VISION ENVIRONMENT

A Trinity Consultants Company

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CORAL MONITORING FOR PORT OF HAY POINT MAINTENANCE DREDGING

NORTH QUEENSLAND BULK PORTS CORPORATION (NQBP)

GLADSTONE OFFICE
+61 7 4972 7530
Unit 3, 165 Auckland Street, Gladstone
PO BOX 1267, GLADSTONE QLD 4680

BRISBANE OFFICE
+61 7 4972 7530
Level 3, 43 Peel Street, South Brisbane
PO BOX 3901, SOUTH BRISBANE QLD 4101

NEW ZEALAND OFFICE
+64 273 053 353
35/115 Bamford Street, Woolston
CHRISTCHURCH, NEW ZEALAND, 8023

E office@visionenvironment.com.au | www.visionenvironment.com.au

REPORT CONTRIBUTORS

Role	Team member
Project Management	Ralph Alquezar, Felicity Melville
Fieldwork	Ralph Alquezar, Mark Jensen, Michael Shanahan, Ashley Campbell, Shakia Hoogewerf, Uly Sanchez-Camara
Reporting & Review	Ralph, Alquezar, Uly Sanchez-Camara, Felicity Melville

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EXECUTIVE SUMMARY

Maintenance dredging at Port of Hay Point, Queensland was undertaken by NQBP for a 20-day period from 25 August to 14 September 2024. Approximately 166,000 m^3 of material was removed by the Trailing Suction Hopper Dredge (TSHD) Brisbane from the departure channel, apron and associated berths and relocated to the Dredge Material Placement Area (DMPA).

Impact monitoring of coral communities in the Hay Point region as per the Port of Hay Point Marine Environmental Monitoring Plan (MEMP) was undertaken during the Pre-dredge period (19 and 20 July, and 7 and 8 August), and the Post-dredge period (21 to 23 October). Surveys were undertaken at three inshore coral locations monitored biannually under the long-term ambient coral monitoring program: Round Top Island, Victor Island and Slade Island. A similar methodology to the ambient program was undertaken, in addition to a rapid coral health assessment technique which was also utilised in the 2019 Hay Point maintenance dredge coral assessment (Vision Environment 2019).

Overall, it was found that no significant variation in most of the monitored coral parameters was evident between the Pre-dredge and Post-dredge surveys. This included major and minor category benthic coverage, occurrence of bleached and diseased coral, occurrence of sediment deposition on corals, abundance of juvenile corals and coral pigmentation. These results indicate no apparent adverse impact from maintenance dredge activities.

Sediments deposited on corals were significantly deeper during the Pre-dredge survey than the Post-dredge survey. As the decrease in sediment depths over time was consistent across all three inshore reefs, regional metocean influences are thought to be responsible, as opposed to effects from maintenance dredge activities.

Minor lightening of coral pigments across all three locations was evident from the Pre-dredge to Post-dredge surveys. This can be attributed to increased ambient light availability from July to October, as day lengths increase. A similar trend was observed during the 2019 Hay Point Maintenance dredge coral assessment (Vision Environment 2019), with coral pigments darker during the winter Post-dredge survey, than the summer Pre-dredge coral pigments.

Macroalgal assemblages were the most common biotic community, and dominated by the brown algae *Sargassum* sp. Hard coral was also commonly encountered, with *Montipora* spp. and *Turbinaria* spp. most frequently recorded. Juvenile corals (recruits) were largely found to be *Turbinaria* spp. across all the monitored inshore reefs. Turfing algae and soft corals were also regularly encountered, while cover of sponges, ascidians, zoanthids, hydroids and bryozoans were less common.

A comparison of the three inshore reefs revealed that Round Top Island contained significantly higher soft coral coverage and abundance of juvenile hard corals, but significantly lower macroalgal coverage than Slade Island and Victor Island. Similar findings have been reported in the ambient monitoring program over the past few years (Chartrand et al. 2022, Chartrand et al. 2023).

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ACRONYMS

AIMS	Australian Institute of Marine Science
ANOSIM	Analysis of Similarity
ANOVA	Analysis of Variance
BOM	Bureau of Meteorology
DES	Department of Environment and Science
DMPA	Dredge Material Placement Area
EMP	Environmental Management Plan
JCU	James Cook University
LMDMP	Long-term Maintenance Dredge Management Plan
LSD	Least Significant Differences
MEMP	Marine Environmental Monitoring Program
NQBP	North Queensland Bulk Ports
P	Probability
PAR	Photosynthetically Active Radiation
PCO	Principal Component Analysis
PERMANOVA	Permutational Analysis of Variance
QA/QC	Quality Assurance/Quality Control
RGB	Red, Green, Blue
RTI	Round Top Island
SI	Slade Island
VE	Vision Environment
VI	Victor Island

1 INTRODUCTION

The Port of Hay Point is North Queensland Bulk Ports (NQBP) southernmost port, and encompasses two coal terminals, which export over 100 million tonnes of coal per year. To maintain safe navigational depths necessary for the manoeuvring and transit of ships in and around the Port of Hay Point, regular maintenance dredging is required to remove naturally accumulated sediment.

In order to manage maintenance dredging, NQBP developed the following plans:

- Port of Hay Point Long-term Maintenance Dredging Management Plan, or LMDMP (NQBP 2024a).
- Port of Hay Point Maintenance Dredging Environmental Monitoring Plan, or EMP (NQBP 2024b).
- Port of Hay Point Marine Environmental Monitoring Plan, or MEMP (NQBP 2024c).

According to the MEMP, NQBP was required to undertake specific impact monitoring of coral communities in the Hay Point region, with surveys undertaken four weeks prior to commencement, and four weeks following the completion, of dredging. Surveys were to be undertaken at the same sites and using the same methodology as ambient coral monitoring which is undertaken biannually by Tropwater from James Cook University (JCU). Coral monitoring has been undertaken at the three inshore reefs of Round Top Island (RTI), Victor Island (VI) and Slade Island (SI) since 2006 (Chartrand et al. 2023).

Vision Environment ANZ (VE) undertook the Pre-dredge coral survey on 19 and 20 July, and 7 and 8 August. Maintenance dredging commenced at 17:00 on 25 August and was completed at 08:00 on 14 September 2024. Approximately 166,000 m^3 of material was removed from the Hay Point berths, apron and departure channel and relocated to the Port of Hay Point Dredge Material Placement Area (DMPA) during the 20-day program. The Post-dredge coral survey was undertaken from 21 to 23 October 2024.

VE also undertook compliance water quality monitoring for the Port of Hay Point maintenance dredging. Water quality monitoring at four sites was undertaken at two trigger sites (RTI and VI) and two control sites (SI and Freshwater Point) from 28 July to 12 October 2024 (Vision Environment 2024).

This report presents the results of the 2024 Port of Hay Point maintenance dredge coral monitoring program undertaken by VE.

2 METHODOLOGY

Figure 1 shows the location of the inshore coral locations and specific monitoring sites, with GPS locations listed in the Appendix (Table A1).

Monitoring was undertaken by VE personnel, who are qualified and experienced in coral surveys. Works were undertaken using sampling procedures which have been derived from standard protocols (AIMS 2004, DES 2018, AIMS 2020), as well as those used in the biannual ambient coral monitoring program (Chartrand et al. 2022, Chartrand et al. 2023, NQBP 2024c), and in the 2019 Hay Point Maintenance dredge coral assessment (Vision Environment 2019). The sampling methodology is summarised below.

Activity	Description
Transect Establishment	As per the MEMP, four sites at each of the three locations are monitored biannually (12 sites total). At each site, three transects were established adjacent to the pre-established sites (36 transects total). Of note was the establishment of Site 7 at RTI, in lieu of Site 6 which was found to be in a high current area and at depth. During the Pre-dredge surveys, thin marking line was deployed along each of the 20 m transects, tied to stakes and remained in place for the Post-dredge surveys to ensure continuity of the monitoring. Line was removed during the latter surveys. GPS co-ordinates and transect directionality were recorded.
Photographic Quadrats	Photographic quadrats were captured at 1 m intervals along transects using the lowest wide-angle setting (28 mm full frame equivalent, behind a flat port, giving an approximate diagonal angle of view of about 60° underwater). Each image was captured at 1 m above the benthos using a reference bar to standardise each photograph. Images were captured parallel to the seafloor to minimise parallax error, and depth was recorded to within +/- 0.1 m using a dive computer. Photographs were taken at the same location within each transect during each survey to ensure accurate Pre-and Post-dredge comparisons.
Sediment Deposition	If sediment covered corals were observed during the fieldwork, sediment depth on the colony surface of up to 20 corals per transect was measured.
Image Analysis	Images were analysed by point count methodology by an experienced taxonomist, where a minimum of 20 randomly selected points were overlayed on each image to determine community demographics. Major community categories included: • Turfing algae • Hard corals • Soft corals • Macroalgae • Sponges and ascidians • Sediment • Other living biota, including hydroids, bryozoans and zoanthids. Macroalgae and hard and soft coral major categories were also designated into minor categories of genus or species. A second taxonomist analysed 10% of images for quality assurance/quality control (QA/QC) purposes. The occurrence of bleaching and coral disease was also assessed, as was the occurrence of sediment deposition on corals. All new recruits across three size classes were recorded: • 0-2 cm diameter • 2-5 cm diameter • 5-10 cm diameter

Figure 1 Hay Point coral monitoring locations.

Activity	Description
Rapid Coral Health Assessment	As per the previous maintenance dredge coral monitoring (Vision Environment 2019), a rapid health assessment was undertaken in 2024. This technique permits the measurement of coral stress prior to observable damage can be detected (Alquezar et al. 2015). During both the Pre- and Post-dredge surveys, up to three individual coral colonies from the commonly occurring genera, *Turbinaria* spp. within each transect were photographed using a custom designed quadrat frame incorporating a white reference colour bar. Red, Green Blue (RGB) colour channels and luminosity (reflected light) were standardised against the white reference colour bar, which corrected colour shifts due to varying ambient conditions across surveys.
Data Analysis	One and two-way Analysis of Variance (ANOVA) were undertaken using Statistica (Version 14.0.1.25) to determine if there were any significant differences ($P < 0.05$) in major substrate cover or coral parameters (bleaching, disease, sediment deposition, coral recruitment and pigment colour) either temporally (Pre-and Post-dredge surveys) or spatially (between locations). Data were tested for homogeneity of variance and normality. Significance levels were increased (99% confidence intervals) where data did not meet that criterion (Underwood 1997, O'Neill 2000). To determine where significant differences existed, Fisher's Least Significant Difference (LSD) *Post hoc* tests were used. Using Primer 6 (Clarke and Gorley 2006), Permutational Multivariate Analysis of Variance (PERMANOVA) hypothesis testing was also used to determine temporal and spatial significant dissimilarities (differences) in substrate community structure (multiple species and how they relate to each other based on percent cover). Analysis of Similarity (ANOSIM) was also undertaken, while Principal Coordinates Ordination (PCO) was used to graphically illustrate the data.

3 RESULTS & DISCUSSION

3.1 Cover and Community Demographics

The most common major community category observed across the surveys and locations (Figure 2, Table A2 in Appendix) were sediments, including sand, pavements and rocks (mean transect cover of 34%), followed by macroalgal assemblages (28%), hard coral (24%), turfing algae (10%) and soft corals (2%). Mean cover of sponges, ascidians, zoanthids, hydroids and bryozoans were ≤ 2%. Similar proportions of the major categories were reported in mid-2023 (Chartrand et al. 2023).

Temporal analysis of the data indicated that there were no significant differences in major category cover between the Pre-dredge and Post-dredge surveys, indicating no apparent impact from maintenance dredge activities.

Significant ($P < 0.05$) spatial difference between locations were evident for soft corals, macroalgae and sponges/ascidians (Figure 2, Table A7 in Appendix). Soft coral cover was significantly higher at RTI (5% during both surveys) than at VI (1%) and SI (1%). In contrast, macroalgae cover was significantly lower at RTI (19 to 21 %), than at VI (30 to 37%) and SI (31 to 32%). Chartrand et al. (2023) also found the highest macroalgal coverage at VI in late 2022 and mid-2023, with macroalgae at this location recorded as consistently increasing since monitoring commenced in 2006. Sponges/ascidians were significantly higher at RTI (2%) and SI (2%) than at VI (<1%). Chartrand et al. (2023) also recorded the highest proportion of sponges at RTI.

Macroalgae, hard coral and soft coral major categories were also designated into minor categories of genus or species (Table A3 in Appendix). Within the macroalgae, the brown algae *Sargassum* sp. (Figure 3), was the most commonly recorded algae, covering 15 to 31% of transects across the two surveys, similar to what has been recorded in the biannual surveys (Chartrand et al. 2022, Chartrand et al. 2023).

The most common hard coral was *Montipora* spp., ranging from 4 to 5% cover at SI and RTI, and 14% cover at VI. *Turbinaria* spp. was the next most common hard coral (Figure 3), with mean transect coverage ranging from 1% cover at VI to 10% cover at RTI. Biannual surveys from mid-2021 to mid-2023 also recorded dominance of these species (Chartrand et al. 2022, Chartrand et al. 2023). The most common soft corals were *Sarcophyton* spp. and *Lobophytum* spp. with coverage ranging from 0.1 to 1.9% across the transects.

Due to the large number of minor category classes, multivariate statistical analyses were used to examine any temporal or spatial changes in cover (Figure 4). No significant dissimilarities (differences) in minor category cover were evident between the Pre-and Post-dredge surveys (ANOSIM R-statistic -0.006; $P > 0.05$; PERMANOVA $P > 0.01$), again indicating no apparent impact from maintenance dredge activities.

However, significant spatial dissimilarities in minor category cover were observed among the locations (ANOSIM R-statistic 0.247; $P < 0.005$; PERMANOVA $P < 0.01$), indicating communities at the three locations varied from one another regarding taxa present and the proportion in which they were found.

No significant interactions were observed between locations and surveys (ANOSIM R-statistic 0.036; $P > 0.005$; PERMANOVA $P > 0.01$).

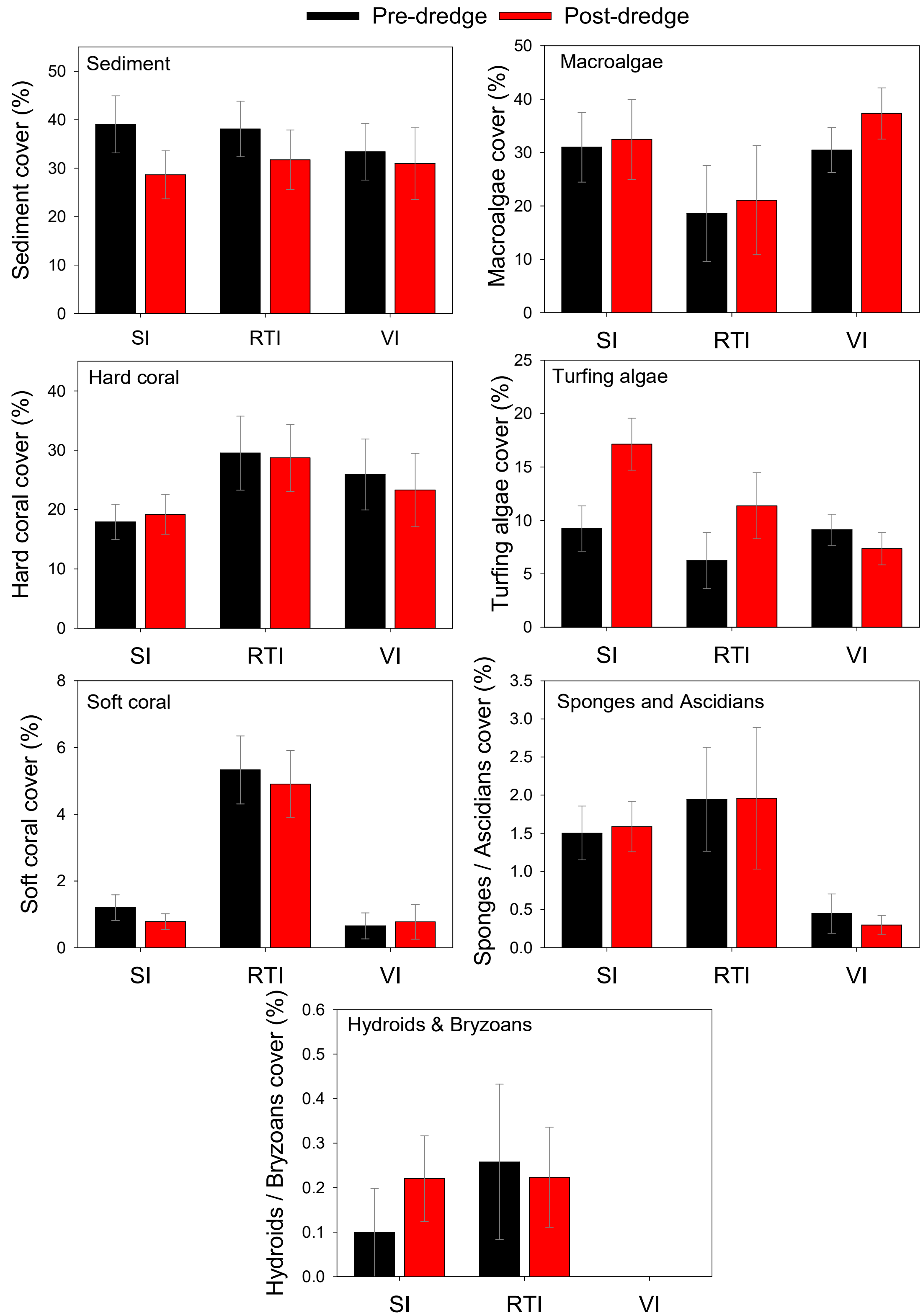

Figure 2 Mean substrate cover of major community categories (sediment, macroalgae, hard coral, turfing algae, soft coral, sponges/ascidians and hydroid/bryozoans) at SI, RTI and VI during Pre- and Post-dredge surveys.

Values are means ± se (n = 12).

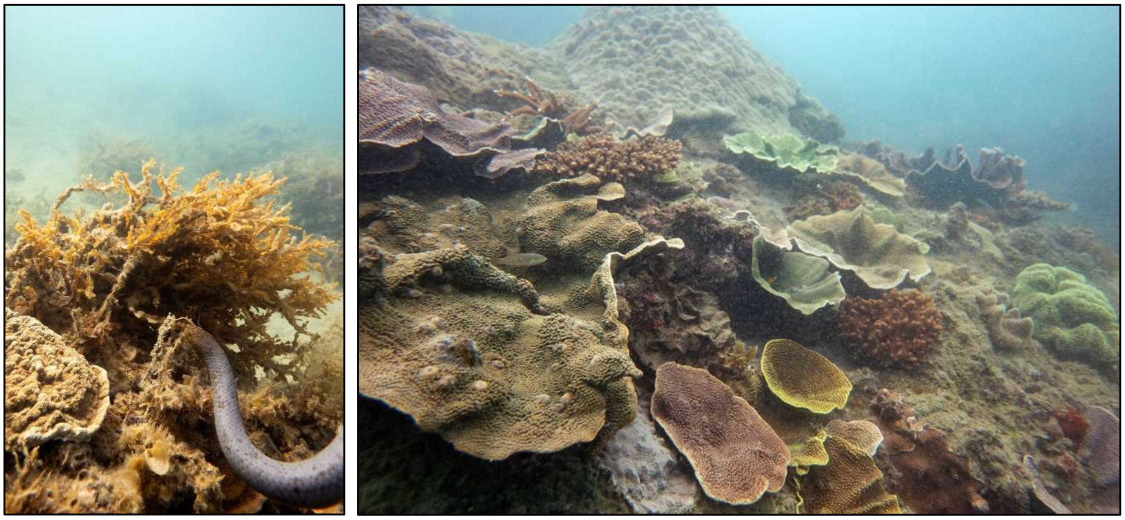

Figure 3 Example of the common macroalgae *Sargassum* sp. with an olive sea snake (*Aipysurus laevis*) at VI, and the hard coral *Turbinaria* spp. at RTI.

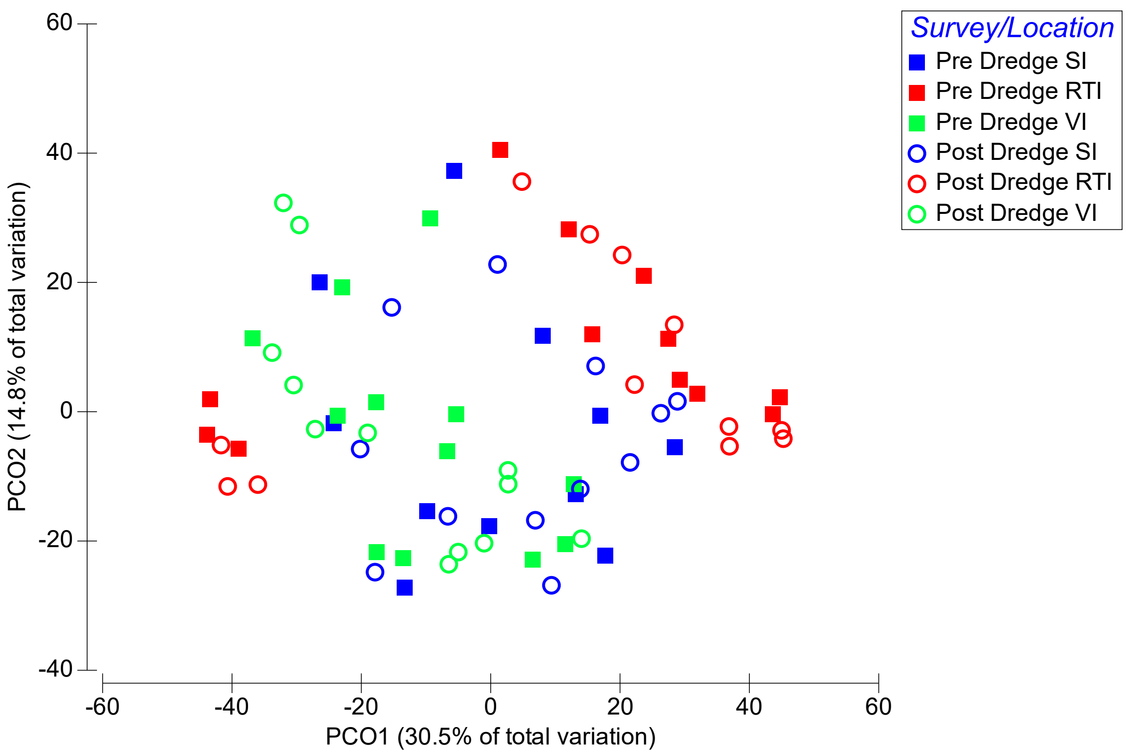

Figure 4 Principal Coordinates Ordination of minor substrate categories at SI, RTI and VI during Pre- and Post-dredge surveys.

Data were standardised and dispersion weighted using Bray-Curtis Similarity. Locations colour coded with Pre-Dredge data denoted by square and Post-Dredge data denoted by circles.

3.2 Coral Bleaching and Disease

During the monitoring program, few corals showed signs of stress, such as bleaching or disease. Less than 2% of corals overall exhibited pale colouration, with < 0.1% presenting bleached white colouration. Less than 0.3% of corals showed any signs of disease (Figures 5 and 6, Table A4 in Appendix).

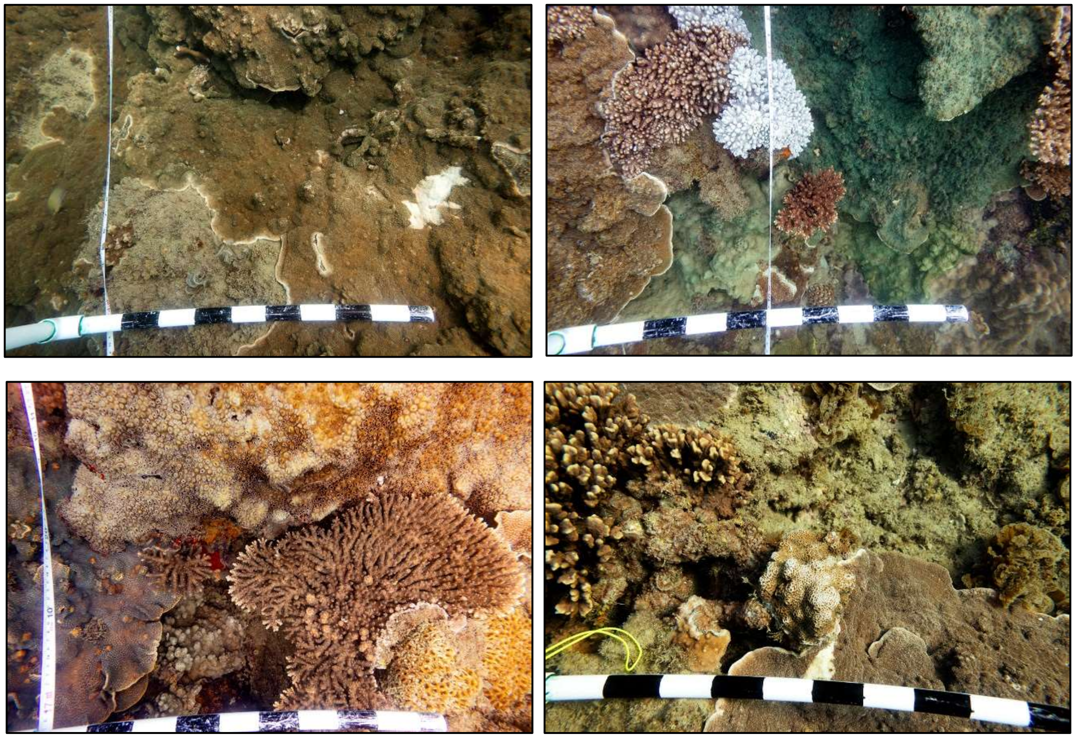

Figure 5 Examples of bleached white *Montipora* spp. and *Sinularia* spp. and bleached pale *Cyphastrea* spp. and *Favia* spp. at Round Top Island.

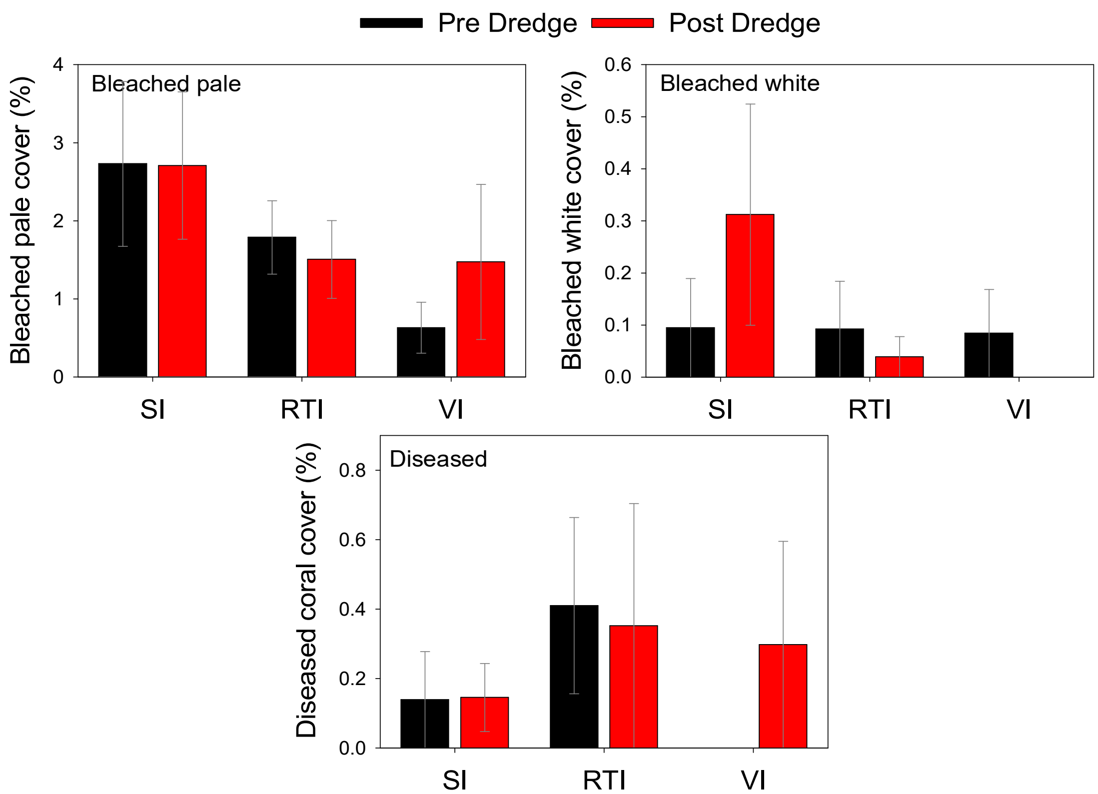

Figure 6 Mean cover of bleached pale corals, bleached white corals and diseased corals at SI, RTI and VI during Pre- and Post-dredge surveys.

Values are means ± se (n = 9 to 18), transect data standardised to hard corals only.

Temporal analysis of the data indicated that there were no significant differences in coral bleaching or presence of disease between the Pre-dredge and Post-dredge surveys, indicating no apparent impact from maintenance dredge activities. No significant spatial difference between locations was evident (Table A7 in Appendix).

3.3 Sedimentation

Sediment deposition on corals was observed at each location during both the Pre-and Post-dredge surveys (Figures 7 and 8, Table A4 in Appendix). Temporal analysis of the data indicated that there were no significant differences in the occurrence of sediment deposition between the Pre-dredge and Post-dredge surveys (Table A7 in Appendix). However, the depth of sediment deposition on corals was significantly ($P < 0.05$) higher during the Pre-dredge survey (0.8 to 0.9 mm) than during the Post dredge survey (0.4 to 0.6 mm). Decreases were consistent across all locations, suggesting regional metocean influences were likely responsible for the decreased sediment deposition depths.

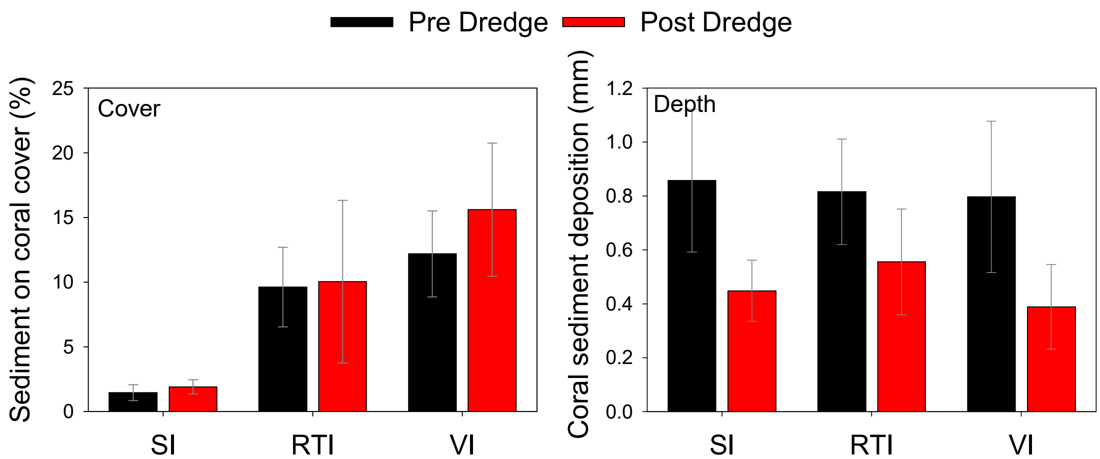

Figure 7 Mean occurrence and depth of sediments deposited on corals at SI, RTI and VI during Pre- and Post-dredge surveys.

Values are means ± se (n = 9 to 18), transect data standardised to hard corals only.

Figure 8 Examples of presence of sediments on coral tissues.

3.4 Juvenile Coral

Overall, juveniles from 19 coral taxa were recorded at the three locations (Table A5 in Appendix), with 1350 juveniles recorded during the Pre-dredge survey and 1162 juveniles recorded during the Post-dredge survey. The most common taxa were *Turbinaria* spp. (74% and 67% respectively in Pre- and Post-dredge surveys, Figure 9), followed by *Favia* spp. (7% and 8%), and *Acropora* spp. (6%).

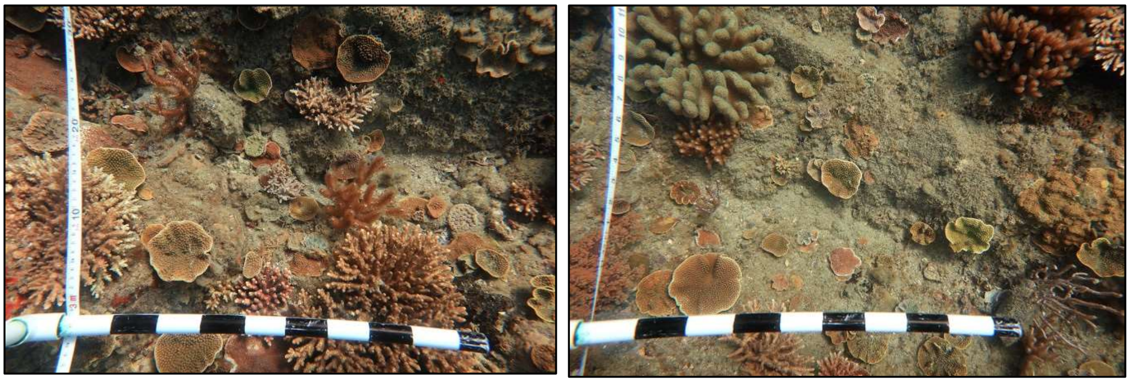

Figure 9 Examples of numerous juvenile *Turbinaria* spp. at RTI.

The juveniles were consistently distributed across the three size classes of 0 to 2cm, 2 to 5 cm and 5 to 10 cm within each of the three locations (Table A6 in Appendix). Analysis of the juvenile abundance data, indicated that no significant differences was evident at each location between the Pre- and Post-dredge surveys, indicating no apparent impact from maintenance dredge activities.

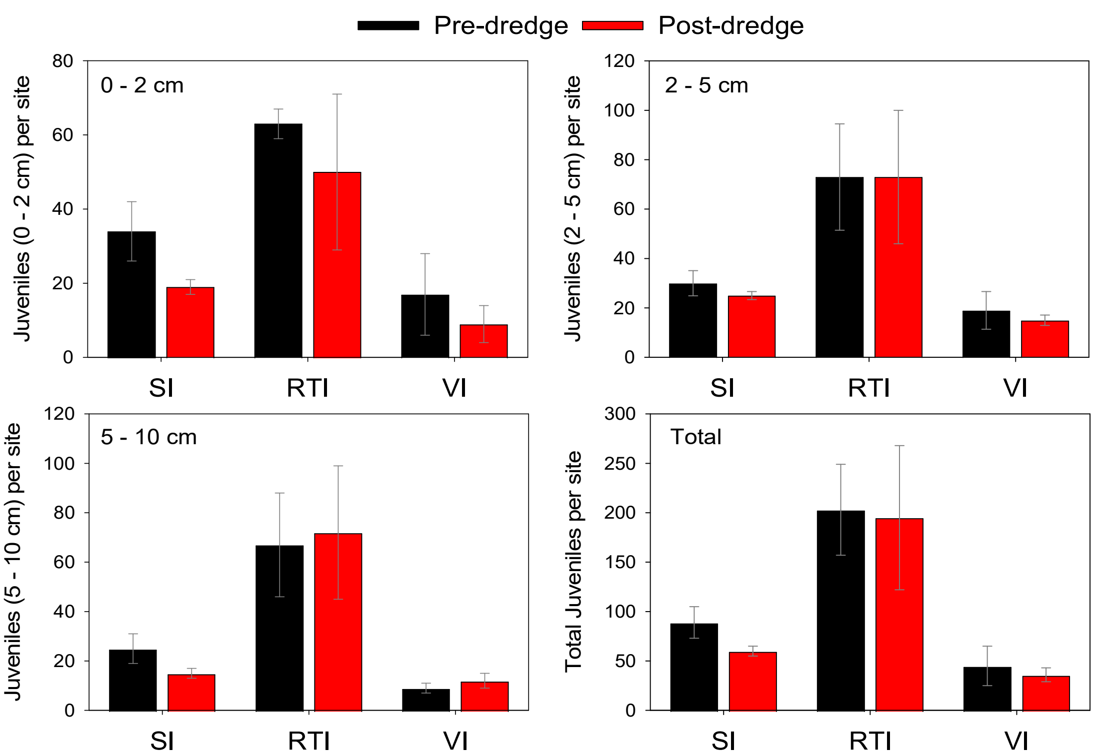

Figure 10 Mean abundance of juvenile corals (size classes and total) per site at SI, RTI and VI during Pre- and Post-dredge surveys.

Values are means ± se (n = 4).

However, significantly ($P < 0.05$) higher abundance of juveniles in all three size classes was evident at RTI (mean of 203 and 195 juveniles per site, respectively for Pre-and Post-dredge surveys), in comparison with SI (89 and 60 juveniles per site) and VI (45 and 36 juveniles per site). Chartrand et al. (2023) also reported that juvenile density was considerably higher at RTI than SI and VI during May 2023. *Turbinaria* spp. were also recorded as the dominant taxa across all three locations (Chartrand et al. 2023).

3.5 Coral Colour Analysis

The temporal analysis of luminosity in *Turbinaria* spp indicated that no significant difference in colour was evident between the Pre- and Post-dredge surveys, suggesting no significant impact from maintenance dredge activities. No significant spatial variation in pigment colour was evident between the three locations.

Overall, a slight negative colour change (5 to 9%) was recorded at each location from the winter Pre-dredge survey to the spring Post-dredge survey (Figure 11). A negative colour change indicates a decrease in pigment colour or lightening of the coral (Figure 12). This is likely due to the increased ambient light availability during the weeks leading up to the Post-dredge survey in October in comparison with the Pre-dredge survey in July/August.

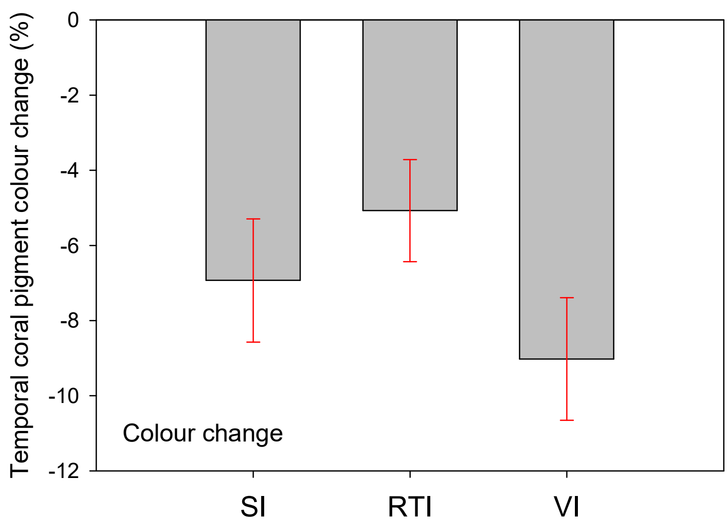

Figure 11 Mean percent colour change in coral pigments at SI, RTI and VI between Pre- and Post-dredge surveys.

Values are means ± se (n = 36); higher negative values denote lighter pigments.

Increased light availability to corals will lead to the coral's zooxanthellae to produce less pigment cells (e.g. chlorophyll) in order to regulate light availability and photosynthesis (Dubinsky and Jokiel 1994, Houlbrèque and Ferrier-Pagès 2009, Nir et al. 2011). Generally, the availability of light, or Photosynthetically Active Radiance (PAR), is higher during the summer months due to the longer day lengths, and lower during the winter months where day lengths are shorter (BOM 2024). In July 2024, the average day length at Hay Point was 11 hours, while in October, the average day length was 12 hours and 40 minutes (Sunrise Sunset 2024).

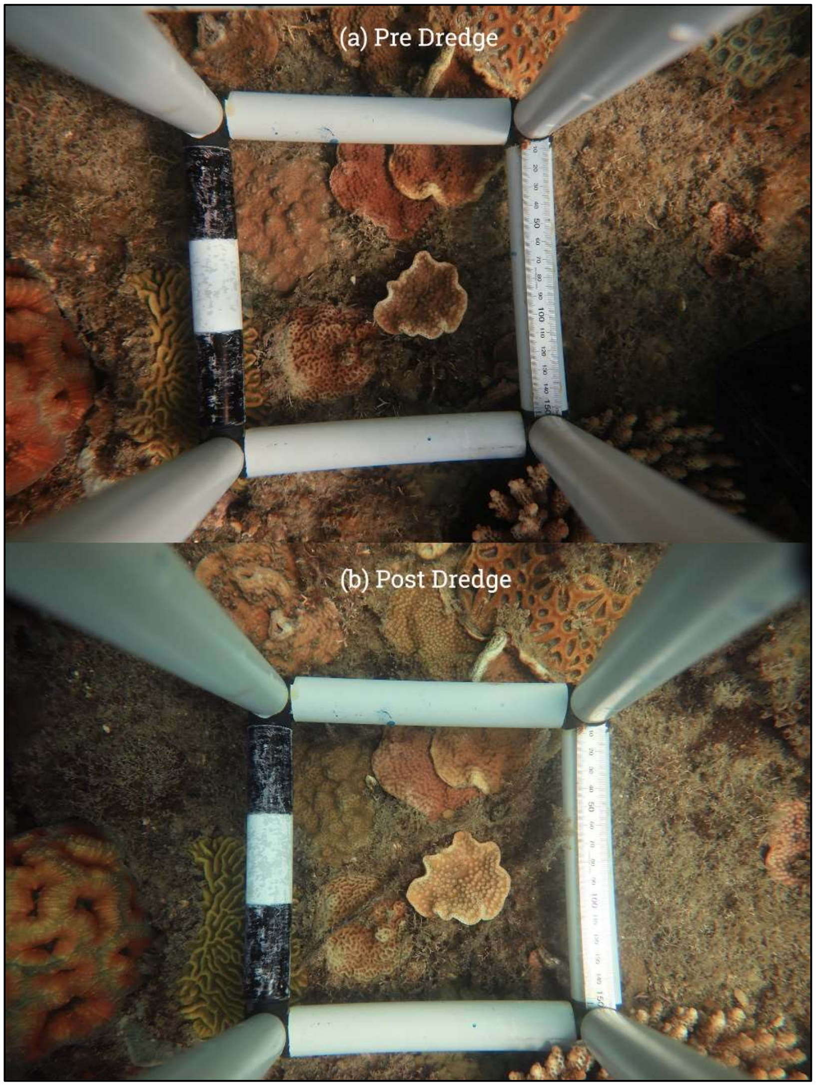

Figure 12 Example of colour decrease from Pre- to Post-dredge surveys in *Turbinaria* spp.

A similar phenomenon was observed during the 2019 maintenance dredge coral monitoring program, where monitored corals exhibited darker pigments during the winter Post-dredge survey, in comparison with the summer Pre-dredge survey (Vision Environment 2019). Corals and their algal symbionts have the ability to regulate changes in light availability through behavioural, morphological and physiological adaptation. This includes changes to polyp feeding regimes, changes in photosynthetic rates, coral skeletal light reflective and absorption properties, changes in algal densities, mucus production and energy shifts in physiology (Anthony and Fabricius 2000, Chen et al. 2005, Rodrigues and Grottoli 2007, Nir et al. 2011, Wangpraseurt et al. 2012, Ben-Zvi et al. 2015, Cruz et al. 2015, Jones et al. 2015).

4 CONCLUSIONS

A summary of the results of the coral monitoring for the Port of Hay Point maintenance dredging are as follows:

- Sediments, including sand, pavement and rocks, were the most common substrate type recorded in the monitored transects, covering approximately one-third of the surveyed area.
- Macroalgal assemblages were the most common biotic assemblage found across the three locations (~ 28%). The brown algae *Sargassum* sp. was the most frequently encountered macroalgal taxon.
- Hard corals covered approximately 25% of the areas surveyed across the three locations. *Montipora* spp. was the most encountered hard coral, followed by *Turbinaria* spp.
- Turfing algae and soft corals were also recorded regularly, while cover of sponges, ascidians, zoanthids, hydroids and bryozoans were sparse.
- Few corals (≤ 2%) exhibited signs of stress, such as bleaching and disease, across the three locations. Sediment deposition on corals was observed at each location.
- Juvenile corals (recruits) were dominated by *Turbinaria* spp. at all three locations. Abundance of juveniles was consistent across the three size classes measured (0 to 2cm, 2 to 5 cm and 5 to 10 cm).
- No significant temporal variation between the Pre-dredge and Post-dredge surveys was evident for any of the coral parameters monitored, including major and minor category coverage, occurrence of bleached and diseased coral, occurrence of sediment deposition, abundance of juvenile corals and coral pigmentation. These results indicate no apparent adverse impact from maintenance dredge activities.
- Of note, was the higher depth of deposited sediments on corals during the Pre-dredge survey than the Post-dredge survey. Decreases were consistent across all three locations, suggesting regional metocean impacts, rather than any influence from maintenance dredge activities.
- Coral pigments did exhibit slight lightening across all three locations from the Pre-dredge to Post-dredge surveys, which is attributable to the increased ambient light availability during the different seasons in which the surveys were undertaken, rather than any influence from maintenance dredge activities. A similar phenomenon was observed during the 2019 maintenance dredge coral monitoring program, also related to seasonal light availability.
- Significant spatial variation across the locations was evident for several monitored coral parameters. Round Top Island exhibited significantly higher soft coral coverage, and significantly lower macroalgal coverage than Slade Island and Victor Island. Round Top Island also contained significantly higher abundance of juvenile corals than the two other locations.

Overall, the surveyed inshore coral habitats at the Port of Hay Point did not appear to be impacted by maintenance dredge activities.

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6 APPENDIX

Table A1 GPS location of coral monitoring sites

Note that depth measurements are indicative and are the means of the recorded dive depths during monitoring. denoted new site established at RTI.*

Location	Mean Depth (m)	Site ID	Latitude	Longitude	No. of transects
Slade Island	4.9	S1	-21.0989	149.2440	3
		S2	-21.0988	149.2450	3
		S4	-21.0961	149.2431	3
		S5	-21.0966	149.2450	3
Round Top Island	5.9	S1	-21.1699	149.2656	3
		S3	-21.1702	149.2668	3
		S4	-21.1719	149.2675	3
		S7*	-21.1732	149.2628	3
Victor Island	4.5	S2	-21.3223	149.3267	3
		S3	-21.3232	149.3276	3
		S5	-21.3197	149.3215	3
		S6	-21.3223	149.3191	3

Table A2 Mean transect cover (%) of major category classes at SI, RTI and VI during Pre- and Post-dredge surveys.

Values are means ± se (n = 12)

Major Category (% cover)	Slade Island		Round Top Island		Victor Island	
	Pre-Dredge	**Post-Dredge**	**Pre-Dredge**	**Post-Dredge**	**Pre-Dredge**	**Post-Dredge**
Turfing Algae	9 ± 2	17 ± 2	6 ± 3	11 ± 3	9 ± 1	7 ± 2
Hard Coral	18 ± 3	19 ± 3	30 ± 6	29 ± 6	26 ± 6	23 ± 6
Soft Coral	1 ± 0	1 ± 0	5 ± 1	5 ± 1	1 ± 0	1 ± 1
Macroalgae	31 ± 7	32 ± 7	19 ± 9	21 ± 10	30 ± 4	37 ± 5
Sponges/Ascidians	2 ± 0	2 ± 0	2 ± 1	2 ± 1	<1	<1
Sediment	39 ± 6	29 ± 5	38 ± 6	32 ± 6	33 ± 6	31 ± 7
Hydroids/Bryozoans	<1	<1	<1	<1	<1	<1
Zoanthids	<1	<1	<1	<1	<1	<1

Table A3. Mean transect cover (%) of minor category classes/taxa at SI, RTI and VI during Pre- and Post-dredge surveys.

Major Category	Minor Category (% cover)	Slade Island		Round Top Island		Victor Island	
		Pre	Post	Pre	Post	Pre	Post
Turfing Algae	Turfing Algae	8.0	17	6.3	11	9.1	7.4
Hard Coral	*Acropora digitifera*	0.4	0.1	0.0	0.1	0.4	0.6
	Acropora formosa	0.3	0.0	1.8	2.5	2.5	2.3
	Acropora hyacinthus	2.7	3.1	4.4	3.7	3.3	3.3
	Acropora spp.	0.2	0.6	0.9	1.3	0.2	0.1
	Anacropora forbesi	0.0	0.1	0.0	0.0	0.0	0.0
	Coscinaraea spp.	0.2	0.1	0.7	1.1	0.2	0.1
	Turbinaria spp.	3.3	2.7	9.7	9.1	1.3	0.9
	Faviidae echinopora	0.0	0.0	0.0	0.0	0.0	0.0
	Favia spp.	0.9	0.8	0.6	1.2	0.1	0.3
	Faviidae Goniastrea	0.4	1.2	2.3	3.1	2.4	1.6
	Faviidae Leptastrea	0.0	0.0	0.0	0.0	0.2	0.0
	Faviidae *Platygyra* spp.	0.2	0.1	0.1	0.1	0.0	0.0
	Galaxea spp.	0.0	0.0	0.4	0.0	0.0	0.0
	Hydnophora excesa	2.1	2.0	1.0	1.4	0.0	0.6
	Lobophyllia hemprichii	0.0	0.0	0.2	0.1	0.0	0.1
	Merulina ampliata	0.0	0.7	0.0	0.2	0.0	0.1
	Montipora capricornis	0.1	0.2	0.2	0.4	0.1	0.6
	Montipora spp.	4.8	5.3	4.6	2.8	14	12
	Montipora verrucosa	0.0	0.0	0.0	0.0	0.0	0.1
	Pectinida spp.	0.0	0.0	0.0	0.0	0.0	0.0
	Pachyseris speciosa	0.0	0.0	0.1	0.0	0.0	0.0
	Pocillopora damicornis	0.2	0.2	0.1	0.2	0.3	0.1
	Pocillopora verrucosa	0.1	0.0	0.0	0.0	0.0	0.0
	Poritidae *Goniopora*	0.0	0.0	0.1	0.0	0.1	0.0
	Poritidae *Porities* spp.	1.1	2.0	2.3	1.3	0.7	0.3
	Psammocora spp.	0.0	0.0	0.0	0.0	0.3	0.0
Soft Coral	*Alcyonium* spp.	0.0	0.0	0.2	0.1	0.0	0.0
	Gorgonian spp.	0.1	0.1	0.4	0.1	0.1	0.0
	Lobophytum spp.	0.4	0.2	1.0	0.6	0.1	0.8
	Nephtheidae spp.	0.1	0.0	1.3	0.9	0.0	0.0
	Sarcophyton spp.	0.3	0.3	1.8	1.9	0.5	0.0
	Sinularia spp.	0.2	0.2	0.6	1.2	0.0	0.0
Macroalgae	*Asparagopsis* spp.	0.0	0.0	0.0	0.0	0.0	0.9
	Caluerpa taxifolia	0.0	0.0	0.0	0.1	0.0	0.1
	Coraline Algae	0.0	0.2	0.0	0.0	0.2	0.1
	Galaxauras spp.	0.0	0.0	0.0	0.0	0.0	0.0
	Halimeda spp.	0.1	0.3	0.0	0.0	0.2	0.1
	Halymenia spp.	0.0	0.0	0.0	0.0	0.0	0.6
	Lobophora spp.	1.4	0.9	0.0	0.4	0.0	0.3
	Padina spp.	1.8	6.0	3.3	4.5	1.1	3.8
	Sargassium spp.	31	25	15	16	29	31
Sponges/Ascidians	Sponge/Ascidian	1.4	1.6	1.9	2.0	0.4	0.3
Bryozoa/Hydroid	Hydroids	0.0	0.2	0.3	0.2	0.0	0.0
Sediment	Dead Coral with Algae	0.0	0.1	0.5	0.0	4.0	0.9
	Pavement	13	5.4	9.8	4.6	0.0	0.1
	Rubble	0.3	0.3	3.6	3.2	0.4	0.1
	Sand	25	23	24	24	29	30

Table A4. Occurrence of bleach and diseased corals, and mean occurrence and depth of sediment on corals at SI, RTI and VI during Pre- and Post-dredge surveys.
Values are means ± se (n = 9 to 18).

Location	Survey	Mean Occurrence per transect (%)				Sediment Depth (mm)
		Bleached Pale	Bleached White	Diseased	Sediment	
Slade Island	Pre-Dredge	2.7 ± 1.1	0.1 ± 0.1	0.1 ± 0.1	1.5 ± 0.6	0.9 ± 0.3
	Post-Dredge	2.7 ± 0.9	0.3 ± 0.2	0.1 ± 0.1	1.9 ± 0.6	0.4 ± 0.1
Round Top Island	Pre-Dredge	1.8 ± 0.5	0.1 ± 0.1	0.4 ± 0.3	9.6 ± 3.1	0.8 ± 0.2
	Post-Dredge	1.5 ± 0.5	0	0.4 ± 0.4	10.0 ± 6.3	0.6 ± 0.2
Victor Island	Pre-Dredge	0.6 ± 0.3	0.1 ± 0.1	0	12.2 ± 3.3	0.8 ± 0.3
	Post-Dredge	1.5 ± 1.0	0	0.3 ± 0.3	15.6 ± 5.2	0.4 ± 0.2

Table A5 Juvenile coral (recruit) taxon and total numbers at SI, RTI and VI during Pre- and Post-dredge surveys.

Taxa	Slade Island		Round Top Island		Victor Island		Total	
	Pre-Dredge	Post-Dredge	Pre-Dredge	Post-Dredge	Pre-Dredge	Post-Dredge	Pre-Dredge	Post-Dredge
Acropora formosa	12	3	40	8	7	2	59	13
Acropora sp	8	15	12	28	8	12	28	55
Alcyonium	0	0	2	13	0	0	2	13
Alveopora	23	17	0	0	1	0	24	17
Coscinaraea	25	17	9	20	3	6	37	43
Favia	38	22	38	59	15	12	91	93
Faviidae Platygyra	1	4	1	6	0	1	2	11
Goniopora	6	0	5	3	2	11	13	14
Lobophyllia hemprichii	7	3	7	3	0	1	14	7
Lobophytum	10	0	6	5	0	0	16	5
Montipora	0	0	0	1	2	1	2	2
Nephtheidae	3	0	0	8	0	0	3	8
Pachyseris	1	0	0	1	0	0	1	1
Pocillopora Damicornis	3	7	9	17	0	0	12	24
Porites	5	2	1	13	0	0	6	15
Psammocora	1	5	0	0	0	0	1	5
Sarcophyton	9	10	10	25	4	4	23	39
Sinularia	7	3	12	17	1	0	20	20
Turbinaria	198	130	660	554	138	93	996	777
Total	**357**	**238**	**812**	**781**	**181**	**143**	**1350**	**1162**
Mean Recruits per Site	**89**	**60**	**203**	**195**	**45**	**36**	**113**	**97**

Table A6 Mean number of coral recruits per site at SI, RTI and VI during Pre- and Post-dredge surveys. *Values are means ± se (n = 4).*

Location	Survey			
		0 – 2 cm	**2 – 5 cm**	**5 – 10 cm**
Slade Island	**Pre-Dredge**	34 ± 8	30 ± 5	25 ± 6
	Post-Dredge	19 ± 2	25 ± 2	15 ± 2
Round Top Island	**Pre-Dredge**	63 ± 4	73 ± 22	67 ± 21
	Post-Dredge	50 ± 21	73 ± 27	72 ± 27
Victor Island	**Pre-Dredge**	17 ± 11	19 ± 8	9 ± 2
	Post-Dredge	9 ± 5	15 ± 2	12 ± 3

Table A7. Summary of one and two-way ANOVAs for major substrate cover and coral health indicators.
Red denotes significant (P < 0.05) differences observed. P =probability.

% Substrate cover	Turfing algae		Hard corals		Soft corals		Macroalgae	
	F Value	P Value	F Value	P Value	F Value	P Value	F Value	P Value
Pre vs Post-dredge (Time)	3.87661	0.053040	0.0264	0.871324	0.2476	0.620356	0.27861	0.599334
Locations	0.83460	0.364175	2.7653	0.100932	56.0488	0.000000	4.25091	0.043054
Time x Locations	0.24631	0.621284	0.0003	0.986967	0.0564	0.813065	0.01743	0.895369
Sites (locations)	4.8472	0.000074	12.3138	0.000000	15.3975	0.000000	28.0499	0.000000
Time x Sites (Locations)	1.7541	0.089694	0.0950	0.999907	0.3648	0.963537	0.2554	0.990998

% Substrate cover	Sponges/ascidians		Sediments		Hydroids/Bryozoans	
	F Value	P Value	F Value	F Value	P Value	P Value
Pre vs Post-dredge (Time)	0.00040	0.984046	1.5325	0.220000	0.02156	0.883698
Locations	4.59996	0.035549	0.1374	0.712028	3.28641	0.074269
Time x Locations	0.00253	0.960048	0.0000	0.995119	0.28723	0.593747
Sites (locations)	6.66998	0.000002	13.5833	0.000000	5.43680	0.000020
Time x Sites (Locations)	0.40051	0.949020	0.3561	0.966624	0.37070	0.961326

Bleaching & Sediments on corals	Bleached Pale		Bleached White		Diseased Coral		Sediments on Corals		Sed depth (mm)	
	F Value	P Value	F Value	P Value	P Value	P Value	F Value	P Value	F Value	P Value
Pre vs Post-dredge (Time)	0.00885	0.925317	0.004933	0.944215	3.49623	0.065814	0.059282	0.808368	0.11269	0.738140
Locations	0.12353	0.726324	0.357138	0.552085	0.12334	0.726525	1.486534	0.226967	0.34091	0.561238
Time x Locations	0.25731	0.613614	0.390918	0.533910	0.17227	0.679410	0.295751	0.588337	0.04680	0.829373
Sites (locations)	2.14973	0.038970	1.007295	0.444677	2.79432	0.008459	1.316521	0.248085	4.52535	0.000151
Time x Sites (Locations)	0.68362	0.746947	0.709295	0.723597	2.17881	0.031714	0.532328	0.871533	1.51774	0.156265

Figure A1. Coral community at RTI, including *Goniopora* sp. in the foreground and *Montipora* spp. in the background.

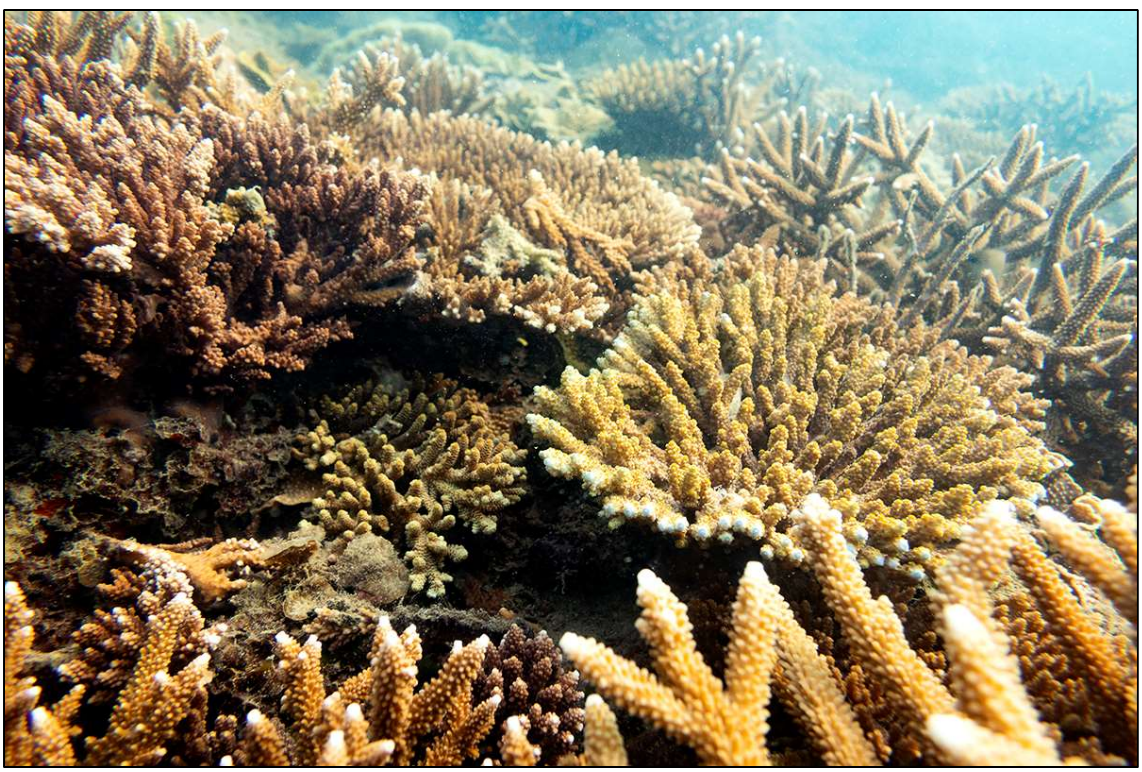

Figure A2 *Acropora* spp. community at VI during the Post-dredge survey.

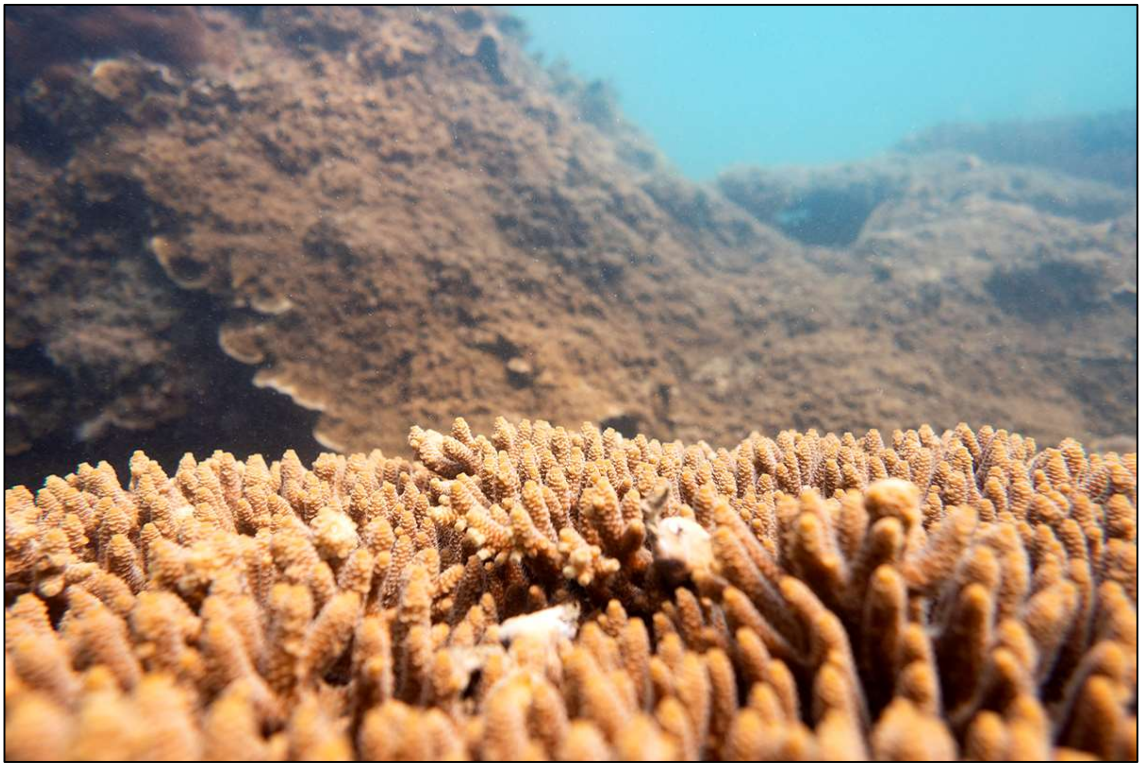

Figure A3 Coral community at VI, including *Acropora* sp. and *Montipora* sp. in the background during the Pre-dredge survey.

Figure A4. *Turbinaria* sp. among the brown macroalgae *Sargassum* sp., with a resident Rolland's demoiselle, *Chrysiptera rollandi*.

Figure A5. *Turbinaria* sp. at RTI.

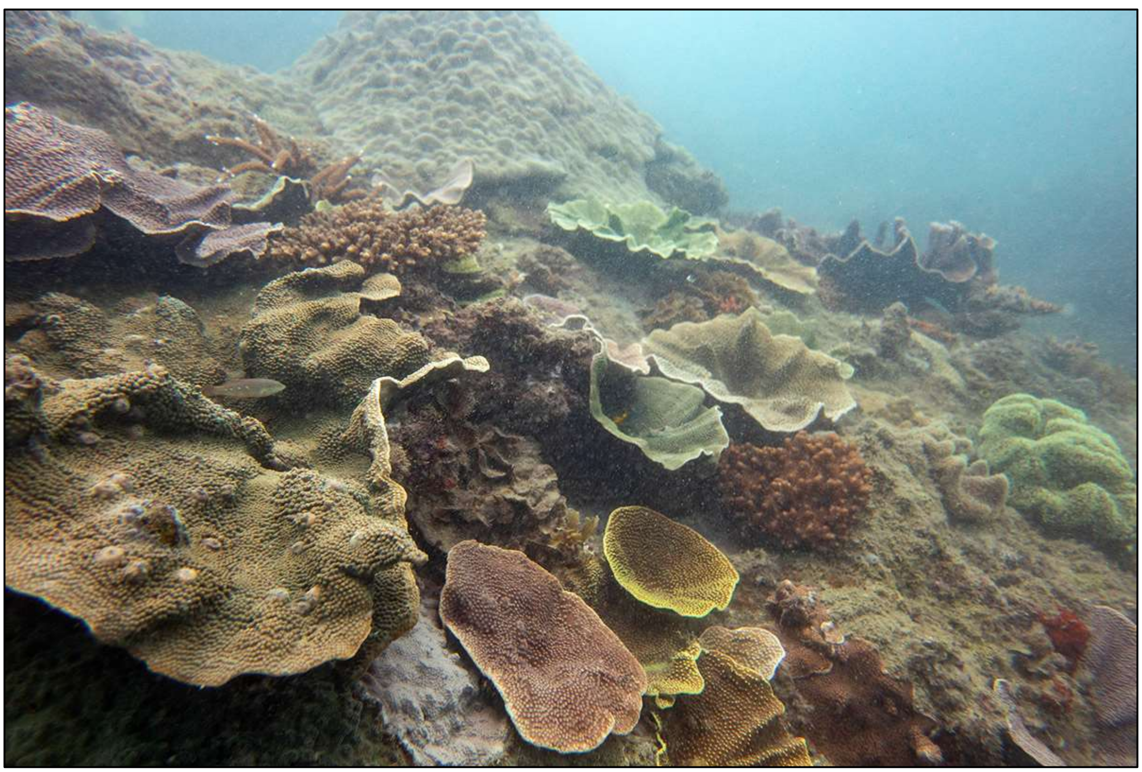

Figure A6. *Turbinaria* spp. dominant reef with *Acropora/Pocillopora* spp. at RTI, with *Porites* sp. in the background and *Sarcophyton* sp. on the right.

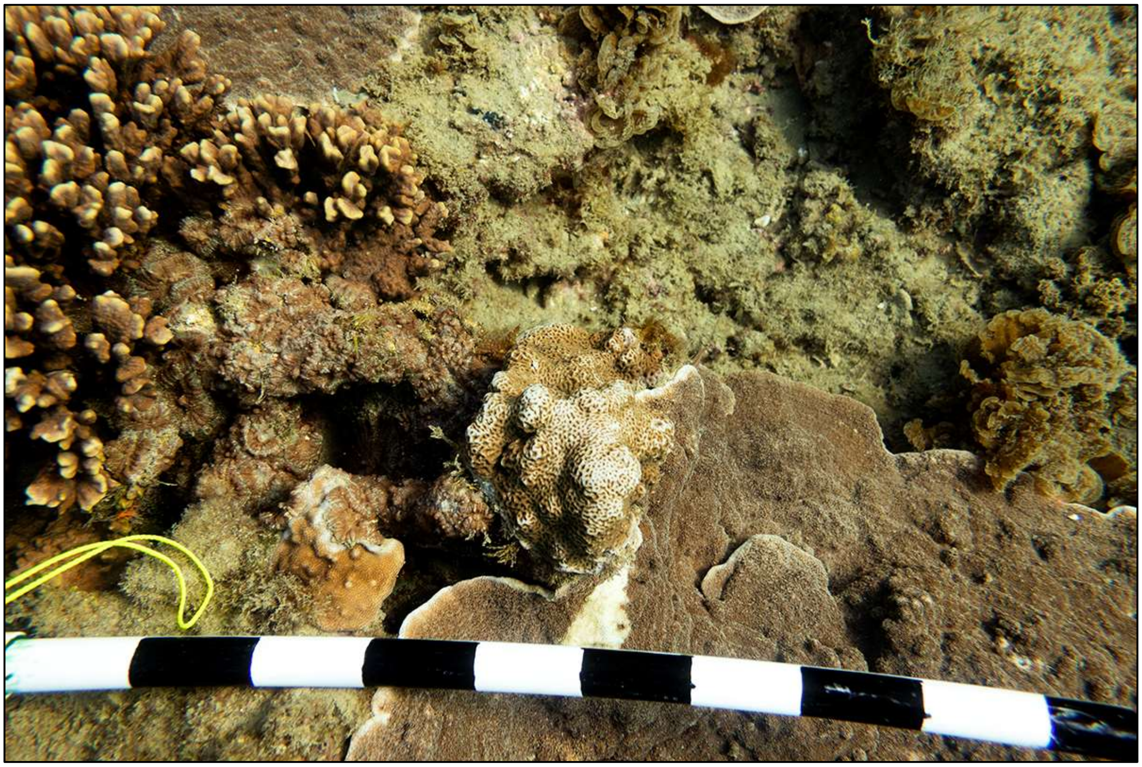

Figure A7. Example of bleached pale *Favia* sp. with partial bleached white *Montipora* sp. at RTI during Pre-dredge surveys.

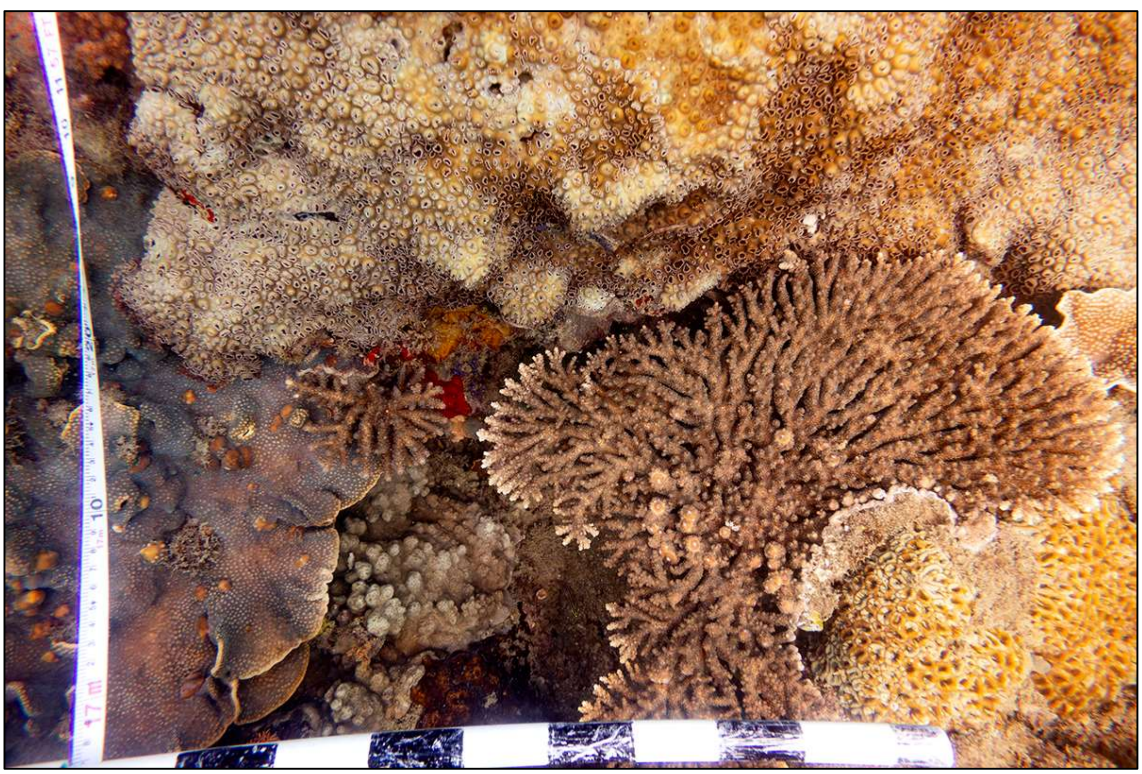

Figure A8. Example of bleached pale *Cyphastrea salae* (top) and *Favia* sp. (bottom right) at RTI during Post-dredge surveys.

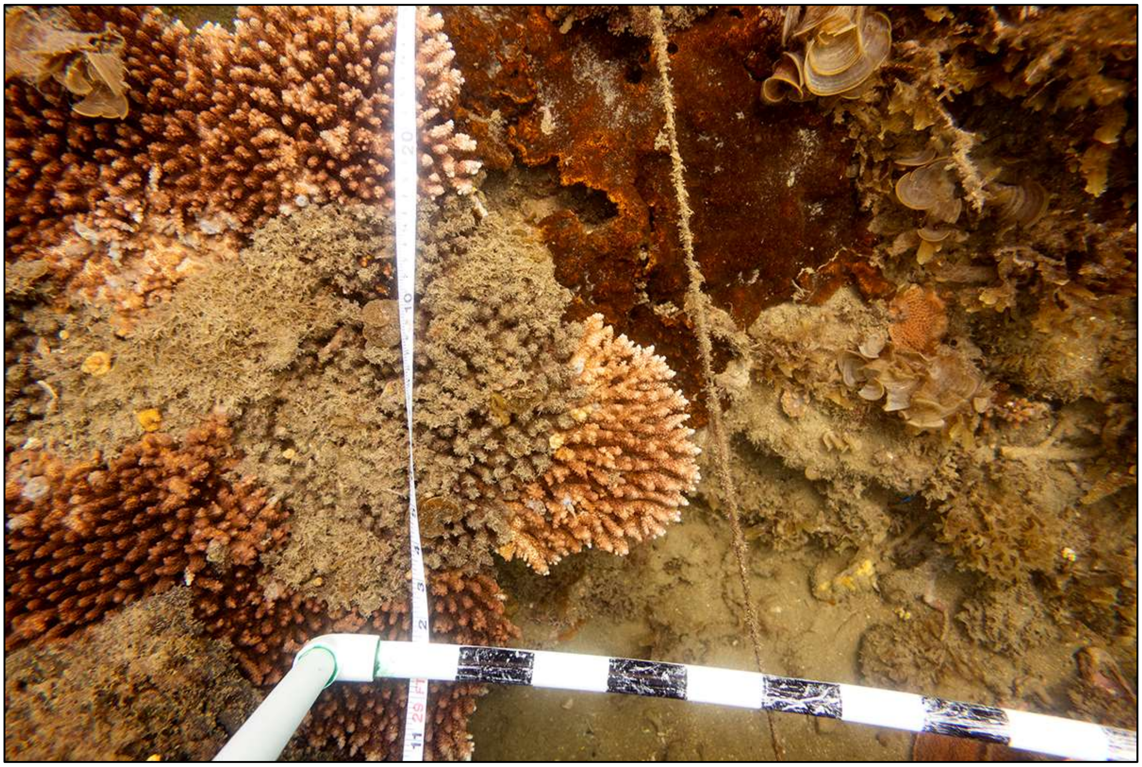

Figure A9. Example of partially dead coral (*Acropora* sp.) with algae at RTI during Post-dredge surveys.

Figure A10. Example of sediment on coral at VI during Post-dredge surveys.

Figure A11. Hydroids encountered at SI during Post-dredge surveys.

Figure A12. Gorgonians and sea stars encountered at SI during Post-dredge surveys.

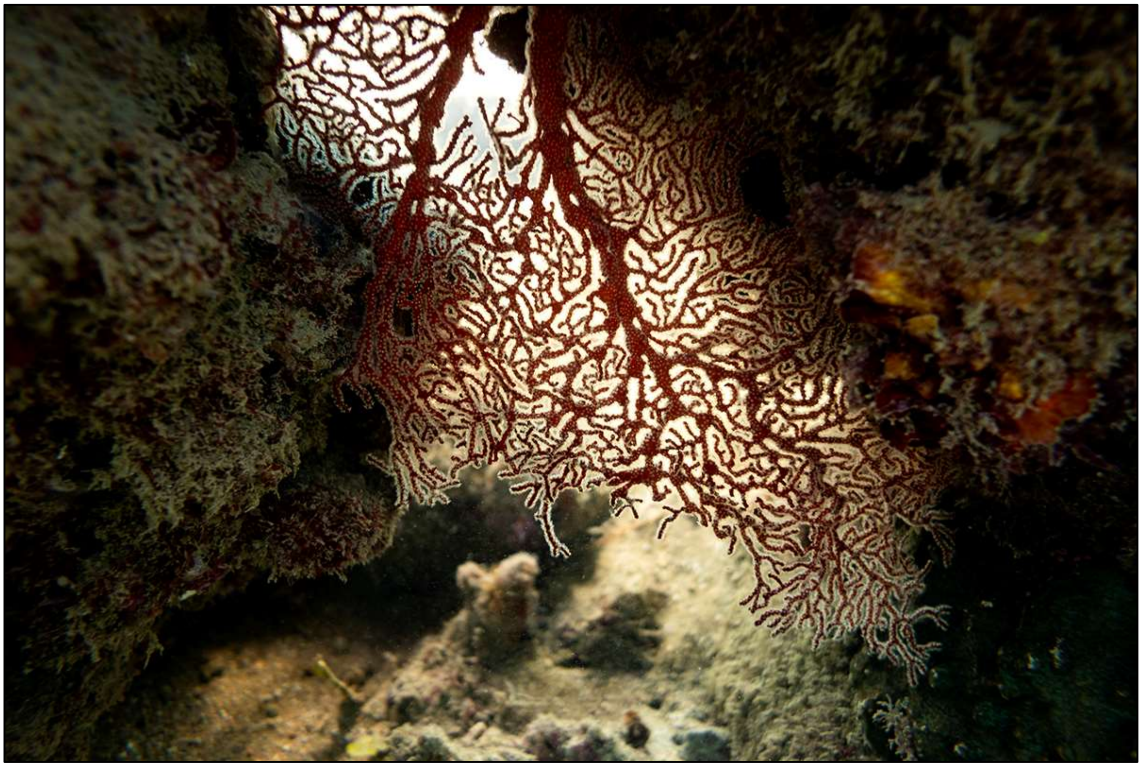

Figure A13. Gorgonians encountered inside a crevice at SI during Post-dredge surveys.

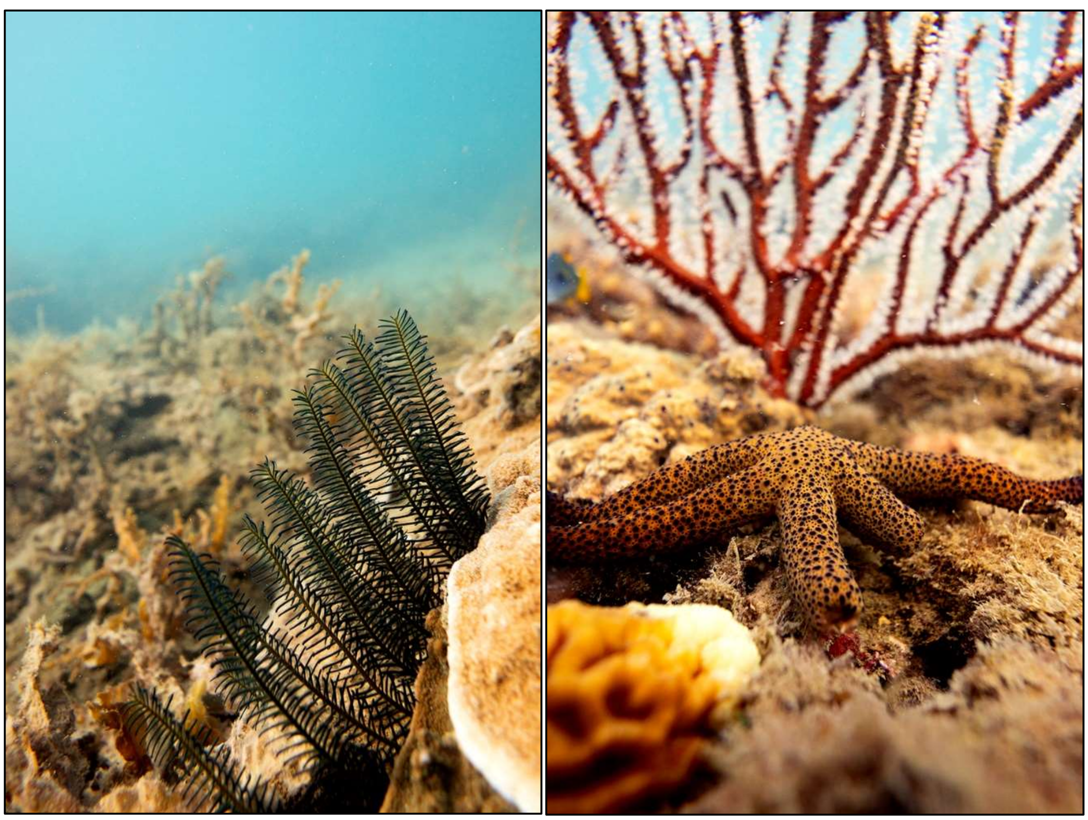

Figure A14. Crinoids (feather stars) and sea stars encountered at VI and SI, respectively.

Figure A15. Resident Olive Sea Snake, *Aipysurus laevis,* among dominant macroalgae, *Sargassum* sp., encountered at VI.

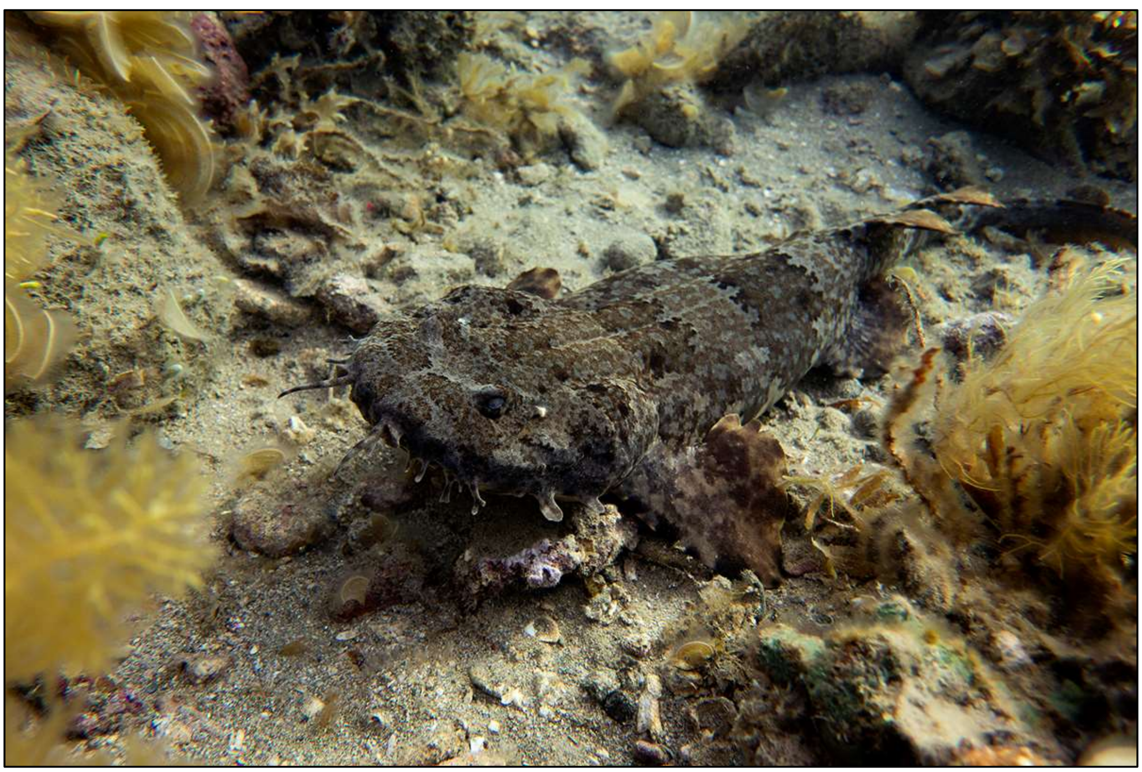

Figure A16. Resident Carpet Shark, *Orectolobus* sp., among dominant macroalgae, *Sargassum* sp., encountered at SI.