Reef Check Australia

South East Queensland
Season Summary Report 2019-2020

REEF CHECK AUSTRALIA

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SEQ Season Summary Report 2019-2020

This project was made possible by a network of dedicated volunteers, generous dive operators, wise advisors, innovative collaborators and supportive funding agencies.

Thank you to the dedicated citizen scientists who have contributed to survey activities: Ashleigh Borra, Isabelle Derouet, Philip Dunbavan, Terry Farr, David Harris, Dave Henry, Lauren Jubb, Jody Kreuger, Lisa McComb, Rachel McVeigh, Deanne Passenger, Sebastiaan Reynhardt, Jayde Roberts, Devin Rowell, Jodi Salmond, Julie Schubert, David Stahel, Cheryl Tan, & Lucy Wells.

A special note of acknowledgement to our trainers, professional volunteers and staff: Jody Kreuger, Josh Passenger, Jodi Salmond and Julie Schubert.

Many of the images used within this document were taken by Reef Check Australia General Manager Jodi Salmond, SEQ Survey Coordinator Julie Schubert and Team Leader Philip Dunbavan. The image on the front was kindly donated by Gary Cranitch, from the Queensland Museum.

Project activities were conducted on the traditional lands of the Quandamooka People, Kabi Kabi First Nation and Yugambeh People. We acknowledge the Traditional Custodians of the land, of Elders past, present and emerging.

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SEQ Season Summary Report 2019-2020

Message from our General Manager

The 2019-2020 season was one of our most challenging yet. More than 30 planned survey expeditions were cancelled due to extreme weather events. The fires and floods of early 2020 left many staff and volunteers fearing for their homes and livelihoods. Then, to top it off, the COVID pandemic threatened to shut down Reef Check Australia in the region, if not Australia. Costs associated with conducting specialised reef health surveys skyrocketed. Forced to charter full vessels, and an increase in our Risk Management procedures to ensure a safe and secure environment for all involved meant stringent requirements put in place to ensure our vital reef health work and community outreach activities could continue, albeit quite differently to before.

Moving training activities, events and communications almost exclusively online meant an increase in workloads, costs and stress, combined with a decrease in staff. It was a very scary time, and one of which we are not out of yet.

It is only due to the outstanding support and understanding of funding partners, in collaboration with the dedicated efforts of so many amazing individuals that Reef Check Australia is still standing. It is a testament to the passionate individuals that make up the Reef Check Australia community and I am truly thankful to be surrounded by each and every one of them.

Thank you to each and every one of you for your support, kind words and dedication to our reefs and oceans.

If you would like to find out more about our activities or help to support us, please visit our website: www.reefcheckaustralia.org.

Jodi Salmond

General Manager, Reef Check Australia

Thank you to industry supporters who provided in-kind support during this survey season for surveys, volunteer training events and advice including: Gold Coast Dive Adventures, Point Lookout Scuba Dive Charters, Subsurface Scuba, and the UQ Moreton Bay Research Station.

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SEQ Season Summary Report 2019-2020

Contents

1.0 PROJECT INTRODUCTION

Since 2001, Reef Check Australia (RCA) has supported citizen science reef monitoring projects on reefs around Australia. For the past 19 years, our surveys have helped with the collection of long-term data relating to reef health at a local, national and global scale.

RCA's survey methods collect quantitative data for substrate cover, key invertebrate species, target fish species, as well as anthropogenic and natural impacts in reef habitats.

This report presents a summary of the findings for surveys conducted in South East Queensland (SEQ) during the 2019-2020 season. Teams of trained volunteers monitored a total of 40 locations on 20 different reefs, which included survey sites ranging from Mudjimba Island on the Sunshine Coast to Palm Beach Reef on the Gold Coast. 16,800m^2 of reef habitat was surveyed in total during the 2019-2020 season (where one survey covers 400m^2), resulting in more than 7000 pieces of data collected, and more than 1,344 hours donated by trained volunteers.

Image 1A Taking a rest on transect

Image 1B Nearest available landing site

The SEQ region is divided into the five sub-regions: Noosa, Sunshine Coast, Outer Moreton Bay, Inshore Moreton Bay and Gold Coast. Some existing RCA monitoring locations were not visited during the 2019-2020 survey season due to weather conditions and/or funding resources. Survey site locations are documented in Table 1 below and those not surveyed in 2019-2020 are shown in *italics*.

Table 1. List of all RCA survey reefs in South East Queensland by Sub-region. Reefs not visited during the 2019-2020 survey season are represented in *italics*.

NOOSA	SUNSHINE COAST	INSHORE MORETON BAY	OUTER MORETON BAY	GOLD COAST
Granite Bay	Bulcock Reef	Amity Point	*Flat Rock Island*	*Cook Island*
Hancocks Shoal	Currimundi Reef	Goat Island	Flinders Reef	Gold Coast Seaway
Jew Shoal	*Dead Mans Reef*	Green Island	*Hutchinsons Shoal*	*Kirra Reef*
Little Halls Reef	Inner Gneerings	Macleay Island	*Marietta Dal*	*Narrowneck Reef*
The Caves	Kings Beach	Mud Island	Shag Rock Island	Palm Beach Reef
	Mooloolah River	Myora Reef		Palm Beach Artificial Reef
	Mudjimba (Old Woman) Island	Peel Island		*Wavebreak Island*
		St Helena Island		

Located in the transitional zone between temperate and tropical waters, South East Queensland (SEQ) hosts a wide diversity of marine species (DeVantier, Williamson & Willan 2010). Our reefs are classified as rocky reefs, with rock forming the substrate upon which the corals attach. This differs to northern Australia reefs where corals live upon a limestone structure created by dead corals. These rocky reefs are still important sources of refuge, nursery areas and food for marine organisms but local authority monitoring is limited (Roelfsema et al. 2019).

While concerted efforts are being made to reduce stressors on our reefs by managing our catchments and waterways (e.g. Pumicestone Passage Catchment Action Plan 2017-2020), the areas of SEQ monitored by Reef Check Australia are in the top ten fastest growing local government areas (Queensland Treasury 2020). This ever increasing population continues to place pressure on our reefs and marine environment. Habitat loss, marine debris, over-fishing and boating activities, combined with climate change, have the potential to create negative consequences for our local reefs and marine organisms in SEQ.

It is expected that SEQ reefs will exhibit species shifts as a result of climate change and anthropogenic impacts therefore it is important to provide long-term monitoring to enable assessment of the changing health and status of the reefs. The citizen science monitoring program conducted by Reef Check Australia provides this crucial data and supports management responses (Schläppy et al. 2017), with the data being widely available to researchers and government departments.

1.1 MONITORING SITES

In the 2019-2020 season, RCA monitored sites along the SEQ coast from Mudjimba Island off the Sunshine Coast all the way to Palm Beach on the southern end of the Gold Coast (see Figure 1.1 for map locations). Reef habitats at the survey sites varied from inshore to offshore areas, and included reef flats, crests and slopes. Sites also spanned protected (marine national park, no-take zones) and non-protected areas. Of the 19 reefs surveyed, 12 were within the Moreton Bay Marine Park.

Figure 1: Map of South East Queensland survey sites from Google Earth, A: Noosa; B: Sunshine Coast; C: Moreton Bay; D: Gold Coast. Note that Noosa was not surveyed this season.

Table 2: Table of RCA monitoring locations from Mudjimba Island to Gold Coast visited in the 2019-2020 SEQ season, including site number, location, depth, year of initial survey and site designation. Site designation includes four zones within the Moreton Bay Marine Park: Marine National Park (MNP), Conservation Park (CP), Habitat Protection (HP) and Ramsar Wetland site status (Ramsar).

LOCATION	SITE #	SITE	DEPTH (m)	1st SURVEY	SITE ZONING
Sunshine Coast	1	Bulcock Beach, Boardwalk	4	2018	MNP, Ramsar
Sunshine Coast	1	Currimundi Reef	9	2009	
Sunshine Coast	2	Currimundi Reef	9	2009	
Sunshine Coast	3	Currimundi Reef	9	2019	
Sunshine Coast	1	Inner Gneerings, The Caves	9	2009	
Sunshine Coast	2	Inner Gneerings, The Caves	9	2013	
Sunshine Coast	1	Kings Beach	5	2009	MNP, Ramsar
Sunshine Coast	1	Mooloolah River, La Balsa	5	2018	
Sunshine Coast	1	Mudjimba Island, NW Reef	9	2013	
Sunshine Coast	1	Mudjimba Island, The Ledge	5	2007	
Sunshine Coast	2	Mudjimba Island, The Ledge	9	2013	
Sunshine Coast	3	Mudjimba Island, The Ledge	6	2013	
Inshore Moreton Bay	1	Amity Point	9	2016	CP, Ramsar
Inshore Moreton Bay	2	Amity Point	5	2016	CP, Ramsar
Inshore Moreton Bay	1	Goat Island, East	5	2009	CP, Ramsar
Inshore Moreton Bay	1	Goat Island, West	5	2014	CP, Ramsar
Inshore Moreton Bay	1	Green Island, East	5	2015	CP, Ramsar
Inshore Moreton Bay	1	Green Island, North	5	2015	CP, Ramsar
Inshore Moreton Bay	2	Green Island, North	2	2020	CP, Ramsar
Inshore Moreton Bay	1	Green Island, West	5	2017	CP, Ramsar
Inshore Moreton Bay	1	Macleay Island	5	2009	HP, Ramsar
Inshore Moreton Bay	1	Mud Island, Coral Galore	5	2017	HP, Ramsar
Inshore Moreton Bay	1	Mud Island, Rubble Patch	5	2017	HP, Ramsar
Inshore Moreton Bay	1	Myora Reef	5	2009	MNP, Ramsar
Inshore Moreton Bay	2	Myora Reef	5	2014	MNP, Ramsar
Inshore Moreton Bay	1	Peel Island, East	5	2009	CP, Ramsar
Inshore Moreton Bay	1	Peel Island, North	5	2009	MNP, Ramsar
Inshore Moreton Bay	1	Peel Island, Northeast	5	2014	CP, Ramsar
Inshore Moreton Bay	1	St Helena, Palindrome	5	2018	MNP, Ramsar
Inshore Moreton Bay	1	St Helena, Ray of Sunshine	5	2018	MNP, Ramsar
Outer Moreton Bay	1	Flinders Reef, Nursery	9	2009	MNP
Outer Moreton Bay	3	Flinders Reef, Nursery	9	2009	MNP
Outer Moreton Bay	1	Shag Rock, East	9	2008	HP
Outer Moreton Bay	1	Shag Rock, West	9	2009	HP
Gold Coast	1	Gold Coast Seaway, SW Wall	5	2007	
Gold Coast	1	Gold Coast Seaway, The Pipe	5	2015	
Gold Coast	1	Palm Beach Artificial Reef	5	2019	
Gold Coast	2	Palm Beach Artificial Reef	5	2020	
Gold Coast	1	Palm Beach Reef	9	2007	
Gold Coast	2	Palm Beach Reef	9	2009	

1.2 KEY FINDINGS FROM 2019-2020 SURVEYS:

The 2019-2020 season included surveys at 40 monitoring locations. Three new locations were surveyed (Green Island North Site 2, Palm Beach Artificial Reef Site 1 and 2).

1.2.1 SUBSTRATE

Of the 40 locations surveyed, most remained relatively stable in hard coral cover. Thirteen locations had decreases of less than 10%, 15 locations had increases of less than 10%, with five showing no change. Two sites showed decreases in coral cover greater than 10% (Inner Gneerings, Site 1 – 17% and Flinders reef The Nursery Site 1 – 12%), however two sites showed increases in hard coral greater than 10% (Goat Island West – 11% and Myora Reef Site 2 – 14%). Three new surveys locations were added this season, therefore a change in coral cover is not included for these sites. Soft coral remained relatively stable, with no change at six locations, decreasing by less than 10% at nine locations, and increasing by less than 10% at three locations. Soft coral increased notably at two locations (Inner Gneerings , Site 1 – 19% and Mud Island, Coral galore – 20%). Smaller increases were noted at Mudjimba Island The Ledge, Site 2 – 12%, Mudjimba Island The Ledge, Site 1 – 11% and Peel Island North – 10%. Soft coral decreased notably at Shag Rock East (15%); Currimundi, Site 3 (14%) and Green Island West (11%).

Image 1.2.1A Peel Island, Photo by Gary Granitch

Image 1.2.1B Happy surveyors

Image 1.2.1C Inner Gneerings, Photo by Gary Granitch

Hard coral cover ranged from 0% found at Bulcock Beach, Gold Coast Seaway South West Wall & The Pipe; Green Island East; Green Island North S2; Mooloolah River; Palm Beach Artificial Reef S1 and S2; to 52% at Myora, Site 2. The average hard coral cover across all surveyed locations was 13% (not including sites with no hard coral recorded). This overall regional average is lower than previous years (15% in 2018-2019 season). This may be partly explained by the additional sites being included for the first time, which have little hard coral cover.

The most predominant substrate type recorded across all 42 surveys was rock, attributing to 33% of the benthos surveyed (this includes all RCA rock categories; rock (RC), rock covered with coralline algae (RCCA) and rock covered with turf algae (RCTA). Sand accounted for the second most abundant substrate, with 19%, whilst hard coral made up 13%.

1.2.2 IMPACTS: CORAL BLEACHING

Coral bleaching was recorded on 29 of the 42 surveys (69% of surveys) which is a reduction to previous years (73% of the sites in 2019, 77% in 2018 and 86% in 2017). On average, 15% of the coral population was affected, with individual colonies suffering an average of 24% surface bleaching. These levels are slightly higher than those recorded in 2019 (8% of the population and 17% for individual colonies). Of the regions, Inner Moreton Bay sites had the highest population bleaching, with an average of 4.75% over all the sites.

Figures 2 to 5 below depict changes in coral cover, and coral bleaching, over time at each site, and are categorised by sub-regions.

Sunshine Coast Regional Summary of Coral Trends and Bleaching

Hard coral coverage has remained relatively constant over the years in the Sunshine Coast. There was a notable decline at Inner Gneerings S1, reducing from 38% in 2019, to 21% in this survey period, however soft coral increased from 2% in 2019 to 21% in this survey period. This site also exhibited the highest percentage of coral bleaching, but at only 3% of the population is consistent with previous years.

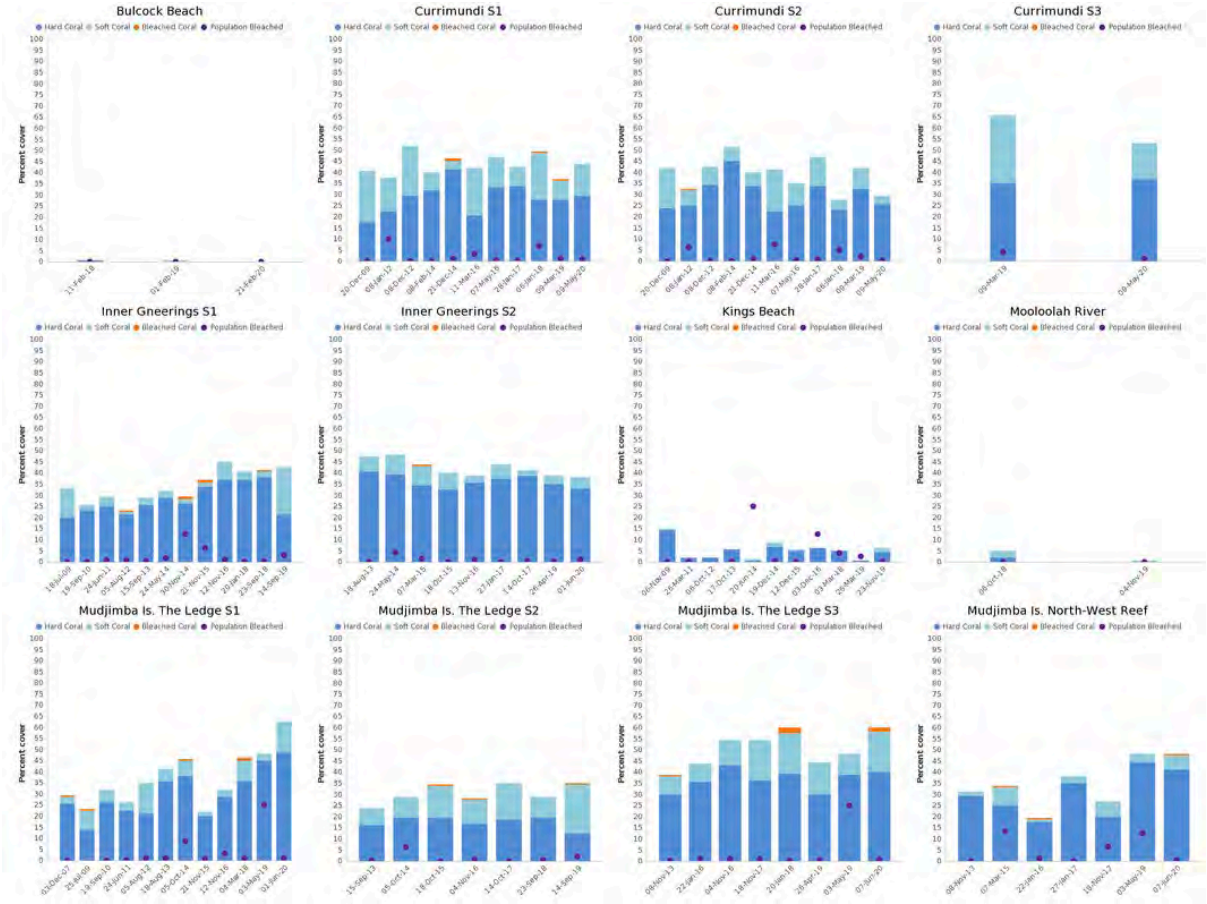


Figure 2: Percent cover of hard coral (blue), soft coral (light blue) and bleached coral (orange) by survey year at Sunshine Coast Reef Check Australia reef health monitoring locations, as per point-intercept substrate surveys for benthic composition. Percentage of the coral population exhibiting bleaching (purple dot) as documented on belt transect survey for reef health impacts, is included where available.

Inner Moreton Bay Regional Summary of Coral Trends and Bleaching

Hard coral coverage has increased slightly at the majority of sites in Inner Moreton Bay, with Goat Island West increasing from 3% in 2018 to 15% in 2020 and Myora S1 increasing from 38% to 52%. Amity Point S2 exhibited the highest percentage of coral bleaching, with 37.5% of the population affected.

Figure 3: Percent cover of hard coral (blue), soft coral (light blue) and bleached coral (orange) by survey year at Inner Moreton Bay Reef Check Australia reef health monitoring locations, as per point-intercept substrate surveys for benthic composition. Percentage of the coral population exhibiting bleaching (purple dot) as documented on belt transect survey for reef health impacts, is included where available. Note that Green Island North S2 is not included as there was no coral.

Outer Moreton Bay Regional Summary of Coral Trends and Bleaching

Hard coral coverage has remained relatively constant over the years in Outer Moreton Bay. However, there were slight decreases at three out of four locations. Flinders Reef, Nursery S1 exhibited the highest percentage of coral bleaching, with 7.75% of the population affected. No bleaching was recorded at Shag Rock.

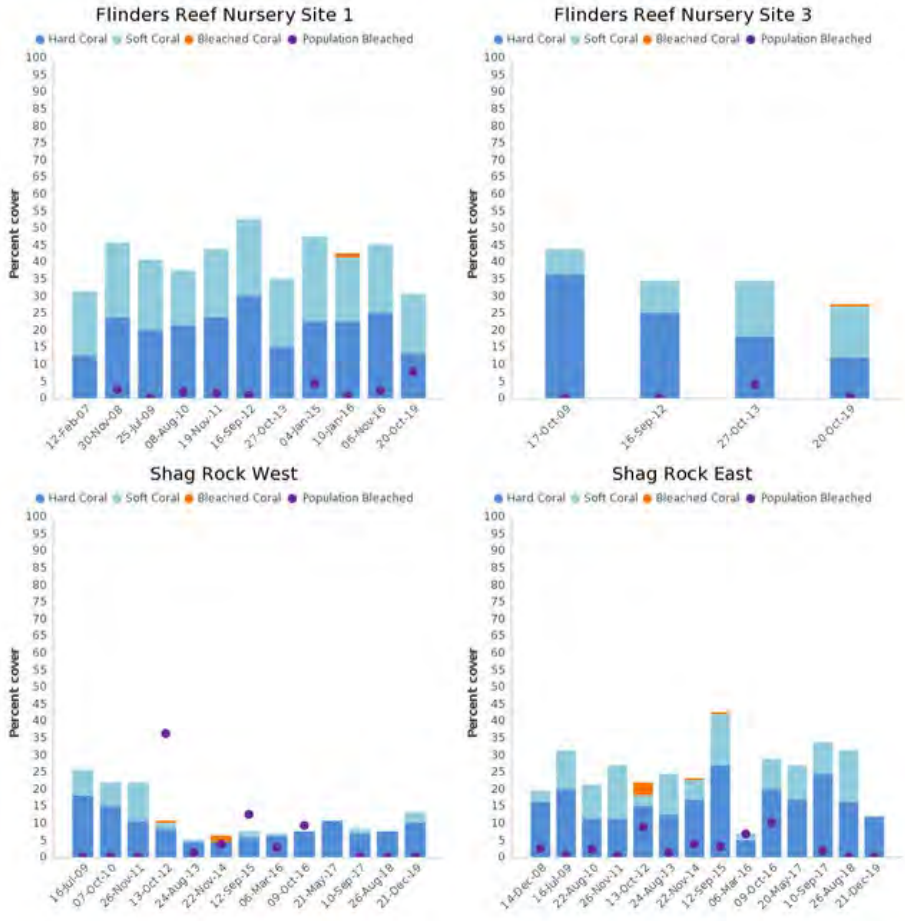


Figure 4: Percent cover of hard coral (blue), soft coral (light blue) and bleached coral (orange) by survey year at Outer Moreton Bay Reef Check Australia reef health monitoring locations, as per point-intercept substrate surveys for benthic composition. Percentage of the coral population exhibiting bleaching (purple dot) as documented on belt transect survey for reef health impacts, is included where available.

Gold Coast Regional Summary of Coral Trends and Bleaching

Hard coral coverage was only found in noticeable quantities at Palm Beach S1 & S2. There was a slight increase in hard coral recorded at Palm Beach S2, although it has not yet returned to levels recorded in 2015. Palm Beach Artificial Reef S1 and S2 are new sites set up to monitor the changes over time of this newly installed artificial reef.

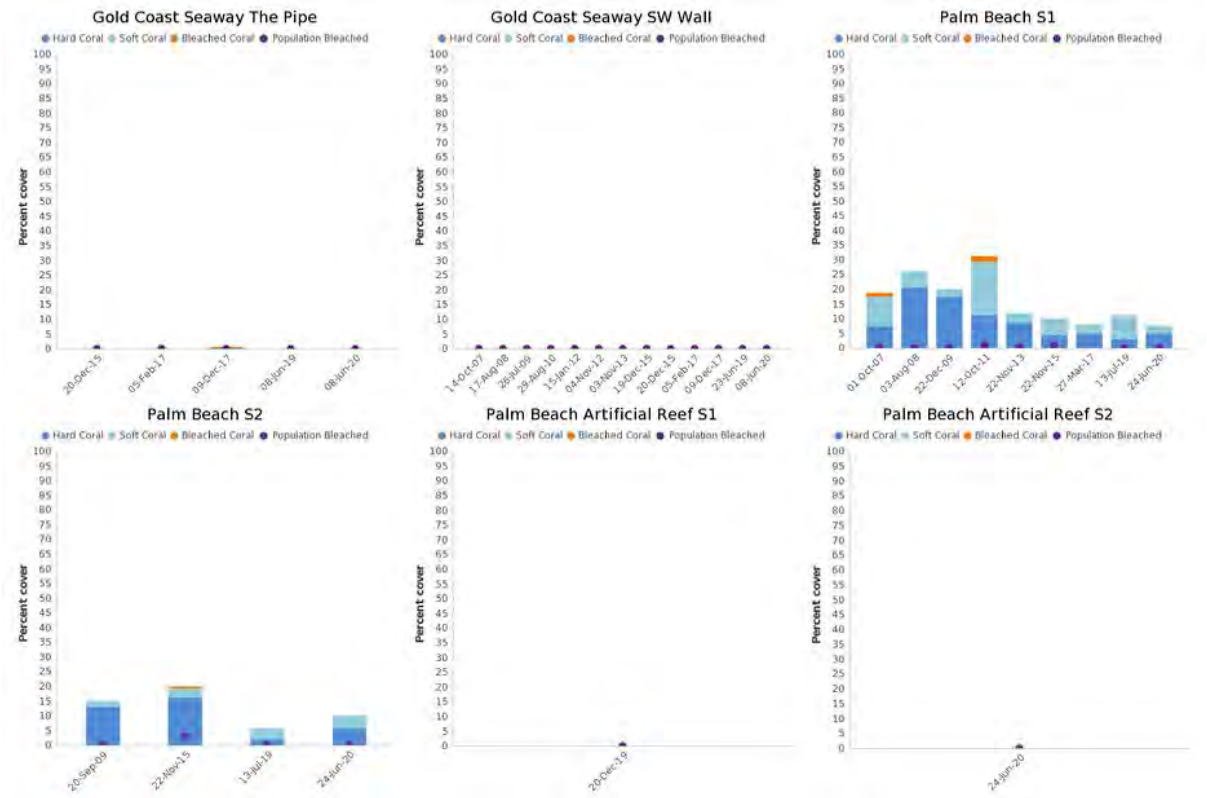


Figure 5: Percent cover of hard coral (blue), soft coral (light blue) and bleached coral (orange) by survey year at Gold Coast Reef Check Australia reef health monitoring locations, as per point-intercept substrate surveys for benthic composition. Percentage of the coral population exhibiting bleaching (purple dot) as documented on belt transect survey for reef health impacts, is included where available.

1.2.3 IMPACTS: CORAL DAMAGE

Coral damage (due to unknown causes) was recorded on 22 of the 42 surveys. The highest recordings for coral damage was at Mudjimba Island The Ledge S3 with a count of 33 incidences. Mudjimba Island North-West recorded 22 incidences. Shag Rock East & Mudjimba Island The Ledge S2 recorded 16 each. A total of 173 incidences of coral damage were recorded this season, which is consistent with last season.

Image 1.2.3 Coral damage

1.2.4 IMPACTS: CORAL DISEASE

Coral diseases were recorded 116 times during the 2019-2020 season, an increase from last season's surveys (100). Of these, 21 recordings of coral disease were taken at Myora S1 and 16 were taken at both Myora S2 and Peel Island North-East.

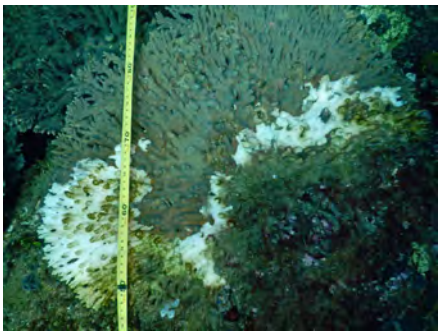


Image 1.2.4 Coral disease

1.2.5 IMPACTS: MARINE DEBRIS

There were 86 incidences of non-fishing related marine debris recorded during the 2019-2020 survey season. The highest recordings of marine debris were 13 and this was found at Mooloolah River, Bulcock Beach and Goat Island West. Non-fishing related marine debris was only recorded on 20 of the 42 surveys.

Fishing line was recorded a total of 283 times during the season. This is slightly more than the number of times fishing line was recorded last season (259). Bulcock Beach only recorded 16 incidences of fishing line, down from 115 last season. This may be due in part to the large number of clean-up dives occurring in this area. The highest recordings were at Gold Coast Seaway South-West Wall (56), Amity Point S2 (50) and Amity Point S1 (42).

Image 1.2.5 Trash

1.2.6 IMPACTS: CORAL SCARRING

Only 141 scars were recorded this season, down from 245 last season. *Drupella* accounted for 38 of the scars, with the remainder unknown. The highest recording of *Drupella* scars was at Mudjimba Island The Ledge S1 with a total of 13 scars.

The highest incidence of unknown scars was recorded at Mudjimba Island North-West Reef (14).

Tables 3, 4 and 5 on the subsequent pages display these key findings by survey name and sub-region.

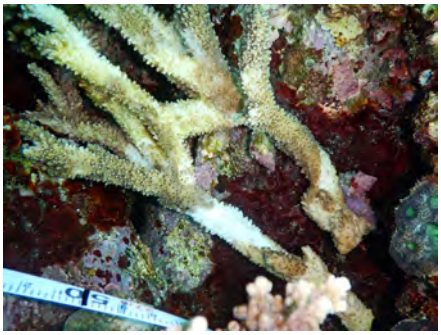


Image 1.2.6 *Drupella* scar

Table 3: Summary table of RCA monitoring findings for surveys conducted on the Sunshine Coast and Outer Moreton Bay in 2019-2020 season. Information includes a basic site summary of average hard and soft coral cover (%), total macroalgae (MA) abundance, nutrient indicator algae (NIA) cover (%), and silt levels (N=none, L=low, M=medium, H=high), as well as a summary of the impacts at each site: average coral bleaching of the population (%) and abundance of reef impacts (coral disease, marine debris, coral damage, and scars). All figures showing a count, rather than a percentage, are a total across all 4 transects at the site (i.e. at total across 80m).

	Basic site summary					Presence of Impacts							
	Hard Coral Coverage (%)	Soft Coral Coverage (%)	Macroalgae (#) per 80m transect	Nutrient Indicator Algae (%)	Silt Loading	Coral Population Bleaching (%)	Coral Disease (#)	Fishing Line (#)	Marine Debris (General) (#)	Anchor Damage (#)	Coral Damage (#) (Unknown Causes)	*Drupella* Scar (#)	Unknown Scar (#)
SUNSHINE COAST													
Bulcock Beach	0.0	0.0	0	0	L	0	0	16	13	0	0	0	0
Currimundi S1	29.4	14.4	2	1.3	N	0.75	5	0	0	0	0	0	6
Currimundi S2	25.6	3.7	3	1.9	N	0.25	3	2	0	0	1	2	2
Currimundi S3	36.9	16.3	3	1.9	N	1.0	0	0	0	0	1	0	8
Inner Gneerings S1	21.3	21.3	0	1.3	N	3.0	2	1	0	0	1	2	5
Inner Gneerings S2	33.0	5.0	13	9.4	N	1.0	4	2	0	0	5	1	7
Kings Beach	4.4	1.9	32	29.4	L	0.25	0	0	1	0	0	0	1
Mooloolah River	0.0	0.6	13	8.1	M	0	1	9	13	0	0	0	0
Mudjimba Island, North West S1	41.3	6.3	0	2.5	L	0.5	2	3	0	0	22	0	14
Mudjimba Island, The Ledge S1	48.8	13.8	1	5	N	1	2	5	0	0	10	13	11
Mudjimba Island, The Ledge S2	12.5	21.9	1	38	N	2.0	0	3	0	0	16	0	3
Mudjimba Island, The Ledge S3	40.0	18.1	0	3.75	L	0.75	6	3	2	0	33	4	10
OUTER MORETON BAY													
Flinders Reef, Nursery S1	13.1	17.5	0	4.4	N	7.75	0	0	1	0	3	3	7
Flinders Reef, Nursery S3	11.9	15	0	3.1	N	0.25	0	0	0	0	12	2	3
Shag Rock, East	11.9	0.0	3	40.0	L	0	12	1	0	0	16	6	0
Shag Rock, West	10.0	3.1	1	11.3	L	0	11	0	0	0	14	2	0

Table 4: Summary table of RCA monitoring findings for surveys conducted in Inner Moreton Bay in 2019-2020 season. Information includes a basic site summary of average hard and soft coral cover (%), total macroalgae (MA) abundance, nutrient indicator algae (NIA) cover (%), and silt levels (N=none, L=low, M=medium, H=high), as well as a summary of the impacts at each site: average coral bleaching of the population (%) and abundance of reef impacts (coral disease, marine debris, coral damage, and scars). All figures showing a count, rather than a percentage, are a total across all 4 transects at the site (i.e. at total across 80m).

	Basic site summary					Presence of Impacts							
	Hard Coral Coverage (%)	Soft Coral Coverage (%)	Macroalgae (#) per 80m transect	Nutrient Indicator Algae (%)	Silt Loading	Coral Population Bleaching (%)	Coral Disease (#)	Fishing Line (#)	Marine Debris (General) (#)	Anchor Damage (#)	Coral Damage (#) (Unknown Causes)	*Drupella* Scar (#)	Unknown Scar (#)
INNER MORETON BAY													
Amity S1	0.6	0.0	0	0	M	12.5	0	42	0	0	0	0	5
Amity S2	6.9	0.0	0	0	M	37.5	2	50	0	0	5	1	3
Goat Island, East	36.3	20.6	0	0	M	1.75	2	17	10	0	8	0	3
Goat Island, West	15	21.9	0	0	L	1.0	3	0	13	0	0	0	1
Green Island, North, Site 1 (Summer)	3.8	11.9	32	21.9	H	3.75	0	1	0	0	3	0	0
Green Island, North, Site 1 (Winter)	6.9	19.4	42	26	M	3	0	0	1	0	1	0	2
Green Island, North, Site 2 (Winter)	0	0	44	27.5	L	0	0	0	1	0	0	0	0
Green Island, West (Summer)	5.6	20.0	32	35	H	1	2	2	0	0	8	0	0
Green Island, West (Winter)	3.1	9.4	18	11	M	0.75	0	0	1	0	3	0	1
Green Island East (summer)	0	0	15	10	H	0	0	0	0	0	0	0	0
Macleay Island	8.8	14.4	57	35.6	M	10	0	0	2	0	0	0	2
Mud Island, Coral Galore (Winter)	0.6	36.3	4	28.8	L	0.25	0	0	0	0	0	0	0
Mud Island, Rubble Patch (Winter)	0.6	1.9	25	21.3	N	0	0	0	1	0	0	0	1
Myora S1	34.4	0.0	0	0	L	1	21	3	1	0	4	0	2
Myora S2	52.5	0.6	0	0	L	1.5	16	3	0	0	4	0	0
Peel Island, East	6.3	10	16	10	L	7.5	1	20	2	0	0	0	1
Peel Island, North	10.6	13.1	9	5.6	L	1.25	5	2	3	0	0	0	0
Peel Island, North East	9.4	3.8	27	16.9	L	1	16	5	10	0	0	0	0
St Helena, Palindrome (Winter)	2.5	6.9	13	35	M	0	0	0	2	0	0	0	0
St Helena, Ray of Sunshine (Winter)	6.3	15.6	22	41.3	M	0.75	0	0	0	0	1	0	0

Table 5: Summary table of RCA monitoring findings for surveys conducted in Gold Coast in 2019-2020 season. Information includes a basic site summary of average hard and soft coral cover (%), total macroalgae (MA) abundance, nutrient indicator algae (NIA) cover (%), and silt levels (N=none, L=low, M=medium, H=high), as well as a summary of the impacts at each site: average coral bleaching of the population (%) and abundance of reef impacts (coral disease, marine debris, coral damage, and scars). All figures showing a count, rather than a percentage, are a total across all 4 transects at the site (i.e. at total across 80m).

	Basic site summary					Presence of Impacts							
	Hard Coral Coverage (%)	Soft Coral Coverage (%)	Macroalgae (#) per 80m transect	Nutrient Indicator Algae (%)	Silt Loading	Coral Population Bleaching (%)	Coral Disease (#)	Fishing Line (#)	Marine Debris (General) (#)	Anchor Damage (#)	Coral Damage (#) (Unknown Causes)	*Drupella* Scar (#)	Unknown Scar (#)
GOLD COAST													
GC Seaway, SW Wall	0.0	0.0	1	0.6	M	0	0	56	6	0	0	0	0
GC Seaway, The Pipe	0.0	0.0	0	0	L	0	0	30	0	0	0	0	0
Palm Beach S1	5	2.5	0	0	N	0.25	0	1	0	0	0	1	3
Palm Beach S2	5.6	4.4	0	0	N	0	0	2	0	0	2	1	2
Palm Beach Artificial Site 1	0	0	32	39	M	0	0	0	0	0	0	0	0
Palm Beach Artificial Site 2	0	0	0	22	N	0	0	0	0	0	0	0	0

1.2.7 INVERTEBRATE ABUNDANCE

Invertebrate surveys were carried out at all locations visited. The most abundant indicator invertebrate were urchins, with 597 individuals recorded in the 2019-2020 season. The vast majority of these were recorded at Palm Beach S1 (127), Palm Beach S2 (132) and Shag Rock West (110) and included longspine (*Diadema* spp.) urchins, pencil urchins and collector urchins.

Anemones were the second most abundant invertebrate with a total of 380 recorded (66 with fish, 314 without fish). The highest numbers recorded were at Palm Beach S1 (131) and Palm Beach S2 (130).

Across the 42 surveys, 22 banded coral shrimp, five lobsters, three giant clams and one *Trochus* snail were recorded. No Crown of Thorns Starfish (COTS), target sea cucumbers or tritons were recorded during the 2019-2020 survey season.

Of the 234 *Drupella* snails that were recorded, 56 were recorded at Shag Rock East, 39 at Mudjimba Island The Ledge S1 and 20 at Mudjimba Island The Ledge S3.

Image 1.2.7A Collector urchin

Image 1.2.7B Anemone with fish

1.2.8 FISH ABUNDANCE

Fish surveys were carried out on all surveys. Again, butterflyfish were the most abundant target fish species with a total of 341 sightings across all surveys. The highest number recorded was 57 at Myora Reef S2. Also recorded were 104 snapper, 29 sweetlips, 23 moray eels, six other parrotfish (not bumphead) and five grouper.

1.2.9 RARE ANIMALS

Many rare animals were sighted during the surveys this season, some of which include wobbegong sharks, stingrays, grey nurse sharks, leopard sharks, turtles, seahorses, frogfish and octopuses.

Image 1.2.9 A frogfish, well disguised at Gold Coast Seaway-The Pipe site.

2.0 SUNSHINE COAST SITE REPORTS

2.1 BULCOCK BEACH, THE BOARDWALK

Bulcock Beach, The Boardwalk, Site 1, was surveyed for the first time in 2018. Bulcock Beach is a popular coastal recreational area located in Caloundra. The boardwalk is a popular fishing spot. This site sits along a rock wall slope in approximately 4m depth. It is characterised by rock, razor clams, ascidians and sand. The site is a nursery for a variety of fish species in the area.

Sand (27.5%) and rock (24%) were the dominant substrate recorded at this site (Figure 2.1.1). This survey saw a significant increase in the 'other' category (consisting primarily of ascidians) for 2020 with 22.5% compared to 0% in 2019. Rubble attributed 16% to the substrate, and Sponge 9%. A low level of silt was recorded on the transect. No nutrient indicator algae or macroalgae were recorded on the transect.

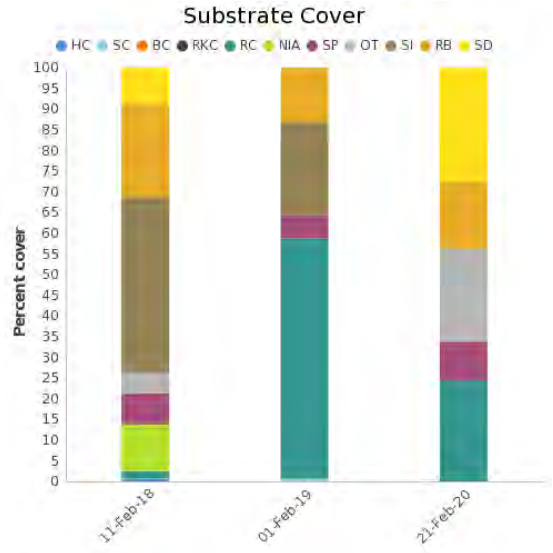


Figure 2.1.1 Benthic type and percentage cover, Bulcock Beach, The Boardwalk, Site 1, 2018-2020

Twenty-nine items of marine debris were recorded; primarily fishing debris. General rubbish items were also recorded including sunglasses, a watch, fishing knives and an entire fishing rod. This is a significant decrease on items recorded in the previous season (115).

Three collector urchins and a non-target sea cucumber were recorded on the invertebrate survey. During the fish survey, 12 butterfly fish, seven snapper and one sweetlip was recorded. A spotted eagle ray and two stonefish were also recorded on the transect.

Image 2.1A Site photograph

Image 2.1B Collector urchin

Image 2.1C Fishing debris

2.2 CURRIMUNDI REEF, SITE 1

Currimundi Reef, Site 1, was surveyed for the first time in 2009. It is situated on the reef flat at nine metres on an exposed rocky outcrop. The reef in this area is reasonably flat although there are walls and rock pinnacles at various depths within the general area. This subtropical reef is not frequented by divers, however sections of Currimundi Reef are utilised by fishers.

Rock made up 50% of the substrate (including rock with turf algae and rock with coralline algae), however hard coral made up 30% of the total substrate, which is consistent with the 2019 survey (Figure 2.2.1). Soft coral attributed 14% to the substrate composition (an increase from 2019), with the balance being sand (6%). Turf algae, *Plocamium* sp. and *Dictyota* sp. were the dominant algae. It was interesting to note that the dominant algae (*Asparagopsis*) from 2019 was observed in very small quantities.

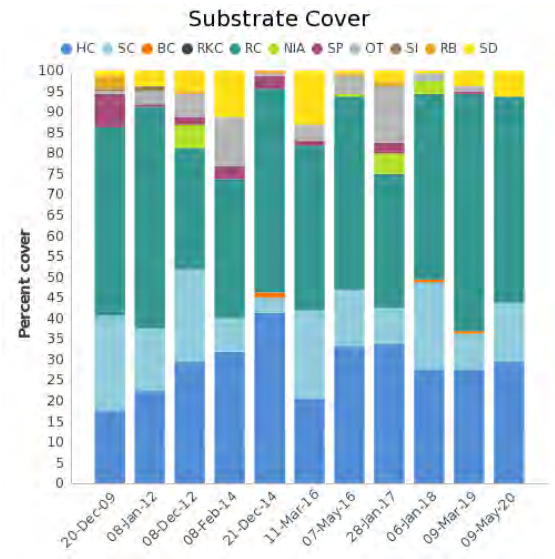


Figure 2.2.1 Benthic type and percentage cover, Currimundi Reef, Site 1, 2009-2020

Bleaching affected less than 1% of the total coral population with an average of 32% of any individual colony being bleached. Coral disease was observed on four coral colonies, whilst six unknown scars were recorded on the impact survey. No items of marine debris were recorded.

Only one anemone (with fish) was observed on the invertebrate survey. A fish survey was conducted and nine butterfly fish, seven snapper and six sweetlip were recorded.

Image 2.2A Site photograph

Image 2.2B Soft coral

Image 2.2C Squid

2.3 CURRIMUNDI REEF, SITE 2

Currimundi Reef, Site 2, is located adjacent to Site 1 and has a similar topography.

Rock made up 64% of the substrate (including rock with turf algae and rock with coralline algae), however hard coral made up 26% of the total substrate, which is slightly lower than the 2019 survey (Figure 2.3.1). Soft coral attributed 4% to the substrate composition (a decrease from 2019), with the balance being sand (5%) and other (Conjevoi)(1%). Turf algae, *Dictyota* and *Halimeda* were the dominant algae. Again the dominant algae (*Asparagopsis)* from 2019 was observed in very small quantities.

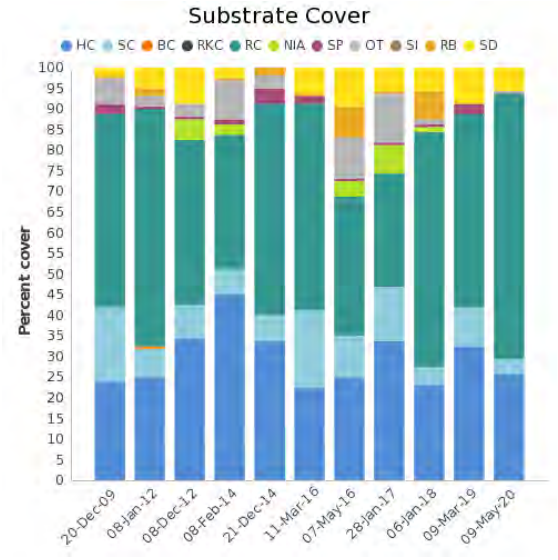


Figure 2.3.1 Benthic type and percentage cover, Currimundi Reef, Site 2, 2009-2020

Bleaching affected less than 1% of the total coral population with an average of 20% of any individual colony being bleached. Coral disease was observed on three coral colonies, whilst two unknown scars, one incident of anchor damage and two *Drupella* scars were recorded on the impact survey. Only two items of marine debris (fishing line) were recorded.

Four anemones with fish, and one without, 13 *Drupella* snails and one collector urchin were observed on the invertebrate survey.

A fish survey was conducted and five butterfly fish and one snapper were recorded.

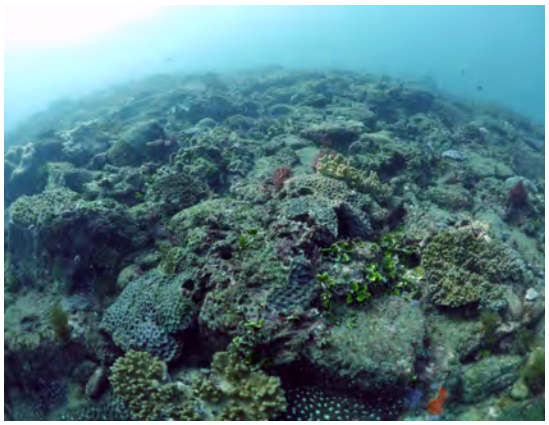


Image 2.3A Site photograph

Image 2.3B *Drupella* snail and scar

Image 2.3C Sign of the times

2.4 CURRIMUNDI REEF, SITE 3

Currimundi Reef, Site 3, is located approximately 2km north of Currimundi Sites 1 and 2. This site has a similar topography to the other 2 sites but is slightly shallower at around 7 metres.

Hard coral made up 37% of the substrate at this site, whilst rock made up 38% of the substrate (including rock with turf algae and rock with coralline algae). (Figure 2.4.1). Soft coral attributed 16% to the substrate composition, with the balance being sponge (1%), sand (6%) and other (ascidians and anemones)(2%). Turf algae and *Dictyota* were the dominant algae, consistent with the 2019 survey.

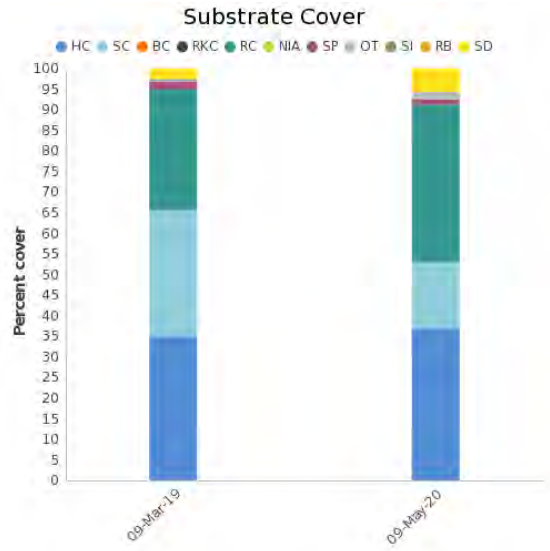


Figure 2.4.1 Benthic type and percentage cover, Currimundi Reef, Site 3, 2019-2020

Bleaching affected less than 1% of the total coral population with an average of 30% of any individual colony being bleached. Coral disease was not observed, whilst eight unknown scars, and one incident of unknown damage were recorded on the impact survey. Items of marine debris were not observed on transect, however the remnants of a small fishing net were observed off-transect.

Of special note on this survey, 37 anemones with fish, and one without, were recorded. Two *Drupella* snails and one lobster were also observed on the invertebrate survey.

A fish survey was conducted and 28 butterfly fish and one snapper were recorded.

Image 2.4A Site Photo

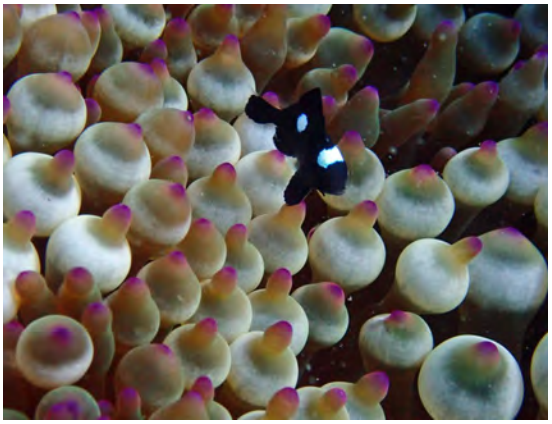


Image 2.4B Bubble tip anemone with fish

Image 2.4B Soft coral with common egg cowrie

2.5 INNER GNEERINGS, THE CAVES; SITE 1

Inner Gneerings, the caves, is situated directly offshore from Mooloolaba and covers a wide range of depths from 10 to 25 m. It is a popular site for recreational fishing and diving. Site 1 is located at a depth of 10 m on the reef floor and is characterised by scattered rocky outcrops surrounded by coral, sponges and a collapsed cave structure. This site has been surveyed annually since 2009.

Rock (47%) was the dominant substrate followed by hard coral (21%); consisting mostly of encrusting forms, and soft coral (21%). Sponge attributed 5% to the substrate, sand; 4% and nutrient indicator algae 1% (Figure 2.5.1). Other attributed less than 1%. No macroalgae was recorded on the transect.

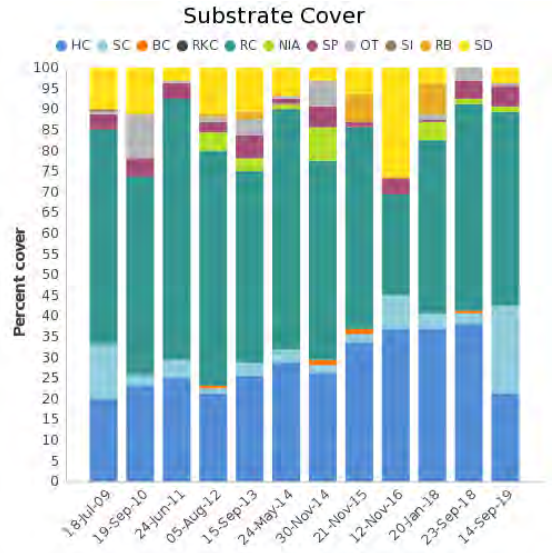


Figure 2.5.1 Benthic type and percentage cover, Inner Gneerings: The Caves, Site 1, 2009-2019

Seven *Drupella* snails and one giant clam were recorded during the invertebrate survey.

Coral bleaching affected 3% of the total coral population, with an average of 16% of each colony showing surface bleaching.

Five scars of unknown origin, two instances of coral disease, two *Drupella* scars, one instance of coral damage and one piece of fishing line debris were recorded.

A fish survey was conducted and six butterfly fish, three parrotfish and one sweetlip were recorded.

Image 2.5A Site photograph

Image 2.5B Giant clam

Image 2.5C Surveyors in action

2.6 INNER GNEERINGS, THE CAVES; SITE 2

Inner Gneerings, Site 2, was surveyed for the first time in 2013. It is situated on the reef flat at eight metres on an exposed rocky outcrop. The topography of the reef in this area is slightly varied with low walls and occasional large rocks. This subtropical reef is frequented by divers and fishers.

Rock made up 51% of the substrate (including rock with turf algae and rock with coralline algae), however hard coral made up 33% of the total substrate, which is consistent with previous years (Figure 2.6.1). Sand (6%), soft coral (5%), sponge (4%), nutrient indicator algae (1%) and rubble (1%) made up the balance of the substrate composition. Turf algae and *Asparagopsis* were the dominant algae, but it was interesting to note that the dominant algae (*Asparagopsis)* was observed in lower quantities than in 2019.

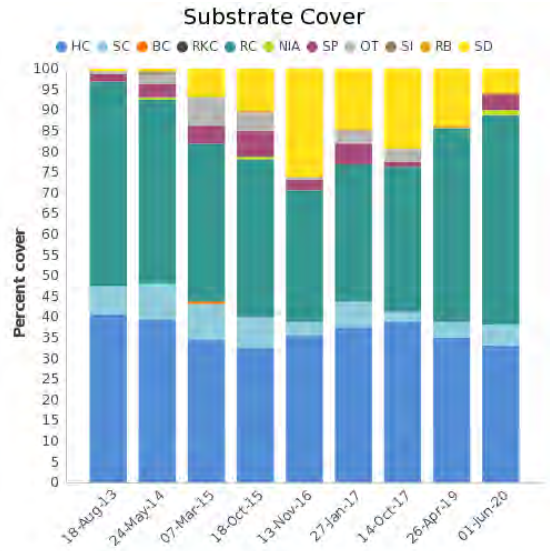


Figure 2.6.1 Benthic type and percentage cover, Inner Gneerings: The Caves, Site 2, 2013-2020

Bleaching affected less than 1% of the total coral population with an average of 9% of any individual colony being bleached. Coral disease was observed on four coral colonies, whilst one *Drupella* scar and seven unknown scars were recorded on the impact survey. Marine debris was limited to two incidences of fishing line.

Three anemones with fish and nine without fish were observed on the invertebrate survey, along with nine *Drupella* snails.

A fish survey was conducted and 10 butterfly fish and two snapper were recorded.

Image 2.6A Site photo

Image 2.6B Butterflyfish

Image 2.6C Bleached hard coral

2.7 KINGS BEACH

Kings Beach Reef is located approximately 100m offshore, close to a boat ramp and regular boat traffic, and near to Caloundra's popular beach front area. It is dominated by rock and sand and is often covered in macroalgae (particularly *Asparagopsis*). The 2011 SEQ floods greatly impacted this site, reducing the hard coral population from 14% to just 2%. Annual monitoring efforts have shown signs of recovery of the site over time, however continued monitoring is required to document potential changes in the future.

Rock (39%) was the dominant substrate followed by sand (36%). Nutrient indicator algae made up 9% of the benthos (Figure 2.7.1). Several hard and soft corals were seen on the transect, however they attributed just 4% and 2% of the total benthos respectively. 'Other' made up primarily of ascidians attributed 6%, and sponge (mostly small round sponges) made up 3%. Thirty-two counts of macroalgae was recorded (*Asparagopsis*).

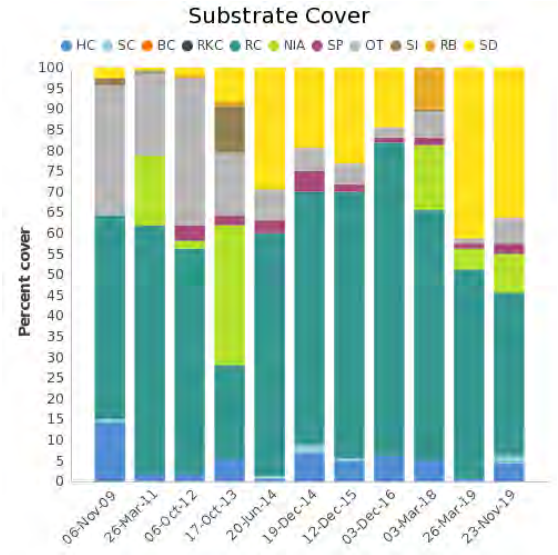


Figure 2.7.1 Benthic type and percentage cover, Kings Beach, 2009-2019

Coral bleaching was recorded just once at this site, with an average of 5% of the entire colony bleached, and <1% of the total coral population. One unknown coral scar and one piece of general trash (a food wrapper) were recorded on the impact survey.

Six *Drupella* snails and two collector urchins were recorded during the invertebrate survey.

Image 2.7A Site photo

Image 2.7B Soft coral

Image 2.7C Wobbegong shark. Photo by Terry Farr

2.8 MOOLOOLABA RIVER, LA BALSA NORTH

The Mooloolah River, La Balsa north, Site 1 was set up in 2018 due to growing interest in the area. The site runs parallel to the shore, at a depth of 5m. It is a popular swimming and fishing location for locals and visitors alike due to its easy access and protection from the wind. It is dominated by rock and sand, but is also home to a variety of interesting species such as nudibranchs, ornate ghost pipe fish and seahorse on occasion.

Sand (38%) was the dominant substrate followed by rock (28%), and silt (23%) (Figure 2.8.1). Several foliose and encrusting hard corals were seen on the transect, however were not captured within the substrate survey. Sponge attributed 9% to the substrate, and rubble 1%. Soft coral made up just 1%. Twelve counts of macroalgae were recorded (*Padina* and *Sargassum*), an increase from 2018 results where no macroalgae was recorded.

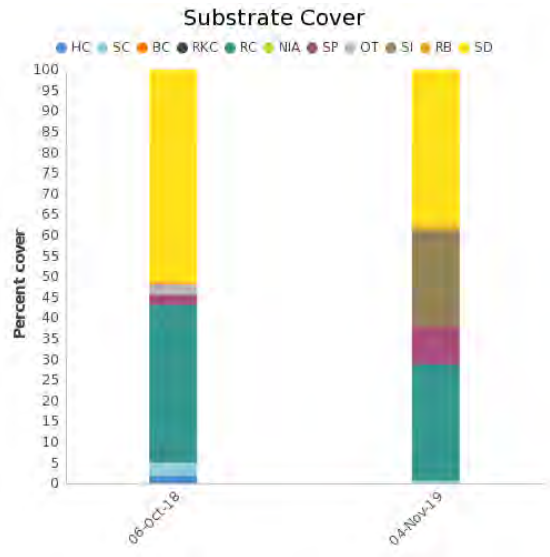


Figure 2.8.1 Benthic type and percentage cover, Mooloolah River, La Balsa North, 2018-2019.

No coral bleaching was recorded at this site. However, eight pieces of fishing line debris and 13 pieces of general trash (glass bottles, tires and an arrow) were recorded.

Two coral banded shrimp, one anemone, and one collector urchin were recorded during the invertebrate survey. A fish survey was conducted, and two butterfly fish were recorded. Several species of nudibranch and one seahorse was seen on transect in 2019.

Image 2.8A Site photo

Image 2.8B Soft coral

Image 2.8C Seahorse

2.9 MUDJIMBA ISLAND, NORTHWEST

Mudjimba Island is located just off the mainland, close to both the Maroochy and Mooloolah River Mouths on the Sunshine Coast. Mudjimba Island is a popular location for in-water activities including fishing, diving and surfing.

The Northwest Reef site was established in 2013 to gather more information about this highly utilised area. Site 1 faces the Northwest side of the island and is situated at a depth of 8m. The site is a relatively flat terrain dominated by hard corals.

Rock was the dominant substrate (43%), followed by hard coral (41%) (Figure 2.9.1). Soft coral attributed 6% to the substrate, with sand (4%), rubble (2%), nutrient indicator algae (2%), sponge (1%) and bleached coral (1%) making up the rest. Turf algae was the dominant algae.

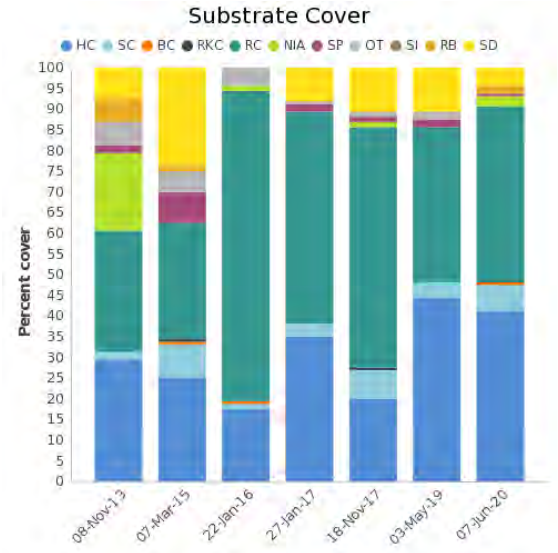


Figure 2.9.1 Benthic type and percentage cover, Mudjimba Island, Northwest Reef, Site 1, 2013-2020.

Coral bleaching was estimated to affect less than 1% of the total coral population, a decrease from 12% in 2019. Unknown coral damage was high with 22 incidents recorded. Two incidents of coral disease, 14 unknown scars and three fishing lines were also recorded.

One anemone with fish, four *Drupella* snails and one collector urchin were recorded.

A fish survey was conducted and 19 butterfly fish, one grouper and one moray eel were recorded. An uncommon marine gastropod, *Coriocella nigra,* was also observed.

Image 2.9A Site photo

Image 2.9B Hard coral recruits

Image 2.9C *Coriocella nigra*

2.10 MUDJIMBA ISLAND, THE LEDGE; S1

Mudjimba Island, The Ledge Site 1 was established in 2007 and is the shallowest site, located on the top of the reef flat. The other sites run parallel to this site on the southern side of Mudjimba Island. It is characterised by rock, and a variety of encrusting corals, soft corals and zoanthids. The location is a frequently used dive and snorkel site due to the availability of shallow reef and diversity of corals and fish.

Hard coral (49%) was the dominant substrate; followed by rock (31%) and soft coral (14%), an increase from previous years. Nutrient indicator algae (4%), other (corallimorphs) (1%) and sand (1%) made up the balance of the substrate (Figure 2.10.1). Only one occurrence of macroalgae was recorded on the transect.

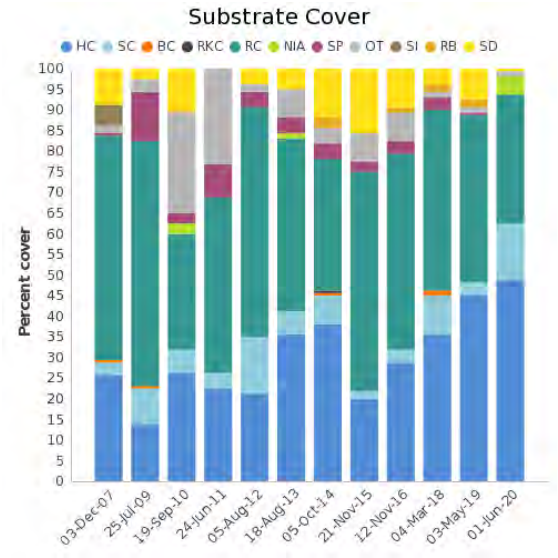


Figure 2.10.1. Benthic type and percent cover: Mudjimba Island, The Ledge, Site 1, 2007- 2020.

Coral bleaching affected 1% of the total coral population, with an average of 10% of each colony showing surface bleaching.

Four incidences of damage of unknown origin, two of disease, 13 *Drupella* scars and 11 incidences of scars of unknown origin were recorded, along with five observations of fishing line and no general trash.

Thirty-one anemones without fish and four with fish were recorded on the invertebrate survey. *Drupella* snails were frequent with 39 recorded and one long-spined urchin. A fish survey was conducted; one grouper, three moray eels and 11 butterfly fish were recorded. A hawksbill turtle and wobbegong sharks were also observed.

Image 2.10A Site photo

Image 2.10B Turtle

Image 2.10C Bleached hard coral

2.11 MUDJIMBA ISLAND, THE LEDGE; S2

Mudjimba Island, The Ledge Site 2 was established in 2013 and is on the deepest section of the steep reef slope. This site sits parallel to Site 1 on the southern side of Mudjimba Island. This deeper location represents a different habitat type to the long-established research Site 1, and Site 3. It is characterised by rock, and a variety of encrusting corals and corallimorphs. The location is well known as a site inhabited by a variety of nudibranch species and turtles.

Nutrient indicator algae (38%) was the dominant substrate; a significant increase from previous years (2018; 3%, 2017; 0%, 2016; 12%) followed by soft coral (22%); rock (17%) and hard coral (13%); mostly branching forms (Figure 2.11.1). Other attributed 10% to the substrate, consisting completely of corallimorphs. No macroalgae was recorded on the transect.

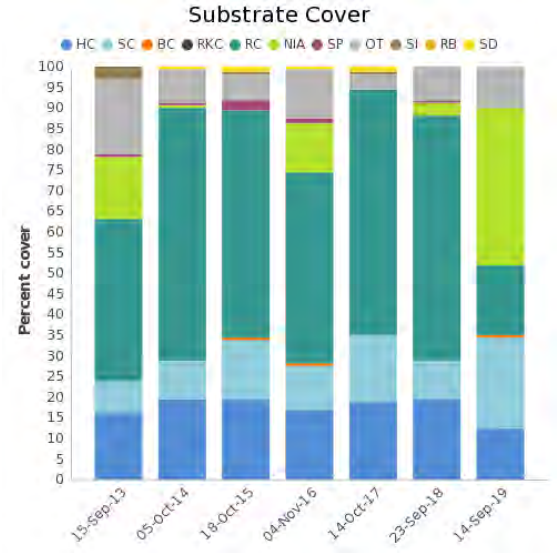


Figure 2.11.1 Benthic type and percentage cover, Mudjimba Island, The Ledge, Site 2, 2013-2019.

Coral bleaching affected 3% of the total coral population, with an average of 24% of each colony showing surface bleaching.

Sixteen incidences of damage of unknown origin, three incidences of scars of unknown origin and three pieces of fishing line were also recorded.

No invertebrates were recorded on the invertebrate survey. A fish survey was conducted and 13 snapper and six butterfly fish were recorded.

Image 2.11A Site photo

Image 2.11B Mushroom coral

Image 2.11C *Halimeda* sp.

2.12 MUDJIMBA ISLAND, THE LEDGE; S3

The Ledge Site 3 was established in 2013, to gather more information about this highly utilised area. Site 3 is situated on the reef slope and sits in between the shallower Site 1 and the deeper Site 2 on the southern side of the island. This additional location represents a different habitat type to Sites 1 and 2, despite their proximity to each other.

Hard corals accounted for 40% of the benthos in 2020 (Figure 2.12.1) and were the dominant substrate. The remaining benthic cover constituents recorded were rock (31%), soft coral (18%), nutrient indicator algae (3.75%), other (3.75%), bleached coral (2%), recently killed coral (<1%) and sponge (<1%). Turf algae and *Halimeda* were the dominant algae's recorded.

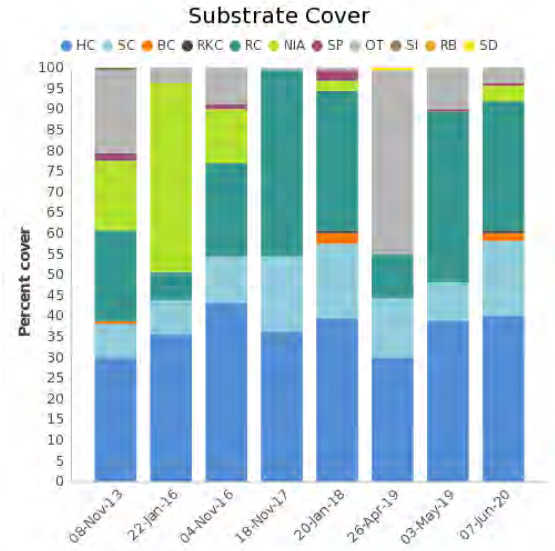


Figure 2.12.1 Benthic type and percentage cover, Mudjimba Island, The Ledge, Site 3, 2013-2020.

Coral bleaching affected <1% of the total coral population, with an average of 15% of each colony with surface bleaching, a decrease from 2019.

Six incidences of coral disease, 33 of unknown damage, 10 unknown scars, four *Drupella* scars, three fishing line and one item of general trash were recorded on the impacts survey.

On the invertebrate survey, 20 *Drupella* snails were recorded. A fish survey was carried out and six butterflyfish, and one moray eel were recorded. A wobbegong, and two Hawksbill turtles were also observed.

Image 2.12A Site photo

Image 2.12B Zoanthids

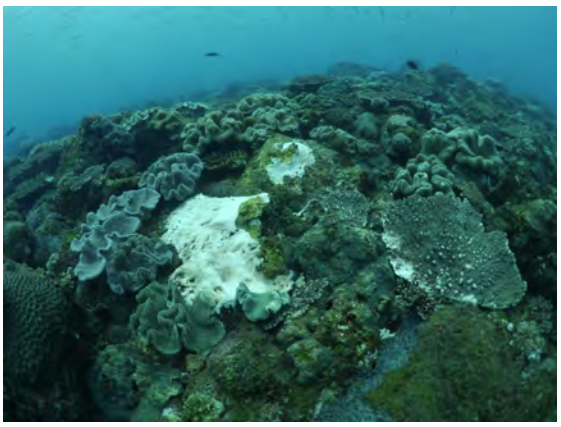


Image 2.12C Damaged coral

3.0 INSHORE MORETON BAY SITE REPORTS:

3.1 AMITY POINT, SITE 1

This is a relatively sheltered site located on the south-west end of North Stradbroke Island and is frequented by vast numbers of fishers, boaters and divers all year round. The site sits on the sandy slope parallel to the rock wall. Whilst the site contains large patches of sand, the limited structure available at this site provides habitat for a large number of species.

Sand (89%) dominated the substrate followed by rock (9%). Silt (1%) and hard coral (1%) made up the balance of the substrate (Figure 3.1.1).

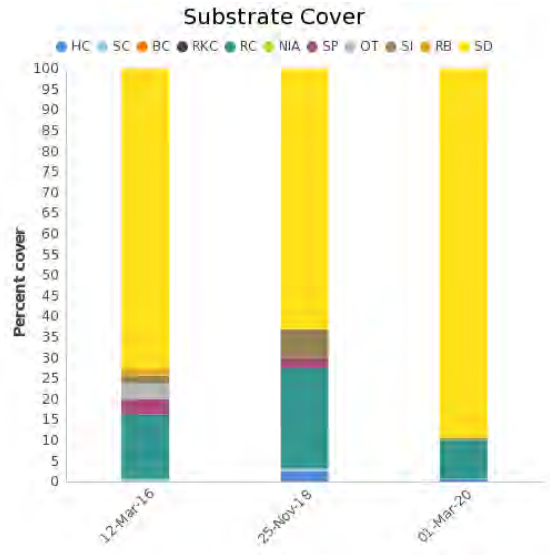


Figure 3.1.1. Benthic type and percent cover: Amity Point, Site 1, 2016- 2020.

Twelve urchins, four anemones, one banded coral shrimp and one collector urchin were recorded during the invertebrate survey. An additional 41, mostly small and mostly bleached anemones, some with fish, were also recorded just off transect during this most recent survey.

Coral bleaching was observed on 2.5% of coral surfaces and on 12.5% of the coral population.

The only impacts observed during this survey were 42 pieces of marine debris which was predominately fishing line.

During the fish survey, two butterfly fish and one sweetlip were recorded, with wobbegong sharks and octopus also observed.

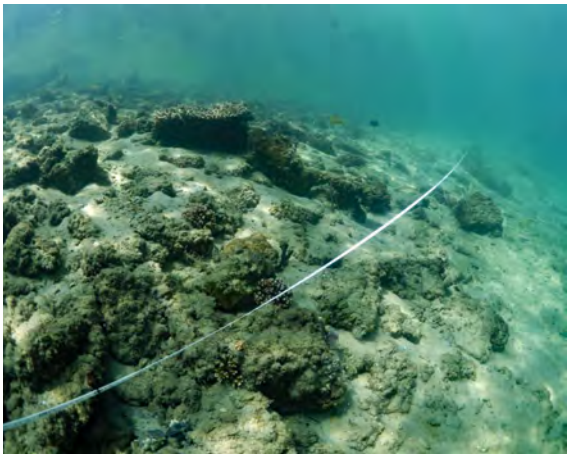


Image 3.1A Site photo

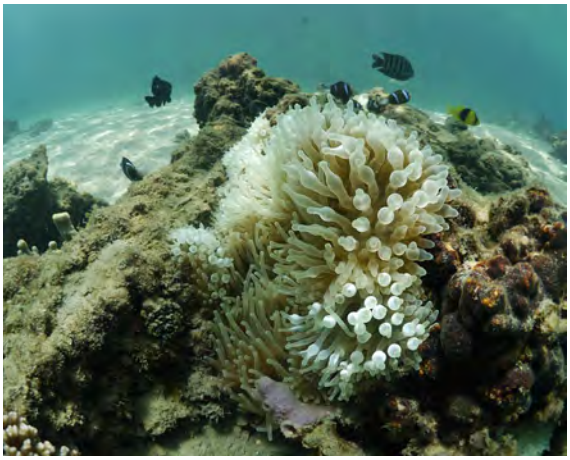


Image 3.1B Anemones with fish

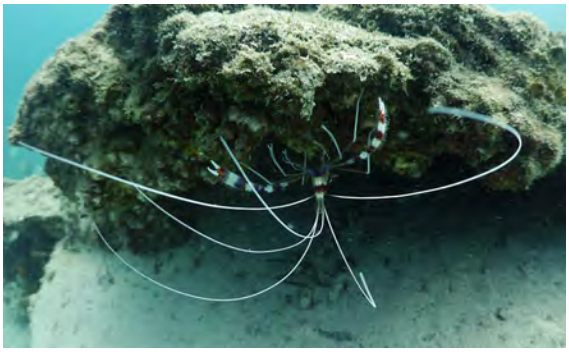


Image 3.1C Banded coral shrimp

3.2 AMITY POINT, SITE 2

This relatively sheltered site is located on the south-west end of North Stradbroke Island and is frequented by vast numbers of fishers, boaters and divers all year round. The relatively shallow site runs along the rock wall, commencing near the public boat ramp. The site is subject to strong tidal currents and the amount of growth on the rocks varies throughout the site.

Rock (45%) and sand (31%) were the dominant substrate followed by silt (12%). The balance of the substrate was made up from hard coral (7%), rubble (4%) and sponge (1%) (Figure 3.2.1).

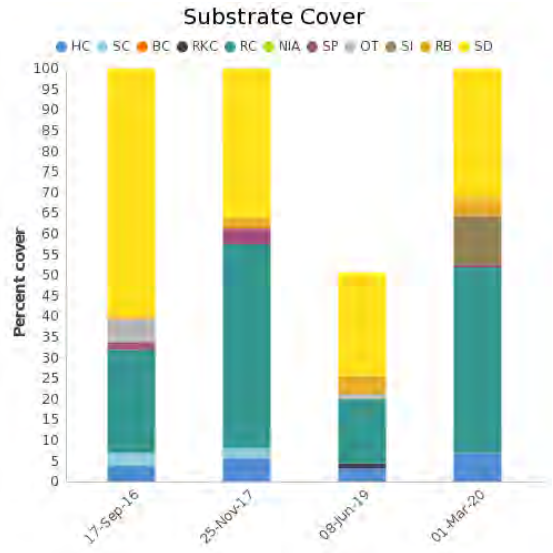


Figure 3.2.1. Benthic type and percent cover: Amity Point, Site 2, 2016- 2020.

An average of 25% of the coral surface was bleached on 37% of the coral population. Sixty-four urchins, one anemone, two banded coral shrimp, two lobsters, and five *Drupella* snails were recorded on the invertebrate survey. The majority of urchins were recorded close to the boat ramp; within the first 20m of the transect.

Fifty pieces of marine debris (mostly fishing line), five incidences of coral damage, three unknown scars, two incidences of coral disease and one *Drupella* scar were recorded during the impacts survey.

During the fish survey, 24 snapper, 22 butterfly fish, three moray eels and three sweetlips were recorded, with wobbegong sharks also observed.

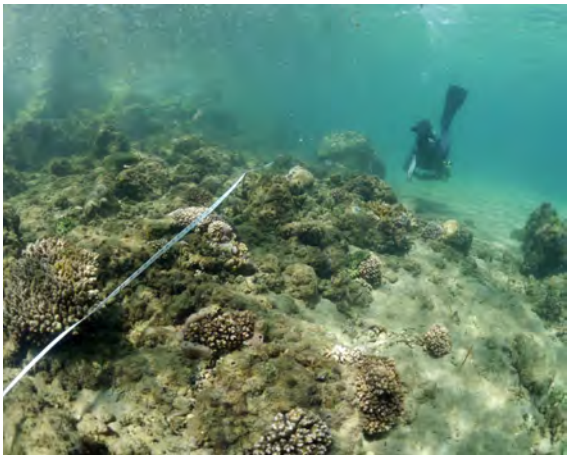


Image 3.2A Site photo

Image 3.2B Fishing line

Image 3.2C Bleached coral

3.3 GOAT ISLAND EAST, SITE 1

Goat Island is situated between North Stradbroke Island and Peel Island in Moreton Bay. A shallow sandy reef fringes Goat Island. Goat Island is exposed to regular traffic, and surge from the nearby boat channel, where the North Stradbroke Island ferries travel.

This site is located on the eastern side of Goat Island on the reef flat. The site was established in 2009 and sits at a depth of around 5m. This site hosts a high concentration of clumping forms of *Acropora*.

Hard coral (36%) was the dominant substrate followed by soft coral (21%) and rock (15%). Rubble (11%), silt (9%) and sand (6%) (Figure 3.3.1) made up the major balance of substrate, with sponge recorded at 2% during this survey.

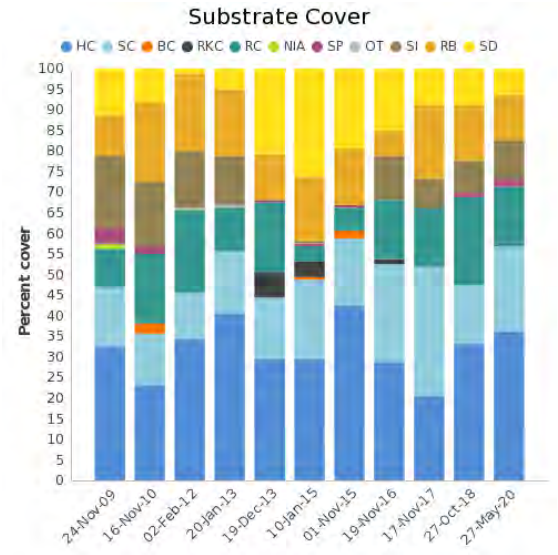


Figure 3.3.1. Benthic type and percent cover: Goat Island East, Site 1, 2009- 2020

Coral bleaching ranged in average from 30% to 62% of the coral surface but overall averaged only 2% of the total coral population. Eight incidences of damage, two of disease and three unknown scars were also recorded plus 17 fishing line and 10 items of general trash.

No invertebrates were observed during the invertebrate survey.

Target fish were limited to two butterflyfish and one snapper, but other fish were observed in the area.

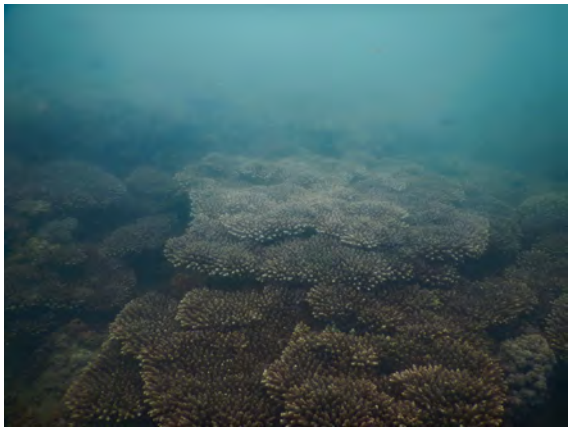


Image 3.3A Site photo

Image 3.3B *Goniobranchus geometricus*

Image 3.3C Bleached Coral

3.4 GOAT ISLAND WEST, SITE 1

This site is located on the western side of Goat Island on the reef flat. The site was established in 2014 and sits at a depth of around 5m. This site hosts patchy coral at a lower concentration compared to the site on the eastern side of the island.

Sand (30%) was the dominant substrate followed by soft coral (22%), hard coral (15%) and rock (18%). Rubble (10%), silt (1%) and sponge (4%) made up the balance of substrate during this survey (Figure 3.4.1).

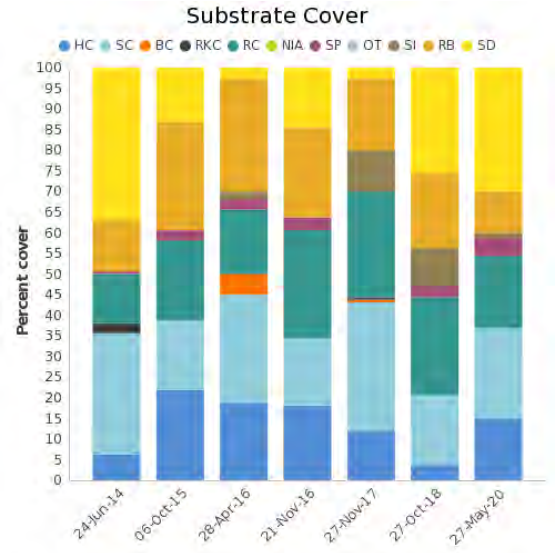


Figure 3.4.1. Benthic type and percent cover: Goat Island West, Site 1, 2014- 2020

Coral bleaching ranged from 5% to 48% of the coral surface but overall averaged only 1% of the total coral population. Disease (three incidences) and one unknown scar were also recorded plus 13 items of general trash. Fishing line was not recorded on this survey.

Invertebrates observed was limited to one *Drupella* snail during the invertebrate survey. Target fish were limited to three butterflyfish and one snapper.

Image 3.4A Site photo

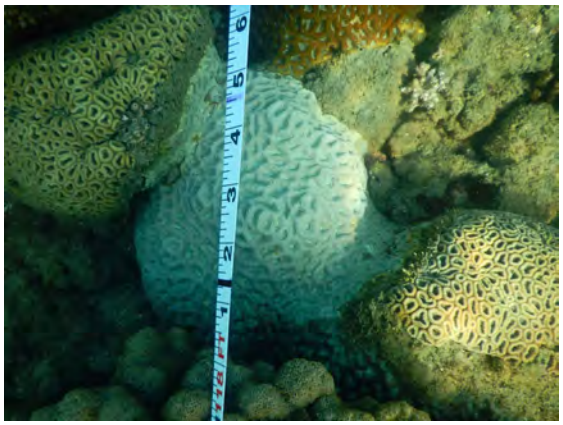


Image 3.4B Hard Corals

Image 3.4C General trash

3.5 GREEN ISLAND NORTH, SITE 1

This site is located on the northern side of Green Island. The site was established in 2015 and sits at a depth of 5m. This site hosts patchy hard and soft coral on a soft sediment benthos.

Silt (53%) was the dominant substrate followed by rock (16%) and rubble (13%). Soft coral (12%), hard coral (4%), and nutrient indicator algae (2%) made up the balance of substrate during the November 2019 (summer) survey. During the winter survey in June 2020, silt had reduced to 22%, with rock recorded at 21%. Soft coral had increased to 19%, with rubble at 16%, sand (14%), hard coral (7%) and sponge (<1%) making up the balance of the substrate (Figure 3.5.1).

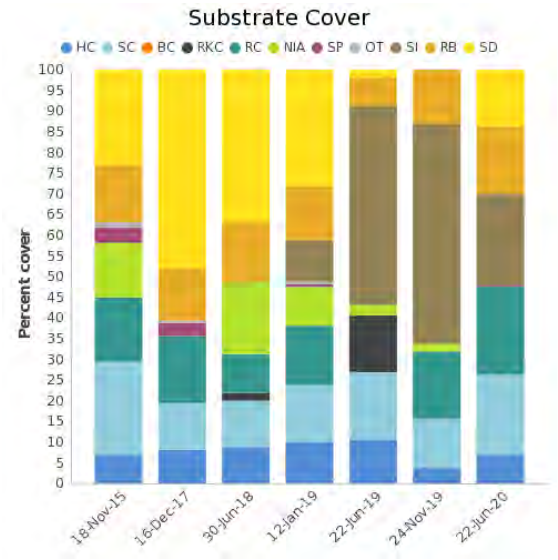


Figure 3.5.1. Benthic type and percent cover: Green Island North, Site 1, 2015 - 2020

In November 2019, 4% of the coral population was recorded as bleached, remaining constant with 3% of the population bleached in June 2020.

Three incidents of unknown damage and one fishing line were recorded in November 2019. In June 2020 only one incidence of unknown damage was recorded along with two unknown scars and one of general. No invertebrates were recorded on the November 2019 invertebrate surveys, but five *Drupella* snails were recorded in June 2020. Fish surveys were conducted with no target fish recorded in November 2019. In June 2020, two butterflyfish, one snapper and one grouper were recorded.

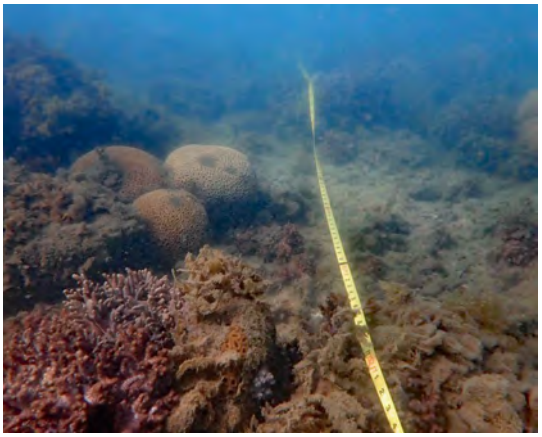


Image 3.5A Site photo

Image 3.5B Foliose hard coral

Image 3.5C Soft corals

3.6 GREEN ISLAND NORTH, SITE 2

This site is located approximately 100m inshore of the longer established Site 1. The site was surveyed in June 2020 to determine if the coral extends into shallower water. This site sits at a depth of around 1m. This site hosts very limited amounts of coral and is dominated by sea grass and algae on a soft sediment benthos.

The substrate was dominated by sand (78%), followed by rock at 18%. Rubble (3%) and silt (<1%), sponge (<1%) and other (<1%) made up the balance of the substrate (Figure 3.6.1). *Sargassum*, was the dominant algae, followed by *Lobophora* and *Padina*.

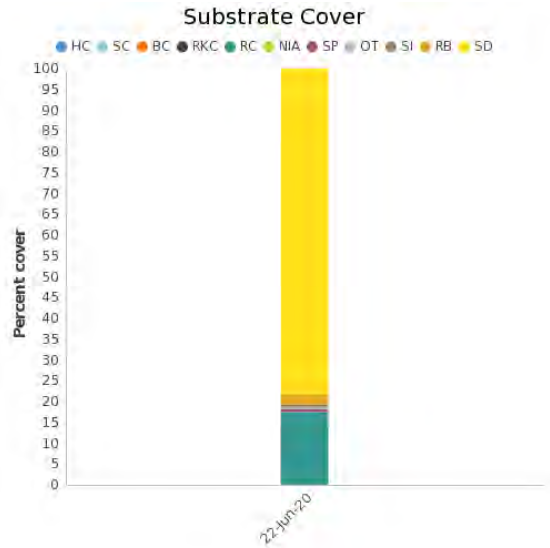


Figure 3.6.1. Benthic type and percent cover: Green Island North, Site 2, 2020

Only one incidence of general trash was recorded on the impacts survey. No invertebrates were recorded on transect.

A fish survey was conducted but no target fish were recorded.

Image 3.6A Site photo

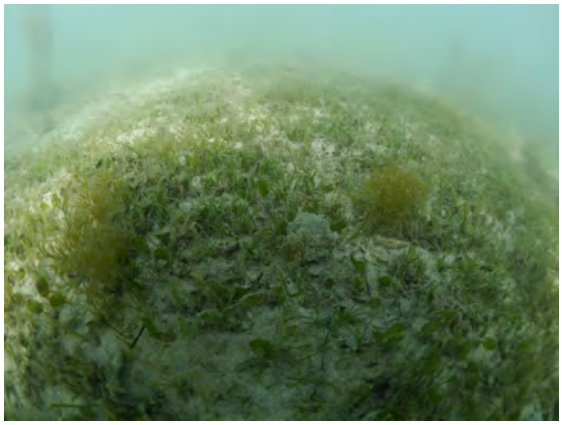


Image 3.6B Seagrass beds

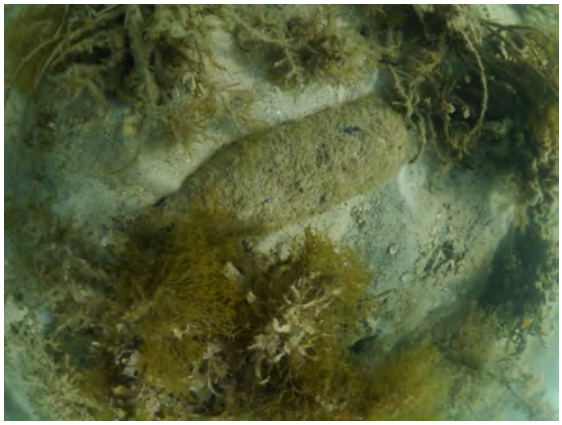


Image 3.6C General trash

3.7 GREEN ISLAND WEST, SITE 1

This site is located on the western side of green island on the edge of the reef flat. The site was established in 2017 and site at a depth of 5m. This site hosts patchy hard and soft coral on a soft sediment benthos.

Rock (39%) was the dominant substrate followed by soft coral (20%), silt (20%) and nutrient indicator algae (15%). Hard coral (6%) made up the balance of substrate during the November 2019 survey. Rock (33%) still dominated the substrate in June 2020. Sand (24%) (not recorded in November 2019) and silt (24%) were the next dominant categories. Soft coral at 9% and hard coral at 3% were a reduction from November. Rubble (4%), sponge (2%) and other (<1%) made up the balance (Figure 3.7.1).

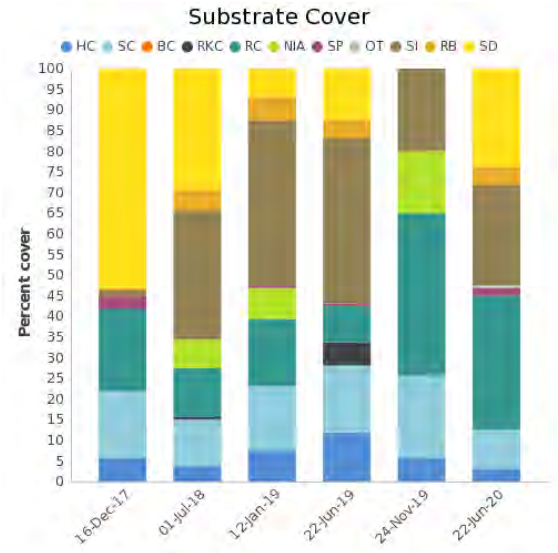


Figure 3.7.1. Benthic type and percent cover: Green Island West, Site 1, 2017 - 2020

Coral bleaching averaged 15% of each colony observed as bleached, with an average of 1% of the coral population bleached in November 2019. This increased to an average of 33% of each colony in June 2020 but remained at 1% of the coral population.

Eight counts of coral damage, two counts of coral disease and two counts of fishing line were recorded in November. Three counts of damage (unknown), one unknown scar and one piece of general trash were recorded in June. No target fish were recorded during the November 2019 survey, however two butterflyfish were observed in June 2020.

Image 3.7A Site photo

Image 3.7B Foliose hard coral

Image 3.7C *Asparagopsis* algae

3.8 GREEN ISLAND EAST, SITE 1

This site is located on the eastern side of green island on the reef flat. The site was first surveyed in 2010 and sits at a depth of 1m. It was surveyed again in 2017 and then in November 2019.

The substrate was dominated by silt (63%), followed by rock (21%), rubble (16%) and nutrient indicator algae (<1%). Hard and soft corals were recorded at <1% each in 2017 however were not observed during this survey (Figure 3.8.1).

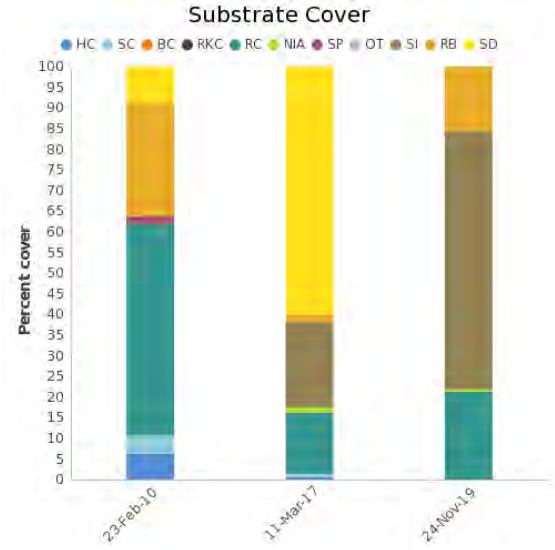


Figure 3.8.1. Benthic type and percent cover: Green Island East, Site 1, 2010 - 2019

Nil coral bleaching and impacts were recorded during the impacts survey, nor were invertebrates recorded. Target fish were not observed during the fish survey, however visibility was limited.

Due to the absence of corals and target organisms in November 2019, a winter survey was not conducted at this site.

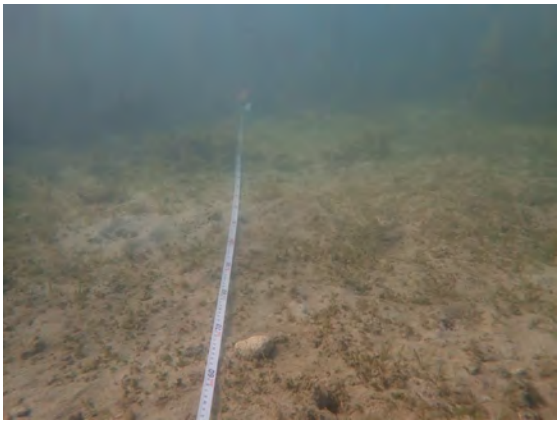


Image 3.8A Site photo

Image 3.8B Dominant algae

Image 3.8C Substrate

3.9 MACLEAY ISLAND, SITE 1

This site is located on the north-eastern side of Macleay Island in proximity to an old disused jetty. The site was established in 2009 and sits at a depth of around 2m. Patchy hard and soft coral communities, with an abundance of macro algae dominate this site.

Silt (39%) was the dominant substrate, a decrease from 45% in 2019. Sand (15%), rock (15%) and soft coral (14%), followed by hard coral (9%), rubble (7%) and sponge (1%) made up the rest of the benthos (Figure 3.9.1).

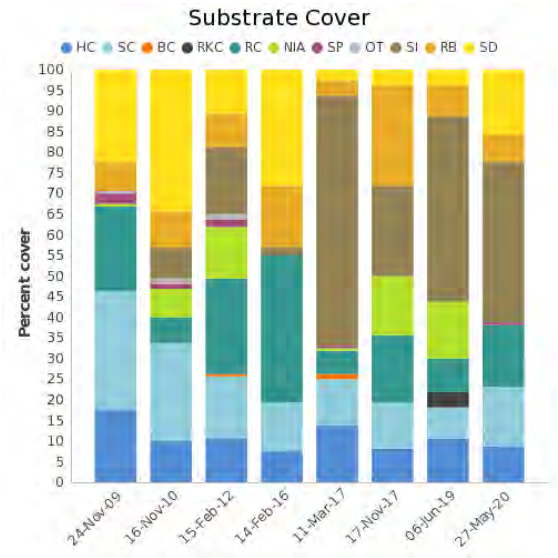


Figure 3.9.1. Benthic type and percent cover: Macleay Island, Site 1, 2009 - 2020

Coral bleaching was high at this site, ranging from 32% to 65% of the coral surface, with an overall average of 10% of the total coral population bleached. Disease, scars and fishing line were not recorded but there were two items of general trash.

Invertebrates were limited to one *Drupella* snail during this survey. The fish survey recorded only one sweetlip, but the amount of sargassum may have impacted the ability to notice smaller target fish.

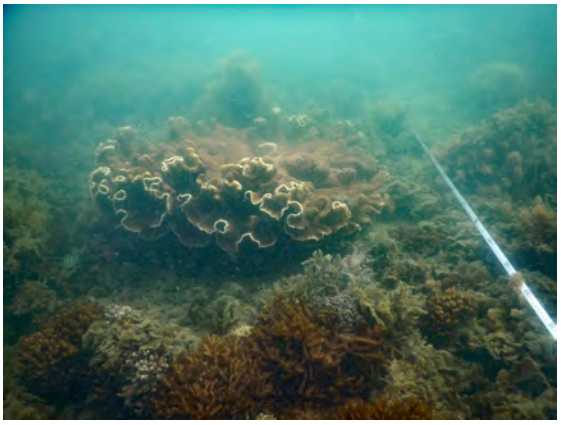


Image 3.9A Site photo

Image 3.9B Bleached Coral

Image 3.9C Dominant Algae - *Sargassum*

3.10 MUD ISLAND, CORAL GALORE

Mud Island is situated between the Port of Brisbane and Moreton Island and was historically used as anchorage for ships that were unable to access the shallow Brisbane River. This site is situated on a rocky slope and supports a population of corals, in contrast to the neighbouring survey site called Rubble Patch (See Section 3.11).

Soft coral made up 36% (an increase from 2019) and hard coral attributed <1% of the total substrate; a decline from January 2019, but an increase from June 2019. Rock made up 11% of the substrate, rubble 7%, with sand making up 14%. Nutrient indicator algae made up a further 26%, silt 4% and other 1% (Figure 3.10.1). *Asparagopsis, Sargassum* and *Lobophora* were the dominant algae. It is noted that a survey was not able to be conducted in January 2020 due to unfavourable weather and water conditions.

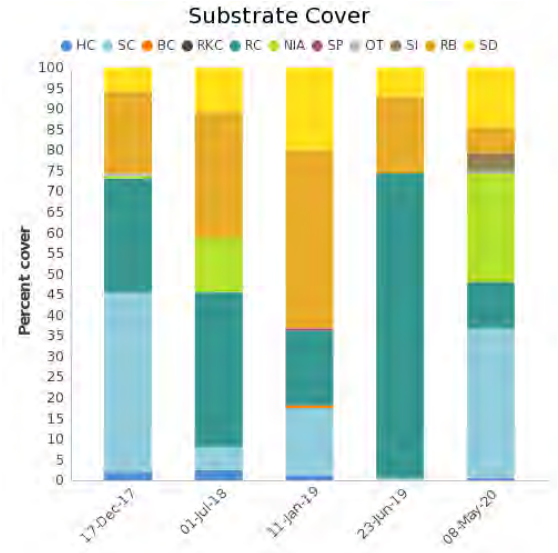


Figure 3.10.1. Benthic type and percent cover: Mud Island, Coral Galore, 2017 - 2020

Bleaching averaged 24% of coral colonies and 1% of the coral population. No other impacts or marine debris were recorded on the impact survey. Target invertebrates were not observed on the invertebrate survey.

A fish survey was conducted and four butterfly fish and one snapper were recorded. Several stingrays were also observed on transect and a pair of rarely recorded sea slugs were observed (Image 3.10B).

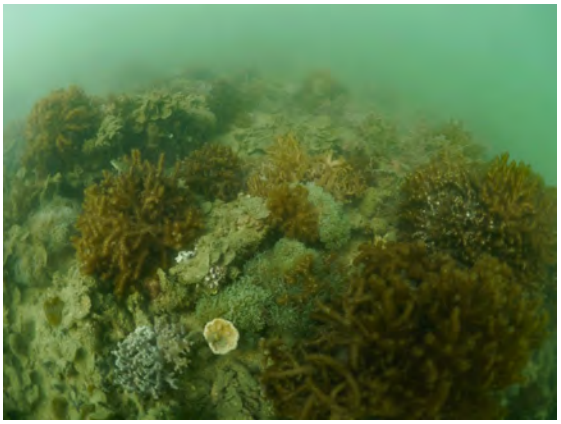


Image 3.10A Site photo

Image 3.10B *Mexichromis multituberculatus*

Image 3.10C Branching hard coral

3.11 MUD ISLAND, RUBBLE PATCH

This site at Mud Island consists primarily of unconsolidated coral rubble, sparse soft coral and algae fields. This site was first surveyed in 2017 after it was identified by Roelfsema et al (2017) as an area of interest.

Hard Coral made up 1% (consistent with 2019) but soft coral at 2% of the total substrate is a decline from 2019. Not surprisingly Rubble made up 40% of the substrate, with rock making up 49%. Nutrient indicator algae made up a further 6% and sand 2% (Figure 3.11.1). *Sargassum* and *Padina* were the dominant algae. It is noted that a survey was not able to be conducted in January 2020 due to unfavourable weather and water conditions.

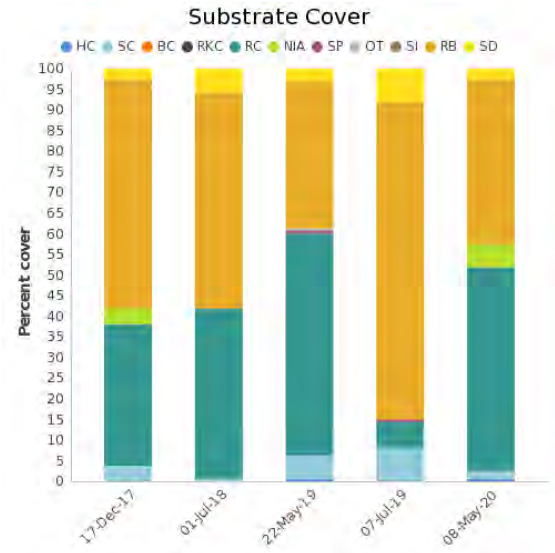


Figure 3.11.1. Benthic type and percent cover: Mud Island, Rubble Patch, 2017 - 2020

Bleaching was not observed. Only one incidence of unknown coral damage was recorded on the impact survey and one item of marine debris. One *Drupella* snail was observed on the invertebrate survey.

A fish survey was conducted and no target fish were recorded.

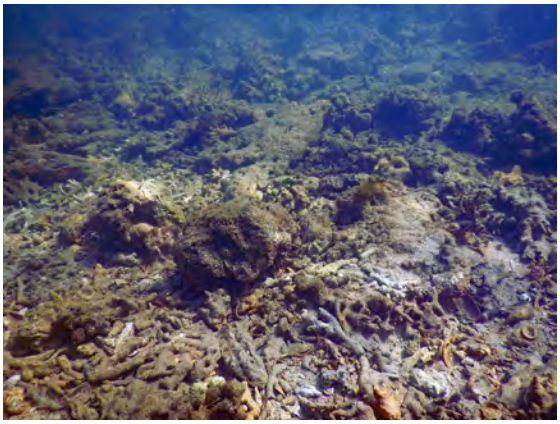


Image 3.11A Site photo

Image 3.11B Soft coral

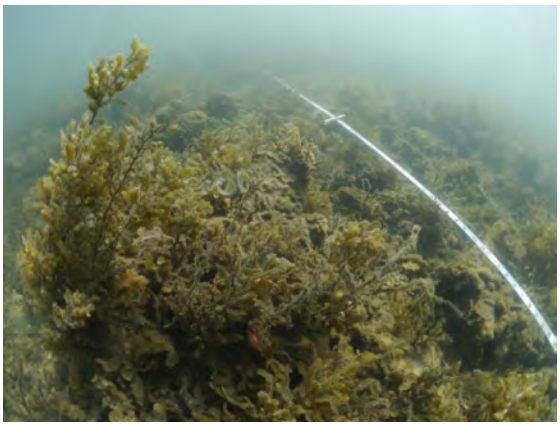


Image 3.11C Dominant algae

3.12 MYORA REEF, SITE 1

This site is located on the western side of North Stradbroke Island on the fringing reef flat. The site is located within the Marine national park green (no take) zone and sits at a depth of around 2m. This site was established in 2009.

Hard coral (34%) (Figure 3.12.1) was the dominant substrate followed by rock (29%) and sand (25%). Rubble (9%), sponge (1%), recently killed coral (1%) and other (1%) made up the balance of substrate during this survey.

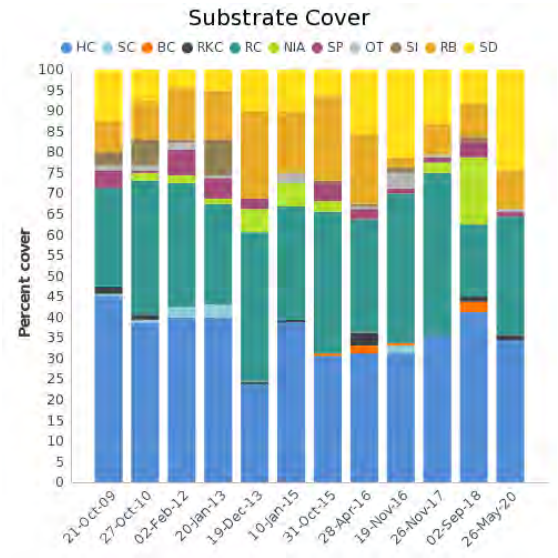


Figure 3.12.1. Benthic type and percent cover: Myora Reef, Site 1, 2009 - 2020

Coral bleaching averaged 29% of the coral surface but overall averaged only 1% of the total coral population. Four incidences of damage, 21 of disease and two unknown scars were also recorded plus three fishing line (despite the zoning) and one item of general trash.

This site had a high number of long-spined urchins, with 56 individuals observed during the invertebrate survey.

Target fish included 14 Butterflyfish, one moray eel and one snapper with three wobbegong sharks also observed.

Image 3.12A Site photo

Image 3.12B Urchin

Image 3.12C Transect photo

3.13 MYORA REEF, SITE 2

This site is located adjacent Site 1 on the fringing reef flat but is slightly shallower. The site sits at a depth of around 1.5m and hosts more hard coral than the slightly deeper Site 1. This site was established in 2014.

Hard coral (52%) was the dominant substrate followed by rock (20%) and rubble (11%). Sand (8%), sponge (7%), silt (1%) and soft coral (1%) made up the balance of substrate during this survey (Figure 3.13.1).

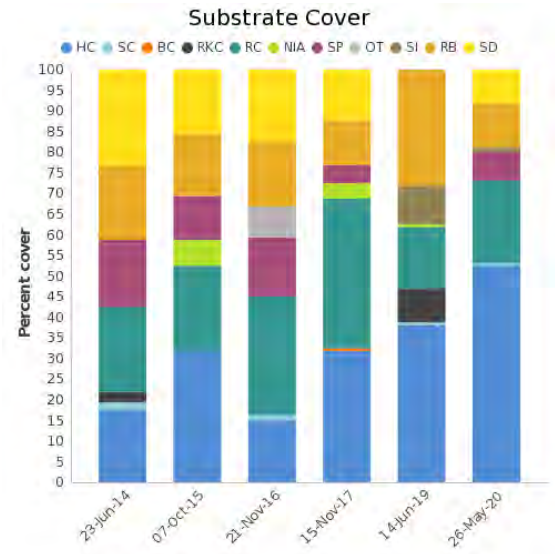


Figure 3.13.1. Benthic type and percent cover: Myora Reef, Site 2, 2014 - 2020

Coral bleaching averaged 51% of the coral surface but overall averaged only 1% of the total coral population. Damage was observed on four corals, with 16 incidences of disease recorded. Fishing line was also recorded on the first two transects.

This site had nine long-spined urchins, a lot less than Site 1, and one collector urchin observed during the invertebrate survey.

Target fish included 57 butterflyfish, 40 snapper and two sweetlips.

Image 3.13A Site photo

Image 3.13B Hard corals

Image 3.13C Non-target sea cucumber

3.14 PEEL ISLAND, EAST

Peel Island is situated in Moreton Bay and experiences heavy boat traffic due to its proximity to a deep channel. Reef Check Australia has three established monitoring sites around Peel Island.

This site is located on the eastern side of Peel Island in proximity to the popular boating location of Horseshoe Bay. The site was established in 2009 and sits at a depth of around 4m. This site hosts patchy hard and soft coral communities on a sand/rubble bottom.

Sand (49%) was the dominant substrate, a substantial increase from 2019, but consistent with 2017. Rock (29%) and soft coral (10%) were followed by hard coral (6%), rubble (3%) and sponge (1%), other (1%) and silt (1%) (Figure 3.14.1). Sixteen counts of macroalgae were recorded.

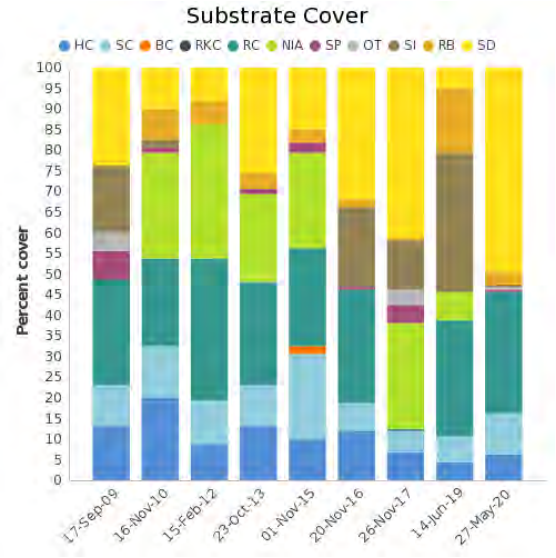


Figure 3.14.1. Benthic type and percent cover: Peel Island East, 2009 - 2020

Coral bleaching ranged from 5% to 51% of the coral surface and overall averaged 7.5% of the total coral population. Coral disease (one incidence) and one unknown scar was also recorded, plus 20 fishing line and two items of general trash.

Invertebrates were limited to two *Drupella* snails and one long-spined urchin during this survey.

The fish survey recorded three butterflyfish and one sweetlip, with nudibranchs and a cowrie also observed.

Image 3.14A Site photo

Image 3.14B Common egg cowrie

Image 3.14C Juvenile Lionfish

3.15 PEEL ISLAND, NORTH

This site is located on the northern side of Peel Island on the reef flat. The site was established in 2009 and sits at a depth of around 2m. This site hosts hard and soft coral communities and is located within the Marine national park green (no take) zone.

Sand (33%) was the dominant substrate followed by rubble (24%) and rock (15%). Soft coral (13%) and hard coral (11%) were higher than in 2018, but lower than previous years. Sponge (3%) and bleached coral (1%) made up the balance of substrate during this survey (Figure 3.15.1).

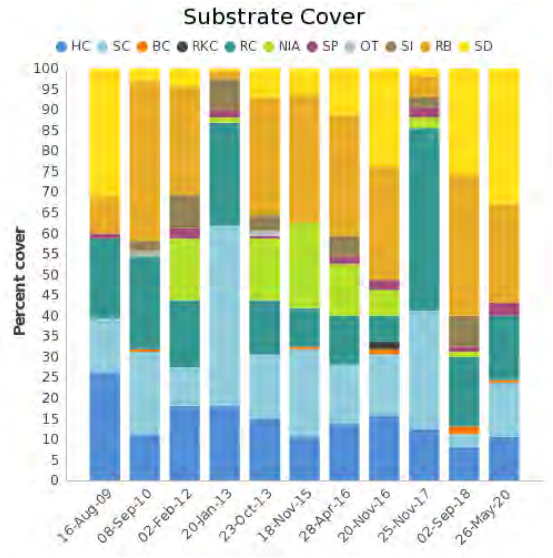


Figure 3.15.1. Benthic type and percent cover: Peel Island North, 2009 - 2020

Coral bleaching ranged from 9% to 100% of the coral surface but overall averaged only 1% of the total coral population. Coral disease was recorded (five incidences) plus two of fishing line and three items of general trash.

Invertebrates were not observed during the invertebrate survey.

Target fish were limited to five butterflyfish and one sweetlip.

Image 3.15A Site photo

Image 3.15B Massive hard coral

Image 3.15C Leathery soft coral

3.16 PEEL ISLAND, NORTH EAST

This site is located on the north-eastern side of Peel Island on the shallow reef flat, just to the north of the Platypus wreck. The site was established in 2014 and sits at a depth of around 2m. This site hosts patchy hard and soft coral communities on a sand/rubble bottom.

Sand (54%) was the dominant substrate, a substantial increase from 2019. Rock (22%) and rubble (11%) were followed by hard coral (9%), which is an increase from 2019, and soft coral (4%) (Figure 3.16.1). Of note, nutrient indicator algae, which represented 16% of the substrate in 2019 was not recorded during this survey.

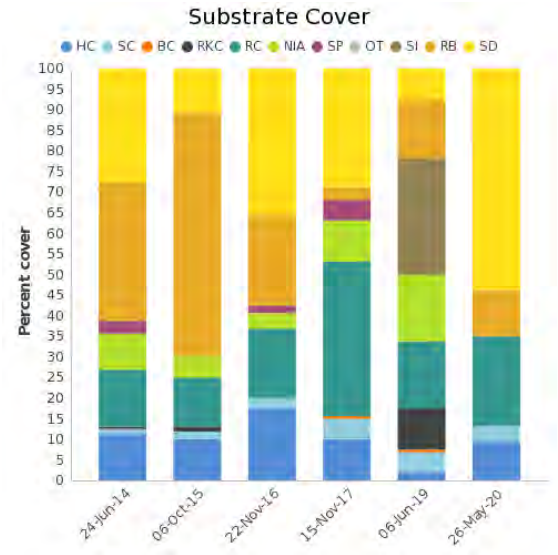


Figure 3.16.1. Benthic type and percent cover: Peel Island North-East, 2014 - 2020

Coral bleaching ranged in average from 8% to 40% of the coral surface but overall averaged only 1% of the total coral population. Sixteen incidences of disease was also recorded plus five counts of fishing line and 10 items of general trash.

Invertebrates were not observed during the invertebrate survey.

Target fish were not observed during this survey.

Image 3.16A Site photo

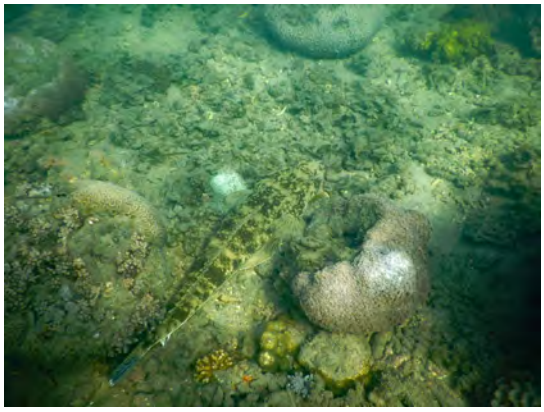


Image 3.16B Flathead

Image 3.16C Interesting bleaching pattern on hard coral

3.17 ST HELENA, PALINDROME

This site at St Helena Island is located in close proximity to the jetty. The substrate is generally soft sediment and sand with patchy coral cover.

Hard Coral made up 2% and soft coral 7% of the total substrate, both an increase from 2019. Rubble made up 42% of the substrate, with nutrient indicator algae making up a further 27%. Silt attributed 14%, rock 6%, while bleached coral and sponge each made up 1% (Figure 3.17.1). *Lobophora* and *Sargassum* were the dominant algae. It is noted that a survey was not able to be conducted in January 2020 due to unfavourable weather and water conditions.

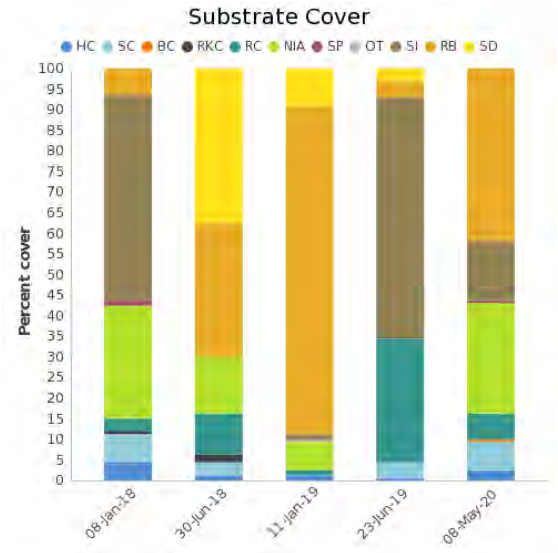


Figure 3.17.1. Benthic type and percent cover: St Helena Island, Palindrome, 2018 - 2020

Bleaching, coral disease, damage and scars were not recorded on the impact survey. Two items of marine debris were recorded. No invertebrates were observed on the invertebrate survey.

A fish survey was conducted and two butterfly fish were recorded.

Image 3.17A Site photo

Image 3.17B Mating crabs

Image 3.17C Massive hard coral

3.18 ST HELENA, RAY OF SUNSHINE

This site at St Helena Island is located off the southern end of the island. The substrate is generally soft sediment and sand with patchy coral cover, however it has a greater cover of coral than Palindrome.

Hard coral made up 6% and soft coral 16% of the total substrate, both an increase from 2019. Rubble made up 13% of the substrate, with nutrient indicator algae making up a further 28%. Silt attributed 13%, rock 6%, sand 16% and sponge 2% (Figure 3.18.1). *Lobophora*, *Sargassum* and *Padina* were the dominant algae. It is noted that a survey was not able to be conducted in January 2020 due to unfavourable weather and water conditions.

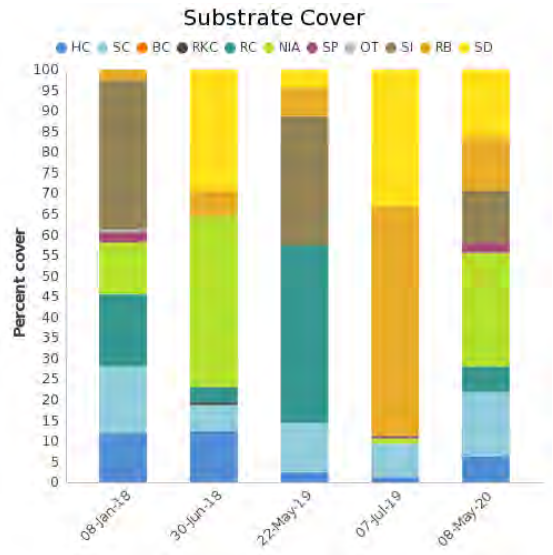


Figure 3.18.1. Benthic type and percent cover: St Helena Island, Ray of Sunshine, 2018 - 2020

Bleaching affected less than 1% of the total coral population with an average of 51% of any individual colony being bleached. Only one incidence of coral damage was recorded on the impact survey. No items of marine debris were recorded. No invertebrates were observed on the invertebrate survey.

A fish survey was conducted and five butterfly fish were recorded.

Image 3.18A Site photo

Image 3.18B Foliose Hard Coral

Image 3.18C Sponge

4.0 OUTER MORETON BAY SITE REPORTS:

4.1 FLINDERS REEF, THE NURSERY; SITE 1

This site is located on the protected leeward side of Flinders reef in the Marine National Park. The site was established in 2007 at a depth of 9m. The site hosts a diversity of hard and soft coral growth forms, sponges and giant clams.

Rock (40%) was the dominant substrate followed by Soft coral (17%). Sand (13%) and hard coral (13%) were followed by other (6%), rubble (4%), nutrient indicator algae (4%) and sponge (3%) (Figure 4.1.1).

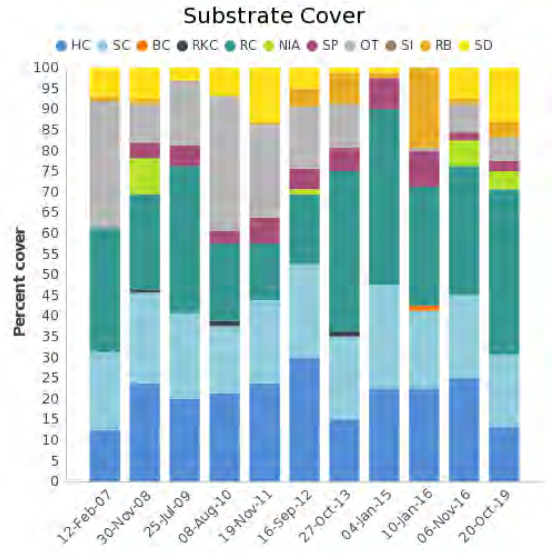


Figure 4.1.1. Benthic type and percent cover: Flinders Reef, The Nursery Site 1, 2007 - 2019

Coral bleaching affected 7.75% of the coral population, with 25% being the average surface bleaching for each colony.

Three incidences of coral damage, three *Drupella* scars and seven unknown scars were recorded during the impacts survey, with only one count of marine debris recorded.

Six *Drupella* snails and 20 long-spined urchin were recorded during the invertebrate survey.

During the fish survey, 28 butterfly fish and one parrotfish were recorded, with a bull ray and turtles also observed.

Image 4.1A Site photo. Photo by Devin Rowell

Image 4.1B Surveyors in action

Image 4.1C Corallimorphs

4.2 FLINDERS REEF, THE NURSERY; SITE 3

This site is located on the protected leeward side of Flinders reef in the Marine National Park. The site was established in 2009 and is located between The Nursery Sites 1 and 2 at a depth of 5m. The site follows a shallow reef contour over a gentle undulating slope. It hosts a diversity of hard coral growth forms, in addition to notable soft coral and corallimorph cover.

Rock (36%) was the dominant substrate followed by sand (19%). Soft coral (15%) and hard coral (12%) were followed by rubble (6%), sponge (6%), nutrient indicator algae (3%), other (2%), and bleached coral (1%) (Figure 4.2.1).

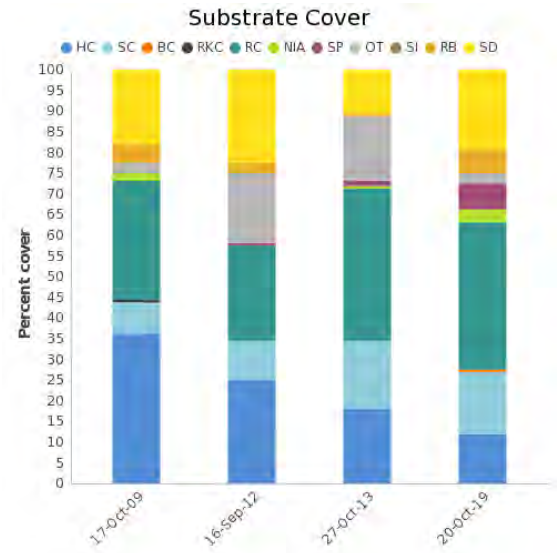


Figure 4.2.1. Benthic type and percent cover: Flinders Reef, The Nursery Site 3, 2009 - 2019

Coral bleaching affected 0.25% of the coral population, with 1.25% being the average surface bleaching for each colony.

Twelve incidences of coral damage, two *Drupella* scars and three unknown scars were recorded during the impacts survey, with marine debris not recorded.

Two giant clams, one lobster, three *Drupella* snails and one long-spined urchin were recorded during the invertebrate survey.

During the fish survey, 20 butterfly fish were recorded, with a wobbegong shark, octopus and turtles also observed.

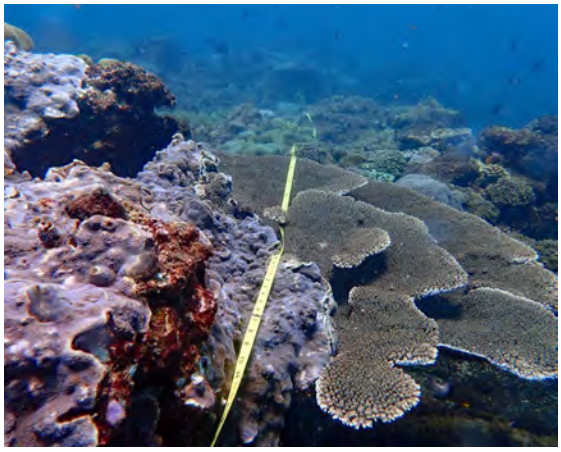


Image 4.2A Site photo

Image 4.2B Surveyor with turtle

Image 4.2C Butterflyfish.

4.3 SHAG ROCK ISLAND, EAST

Shag Rock is a twin rock structure offshore from North Stradbroke Island and is a popular location for diving, fishing and boating.

This is a relatively sheltered cove situated on the south-eastern side of Shag Rock. The site sits on the reef slope and was established in 2008 due to its popularity with divers.

Nutrient indicator algae (38%) and rock (35%) were the dominant substrate followed by hard coral (12%). Other (9%) and sand (3%) were followed by sponge (1%), rubble (1%) and recently killed coral (1%) (Figure 4.3.1).

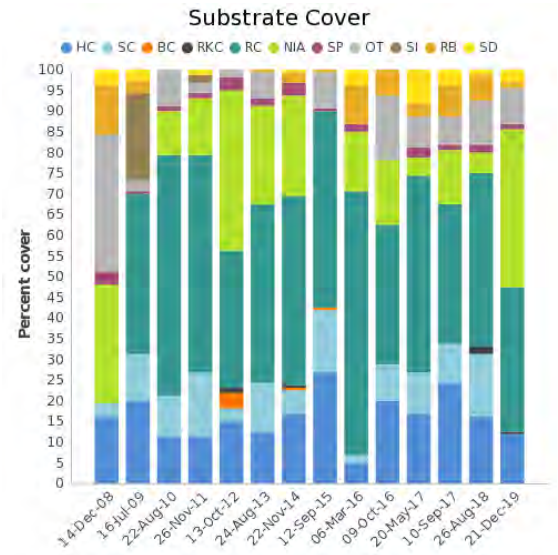


Figure 4.3.1. Benthic type and percent cover: Shag Rock Island East, 2008 - 2019

Coral bleaching was not observed.

Sixteen incidences of coral damage, 12 incidences of coral disease, six *Drupella* scars and one piece of marine debris were recorded during the impacts survey.

Fifty-four urchins, seven anemones and 56 *Drupella* snails were recorded during the invertebrate survey.

During the fish survey, five butterfly fish, three parrotfish, three snapper and nine sweetlip were recorded, with wobbegong sharks, blue spotted rays and bull rays also observed.

Image 4.3A Site photo

Image 4.3B Nutrient Indicator Algae

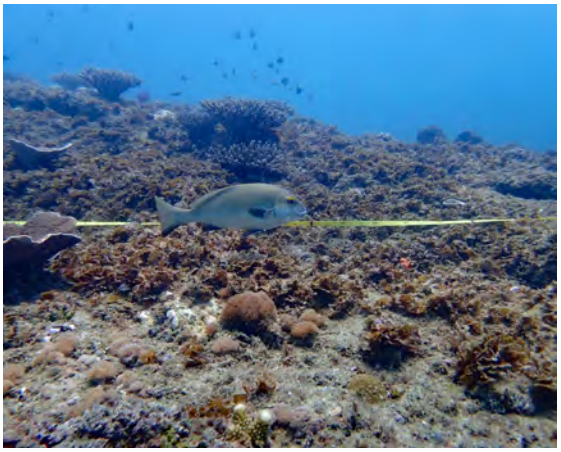


Image 4.3C Gold Spotted Sweetlips

4.4 SHAG ROCK ISLAND, WEST

This site sits on the exposed northern side of Shag Rock. It features a gentle rocky slope with patchy hard corals and consistent populations of sea urchins. High counts of boat and anchor damage were recorded in 2015 following the demise of a small boat at this site. This site was established in 2009 to enable a more complete understanding of the range of habitat offered at Shag Rock.

Rock (50%) was the dominant substrate followed by rubble (15%). Nutrient indicator algae (11%) and hard coral (10%) were followed by sand (9%), soft coral (3%), other (1%) and sponge (1%) (Figure 4.4.1).

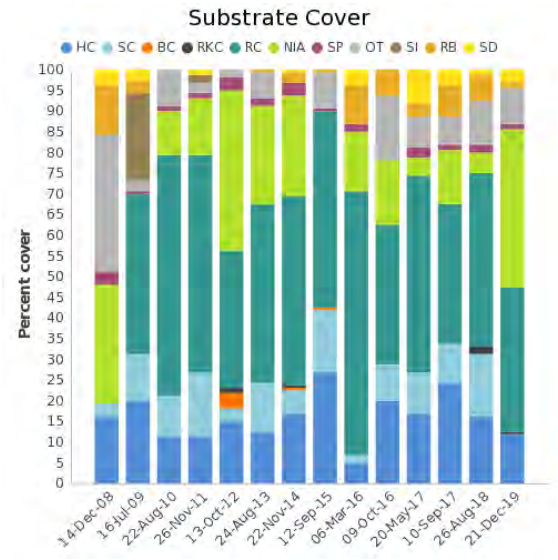


Figure 4.4.1. Benthic type and percent cover: Shag Rock Island West, 2008 - 2019

Coral bleaching was not observed.

Fourteen incidences of coral damage, 11 incidences of coral disease and two *Drupella* scars were recorded on the impacts survey. Marine debris was not recorded

The invertebrate survey recorded 110 urchins, 14 anemones and 19 *Drupella* snails. One giant clam was recorded off transect.

During the fish survey, 13 butterfly fish and one sweetlip were recorded, with leopard sharks, nurse sharks and blue spotted rays also observed.

Image 4.4A Site Photo

Image 4.4B Leopard Shark

Image 4.4C Giant Clam

5.0 GOLD COAST SITE REPORTS:

5.1 PALM BEACH REEF, SITE 1

Palm Beach Reef is an extensive rocky reef made up of numerous ridges and gullies, located 800-1000 m offshore. The reef has patchy hard coral cover and hosts a high number of benthic invertebrates such as sponges, ascidians and a high abundance of anemones. It also has a notably high abundance of sea urchins.

Site 1 was established in 2007 to gain a better understanding of the subtropical reefs in the Gold Coast sub-region. The site is situated on the reef flat.

Hard coral accounted for 5% of the benthos, and soft corals 2% (Figure 5.1.1). Rock made up the majority of the substrate at 64%. Other (11%), sand (10%), sponge (7%) and rubble (1%) made up the balance.

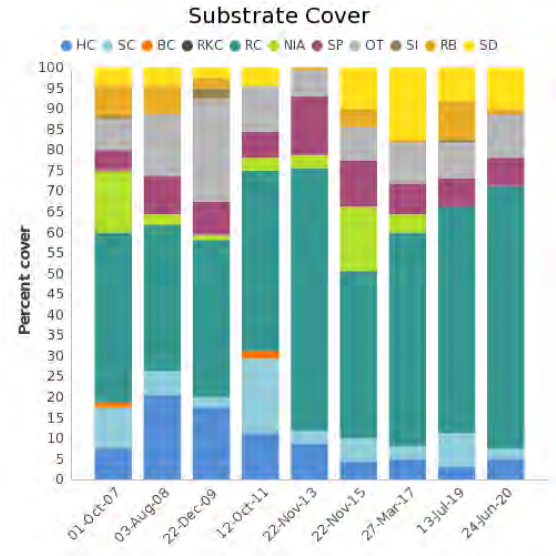


Figure 5.1.1. Benthic type and percent cover: Palm Beach Reef, Site 1, 2007 - 2020

Only two incidences of coral bleaching were recorded at an average of 10% of the coral surface. Three unknown scars, and one *Drupella* scar were recorded. Marine debris was not observed.

Six anemones with fish, 125 anemones without fish, seven *Drupella* snails, 23 collector urchins, 32 *Diadema* urchins and 72 pencil urchins were recorded on the invertebrate survey. Ten butterflyfish, two moray eels and two sweetlips were recorded on the fish survey. Octopus, wobbegongs and a turtle were also observed.

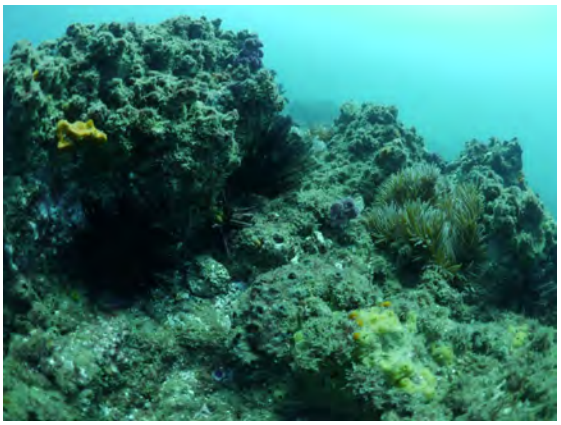


Image 5.1A Site photo

Image 5.1B Pencil urchin

Image 5.1C Turtle

5.2 PALM BEACH REEF, SITE 2

Palm Beach Reef, Site 2 is located in close proximity to the long-established Palm Beach Reef, Site 1 and was established in 2009. This site is located on the reef flat.

Hard coral accounted for 6% of the benthos and soft coral 4% (Figure 5.2.1). Rock constituted 65% of the substrate (an increase from 2019), other 13%, sponges 6%, sand 6% and rubble <1%.

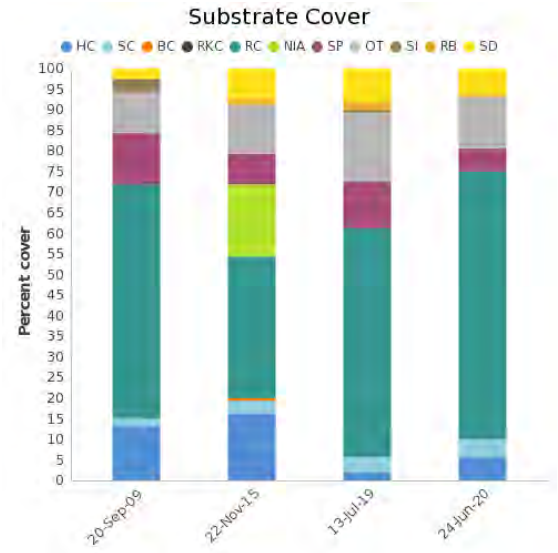


Figure 5.2.1. Benthic type and percent cover: Palm Beach Reef, Site 2, 2009 - 2020

No coral bleaching was recorded. One *Drupella* scar, two unknown scars and two fishing line were recorded on the impacts survey.

Similar to site 1, 127 anemones without fish and three anemones with fish were recorded on the invertebrate survey. Five banded coral shrimp, 16 *Drupella* snails, one *Trochus* shell, five collector urchins, 62 *Diadema* urchins and 65 pencil urchins were also recorded.

Target fish were limited to two butterflyfish, two grouper (one of which was an Eastern Blue), two moray eels and two parrotfish, but two octopus, one turtle, and two wobbegongs were also observed.

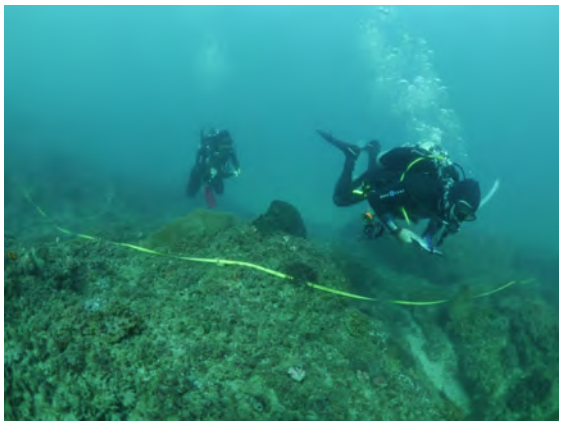


Image 5.2A Site photo

Image 5.2B Moray eel

Image 5.2C *Hexabranchus sanguineus*

5.3 PALM BEACH ARTIFICIAL REEF, SITE 1

Palm Beach Artificial Reef is a man-made reef composed entirely of natural rock and located approximately 270m from the shoreline. Site 1 is the deeper of the two sites at 5m, which is the also the maximum depth in this area.

The reef was completed in 2019 to assist with shoreline protection in this area. Monitoring was established at the end of 2019 to document changes in benthic recruitment and utilisation as habitat by marine organisms.

Rock accounted for 51% of the benthos, and sand 24% (Figure 5.3.1). Nutrient indicator algae (20%) and other (ascidians) (5%) made up the balance.

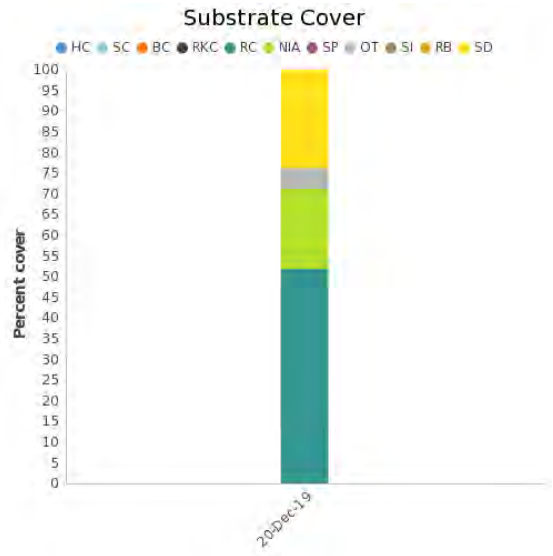


Figure 5.3.1. Benthic type and percent cover: Palm Beach Artificial Reef, Site 1, 2019

As there was no coral, bleaching and coral damage was not recorded. Marine debris was not observed.

Invertebrates were not recorded on the invertebrate survey, nor were any target fish.

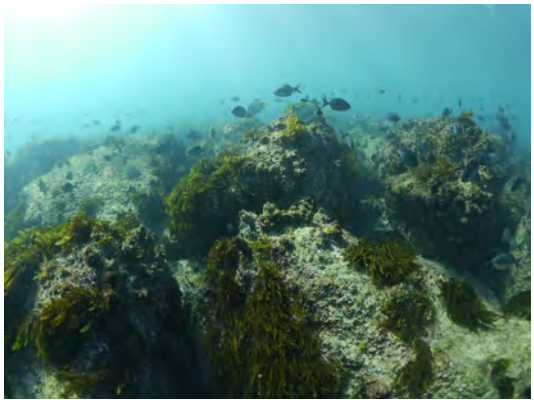


Image 5.3A Site photo

Image 5.3B Ascidians

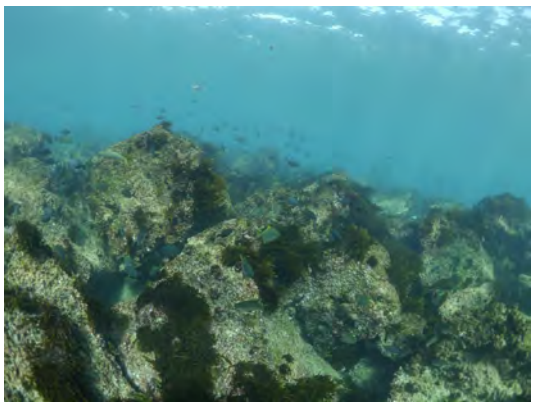


Image 5.3C Schools of fish

5.4 PALM BEACH ARTIFICIAL REEF, SITE 2

Palm Beach Artificial Reef is a man-made reef composed entirely of natural rock and located approximately 270m from the shoreline. Site 2 is shallower at 3m, but runs parallel to Site 1.

Rock accounted for 70% of the benthos, and nutrient indicator algae 22% (Figure 5.4.1). Other (ascidians) (8%) made up the balance.

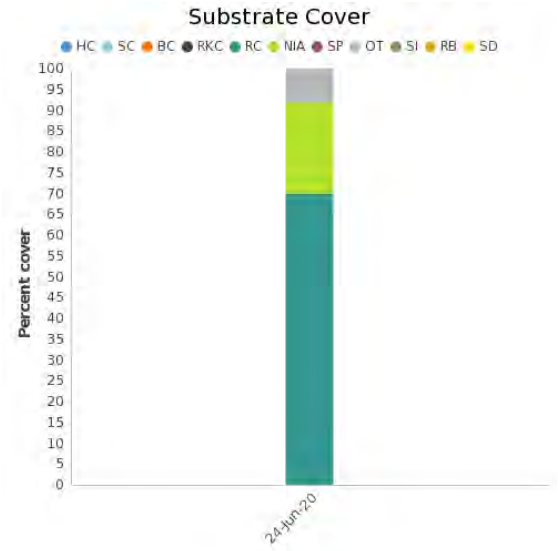


Figure 5.4.1. Benthic type and percent cover: Palm Beach Artificial Reef, Site 2, 2020

As there was no coral, bleaching and coral damage was not recorded. Marine debris was not observed.

Invertebrates were not recorded on the invertebrate survey, however three butterflyfish were recorded on the fish survey, with an abundance of non-target fish also observed utilising the reef.

Image 5.4A Site photo

Image 5.4B Dominant algae

Image 5.4C Dominant mollusc

5.5 GOLD COAST SEAWAY, SOUTHWEST WALL; SITE 1

The Gold Coast Seaway South-West Wall site was established in 2007 and was established to record the impacts upon this heavily utilised site. It is located on the sandy slope parallel to the rock wall. It is characterised by rocks and sand, with a variety of hydroids and algae. The location is frequently used by divers and snorkelers due to the availability of shallow habitat and diversity of fish.

Rock (41%) was the dominant substrate; followed by sand (27%), silt (31%) and rubble (1%) (Figure 5.5.1). This is an increase in silt from 2019 but consistent with 2017. Only one occurrence of macroalgae was recorded on the transect.

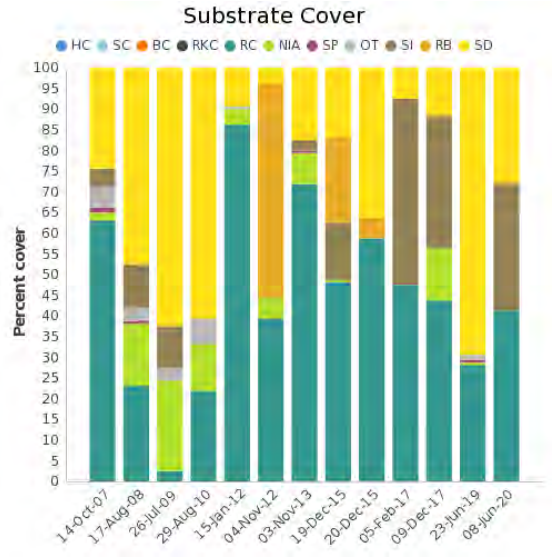


Figure 5.5.1. Benthic type and percent cover: Gold Coast Seaway, South-West Wall, 2007 - 2020

Coral bleaching was not recorded and coral was not recorded during the survey.

Fishing line represented the largest impact, with 56 incidences recorded and six observations of general trash. During the invertebrate survey, nine banded coral shrimp were recorded and one *Drupella* snail.

A fish survey was conducted and eleven butterfly fish, five moral eels and one sweetlip were recorded. Large schools of tarwhine and luderick were also observed along with numerous nudibranchs observed on the hydroids. We were also fortunate to record one seahorse.

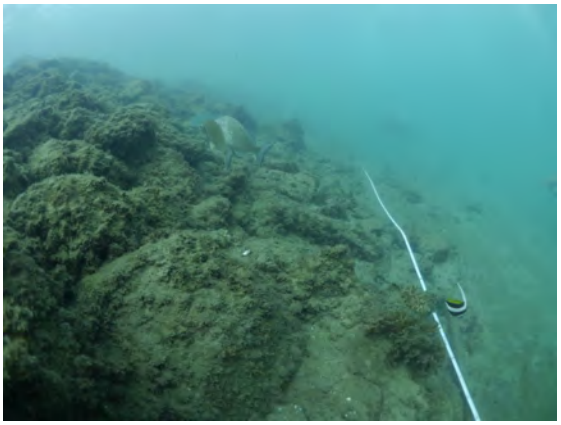


Image 5.5A Site photo

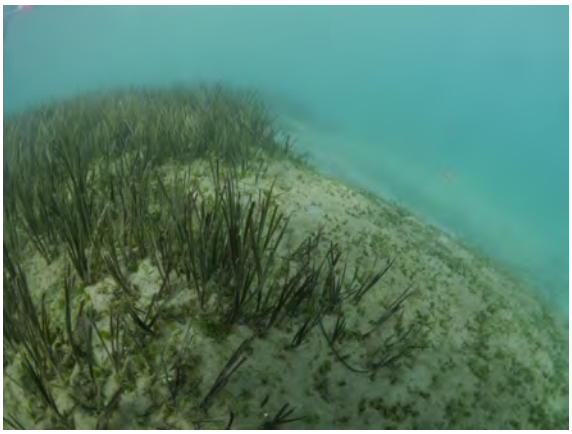


Image 5.5B Seagrass

Image 5.5C Seahorse

5.6 GOLD COAST SEAWAY, THE PIPE; SITE 1

The Gold Coast Seaway - The Pipe site was established in 2015 to record the impacts upon this heavily utilised site. It is located on the sandy slope parallel to the rock wall. It is characterised by large rocks and sand, with scattered sponges and algae. The location is a frequently used dive and snorkel site due to the availability of shallow habitat and diversity of fish.

Sand (69%) was the dominant substrate; followed by rock (31%) (Figure 5.6.1), with one record of sponge on survey. This is different to 2019 where silt dominated but is consistent with substrate composition in 2017.

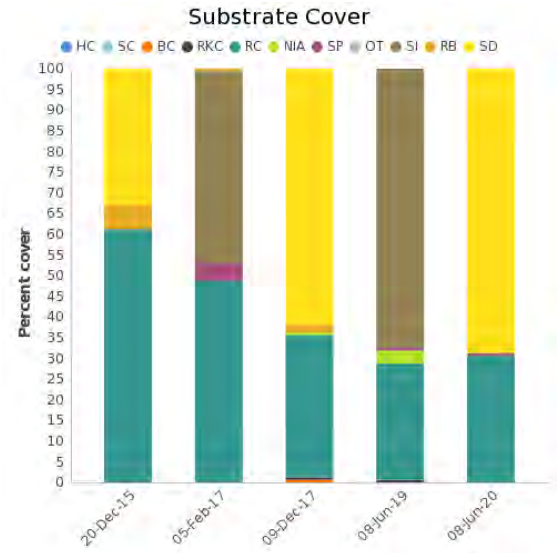


Figure 5.6.1. Benthic type and percent cover: Gold Coast Seaway, The Pipe, 2015 - 2020

Coral bleaching was not recorded and coral was not recorded during the survey.

Fishing line represented the largest impact, with 30 incidences recorded. General trash was not recorded on survey.

During the invertebrate survey, three banded coral shrimp were recorded and 10 *Drupella* snails.

A fish survey was conducted and 12 butterfly fish and five moral eels were recorded. Large schools of tarwhine and luderick were also observed along with one frogfish (Refer Image 1.2.9).

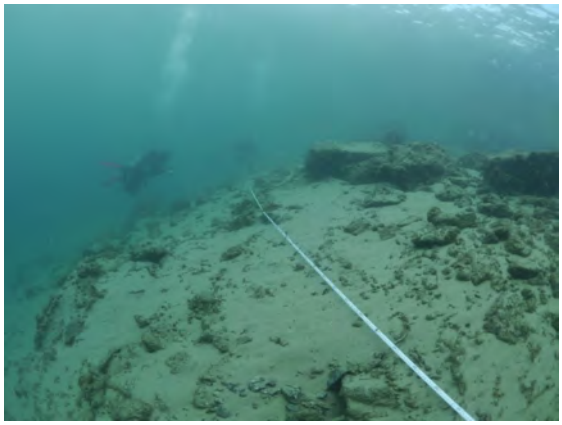


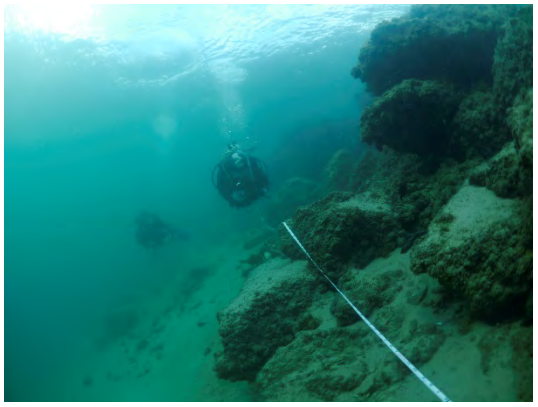
Image 5.6A Site photo

Image 5.6B Whiting and butterflyfish

Image 5.6C Juvenile painted cray

6.0 TEAM SURVEY PHOTOS





Our survey activities are made possible by our trained citizen scientists who donate their time, energy and skills! Thank you all!

7.0 LITERATURE CITED

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