2004; Shears and Ross 2010; Rilov and Schiel 2011; South 2016). There is also evidence of considerable stability in these communities with a number of sponges on these transects having been present for several decades (refer to site photo comparisons section of report). The ability to track individual organisms as far back as 1991 provides some confidence that significant changes in the biology of these reefs would be detectable using the current survey methodology.

In general terms, the reefs around Motuotau appear to be healthy and in a state that is comparable to other reefs of similar depth, aspect and exposure along the Bay of Plenty coastline. It is worth noting that the biological communities of this region have been modified by the removal of top predator species through fishing. No crayfish (*Jasus edwardsii*) or snapper (*Pagrus auratus*) of legal size were observed while conducting these surveys. Consequently, the benthic communities surveyed here may not be what would be expected under entirely natural circumstances. This is not a response of the Port of Tauranga's dredging activities but a consequence of the management of fisheries in New Zealand.

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