Reef Check Australia

South East Queensland
Season Summary Report 2020-2021

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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 and entered data: Tania Alajo, Ashleigh Borra, Ilha Byrne, Paul Colquist, Philip Dunbavan, Donna Easton, Terry Farr, Monique Grol, Andy Holland, Chris Klaas, Eva Kovacs, Emily Lansdown, Lisa McComb, Rachel McVeigh, Peter Nicholls, Andrew O'Hagan, Devin Rowell, Jodi Salmond, Julie Schubert, Mark Stenhouse, Cheryl Tan, Cedric van den Berg, Breanne Vincent & 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 and SEQ Survey Coordinator Julie Schubert. The image on the front was taken from Mudjimba Island on the Sunshine Coast by Jodi Salmond.

Project activities were conducted on the traditional lands of the Quandamooka People, Kabi Kabi First Nation and Yugambeh People. We acknowledge and pay respect to the past, present and future Traditional Custodians and Elders of this nation and the continuation of cultural, spiritual and educational practices of Aboriginal and Torres Strait Islander peoples

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SEQ Season Summary Report 2020-2021

Message from our General Manager

Around the world, reefs are under pressure from factors such as pollution, development, climate change and heavy human use of ocean environments. Climate change continues to be the greatest threat to the future of coral reefs around the world, but we continue to do what we can to inspire, educate and engage those around us to make the best possible choices for the health of our oceans, and the future of our planet.

The 2020-2021 season was full of challenges for us all. The entire Reef Check Australia team has been working hard to clean up our coastline, catchments and oceans with a variety of clean-up activities. We have participated in a huge number of community education and engagement events, despite the challenges, and we continued vital reef health monitoring along the length of the South East Queensland coastline, despite unpredictable weather patterns joining forces with the big C to do their collective best to foil continually updated plans. Survey expeditions were cancelled and rescheduled. Community events were set up and shut down hours later.

But we persevered.

This past year has taught us many things. Resilience, adaptability, and gratitude. We have sharpened our MacGyver skills and are not only able to adapt quickly, but we can also make just about anything out of zip ties and duct tape. We have reconnected with ourselves, each other and the world around us. Some of us have mastered zoom and team meetings. Some of us are still learning. Importantly, we have worked together.

As we look back on the past 12 months, I want to take a moment to say thank you. Thank you to every individual, community group, business and volunteer that has helped us all get to where we are. It is due to the outstanding support of funding partners, and the dedicated efforts of oh so many amazing individuals that make up Reef Check Australia that we are able to continue to do what we all love; better understand, appreciate and work to protect our marine ecosystems. I am truly thankful to be surrounded by such an amazing team, and community. Thank you to each and every one of you for your support, kind words and dedication to our reefs and oceans.

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

A big 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, GO Dive Brisbane, Subsurface Scuba and Kirra Dive.

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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 2020-2021 season. Teams of trained volunteers monitored a total of 32 locations on 18 different reefs, which included survey sites ranging from Mudjimba Island on the Sunshine Coast to Cook Island south of the Gold Coast. Of these 32 locations, 6 reefs are surveyed twice annually (Mud Island – Coral Galore and Rubble Patch; St Helena Island – Palindrome and Ray of Sunshine; Green Island – North and West), all remaining sites are only surveyed once per annum. 12,800m^2 of reef habitat was surveyed in total during the 2020-2021 season (where one survey covers 400m^2), resulting in more than 7000 pieces of data collected, and more than 1,200 hours donated by trained volunteers.

Image 1A Resident schools of fish – Mudjimba Island

Image 1B Moray eel – Currimundi Reef

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 2020-2021 survey season due to a down-turn in funding resources. Survey site locations are documented in Table 1 below and those not surveyed in 2020-2021 are shown in *italics*.

Table 1. List of all RCA survey reefs in South East Queensland by Sub-region. Reefs not visited during the 2020-2021 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		

Faced with uncertainty on the survival of coral reefs due to increased impacts from climate change, scientists are investigating ways of creating heat resistant corals (e.g. Buerger *et al.* 2020) to provide options for the survival of reefs into the future. Subtropical reefs such as those in South East Queensland are therefore likely to become increasingly important habitats with potential poleward range shifts in marine organisms (Beger *et al.* 2014) without the capacity to rapidly adapt to increasing ocean temperatures and acidification. However these reefs are also subject to thermal stresses in subtropical and endemic species (Cant *et al*. 2020).

The reefs of South East Queensland have demonstrated resilience over the years of monitoring conducted by Reef Check Australia. Whilst percentages of hard and soft corals and algae have fluctuated from year to year (or season to season in Moreton Bay), none of the areas surveyed regularly have shown significant long term loss of coral cover, with the exception of Kings Beach. This area was heavily impacted by floods in 2011 and coral cover on transect has not recovered to pre-flood levels (Figure 2.7.1). However numerous hard corals were observed in the shallows during the most recent survey so we hope this is a pre-cursor to overall improvement in this area.

Continued monitoring is important in these habitats to constantly monitor change, positive or otherwise, else we risk the force of shifting baseline syndrome. As stated by Callum Roberts;

"this tendency (of shifting baseline syndrome) renders each new generation blind to past losses, setting their personal baseline of normality by what they first find"

1.1 MONITORING SITES

In the 2020-2021 season, RCA monitored sites along the SEQ coast from Mudjimba Island off the Sunshine Coast all the way to Cook Island south 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 18 reefs surveyed, seven were within the Moreton Bay Marine Park.

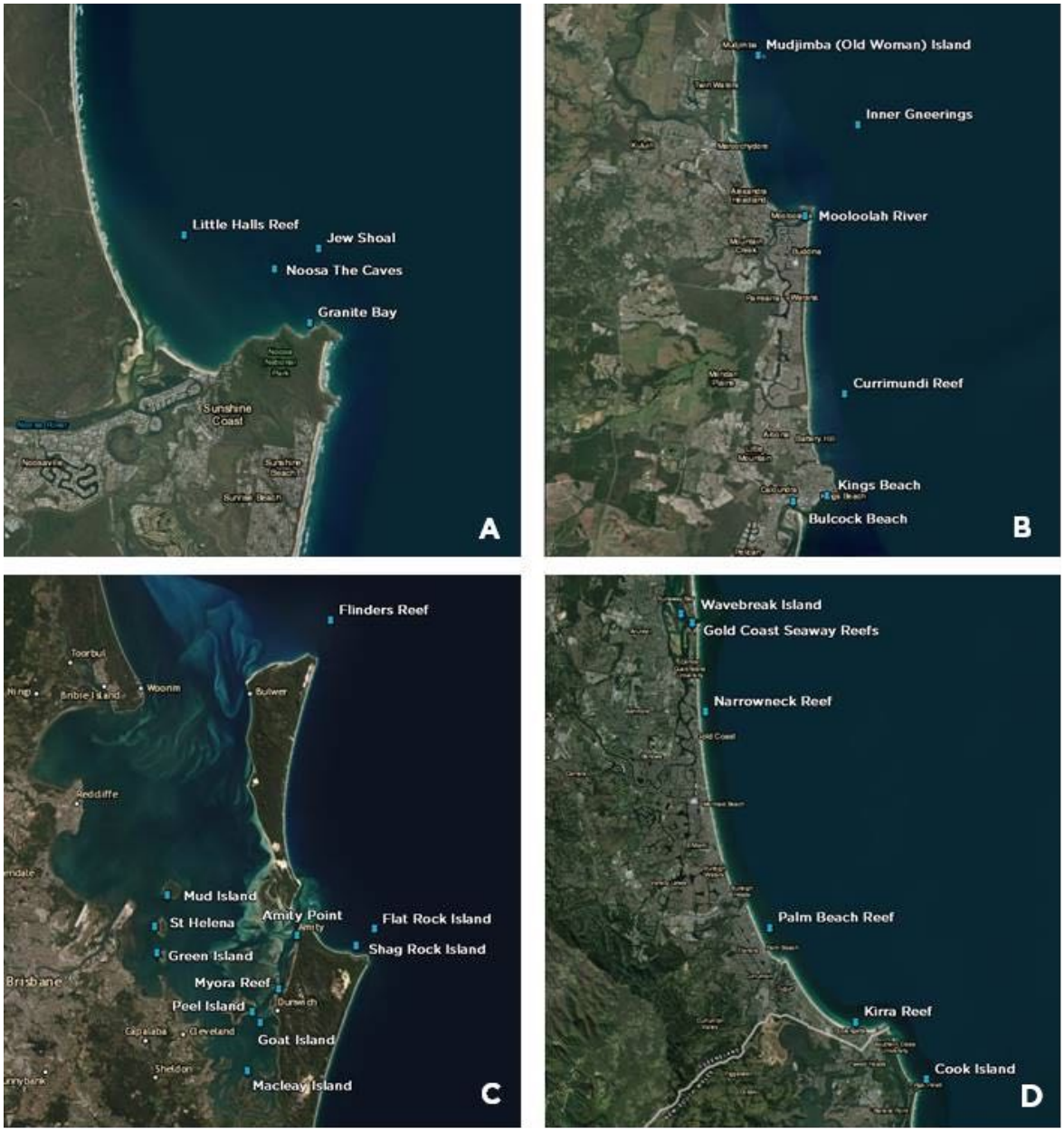


Figure 1: Map of South East Queensland survey sites from Google Earth, A: Noosa; B: Sunshine Coast; C: Moreton Bay; D: Gold Coast. Note that Noosa, Flinders Reef and a number of inner and outer Moreton Bay sites were not surveyed this season.

Table 2: Table of RCA monitoring locations from Mudjimba Island to Gold Coast visited in the 2020-2021 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	Green Island, North	5	2015	CP, Ramsar
Inshore Moreton Bay	1	Green Island, West	5	2017	CP, 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	St Helena, Palindrome	5	2018	MNP, Ramsar
Inshore Moreton Bay	1	St Helena, Ray of Sunshine	5	2018	MNP, Ramsar
Outer Moreton Bay	1	Shag Rock, East	9	2008	HP
Outer Moreton Bay	1	Shag Rock, West	9	2009	HP
Outer Moreton Bay	1	Flat Rock, Shark Gulley	9	2009	MNP
Outer Moreton Bay	1	Flat Rock, The Nursery	9	2008	MNP
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 Reef	9	2007	
Gold Coast	2	Palm Beach Reef	9	2009	
Gold Coast	1	Wavebreak Island	9	2019	
Gold Coast	1	Narrowneck Reef	9	2007	
Gold Coast	1	Kirra Reef	5	2016	
Gold Coast	1	Cook Island	7	2019	Aquatic Reserve

1.2 KEY FINDINGS FROM 2020-2021 SURVEYS:

The 2020-2021 season included surveys at 32 monitoring locations.

1.2.1 SUBSTRATE

Of the 32 locations surveyed, most remained relatively stable in hard coral cover. Twelve locations had decreases of less than 10%, six locations had increases of less than 10%, with the remainder showing no change. One site showed an increase in hard coral cover greater than 10% (Inner Gneerings, Site 1 – 11%). Soft coral remained relatively stable, with increases above 10% at Currimundi Reef (Site 1 - 9%, Site 2 – 12% and Site 3 – 17%) and Mudjimba Island (Northwest Reef – 12%). Soft coral decreased at one location (Inner Gneerings, Site 1 – 10%).

Image 1.2.1A Mudjimba Island (Gary Cranitch)

Image 1.2.1B Happy surveyors

Hard coral cover ranged from 0% found at Bulcock Beach, Gold Coast Seaway South West Wall & The Pipe; Kirra Reef; Mooloolah River; Narrowneck Artificial Reef and Wavebreak Island to 46% at Mudjimba Island, North West Reef. The average hard coral cover across all surveyed locations was 15% (not including sites with no hard coral recorded). This overall regional average is consistent with previous years.

The most predominant substrate type recorded across all 32 survey sites was rock, attributing to 36% 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). Silt accounted for the second most abundant substrate, with 26%, sand made up 18%, whilst soft coral made up 10%. These percentages are based on the number of sites on which these substrate categories were recorded. High levels of silt were detected at St Helena Palindrome (72% during the summer survey), Mooloolah River – 55% and the Gold Coast Seaway (The Pipe – 57%, South-west Wall – 54%).

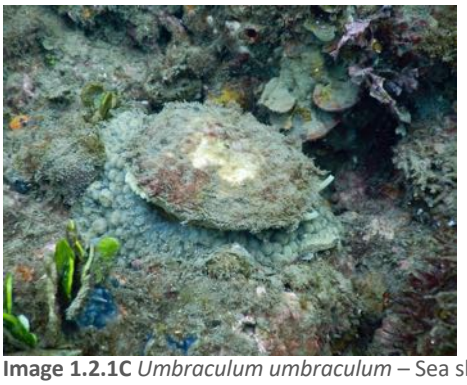


Image 1.2.1C *Umbraculum umbraculum* – Sea slug

1.2.2 IMPACTS: CORAL BLEACHING

Coral bleaching was recorded on 21 of the 32 survey sites (66% of survey sites) which is a slight reduction from 2020 (69%) and a continuing downward trend from previous years (73% of the sites in 2019, 77% in 2018 and 86% in 2017). On average, 4% of the coral population was affected, with individual colonies suffering an average of 18% surface bleaching. Again, these levels are slightly lower than those recorded in 2020 (15% of the population and 24% for individual colonies). Of the regions, Outer Moreton Bay sites (Flat Rock and Shag Rock) had the highest population bleaching, with an average of 14.25% 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 on the Sunshine Coast. Mudjimba, The Ledge, Site 2 exhibited the highest percentage of coral bleaching, but at only 2% of the population. Bleaching ranged from 0.5% to 2.25% of the population, whilst individual colonies ranged from 9.5% to 47% of the surface bleached.

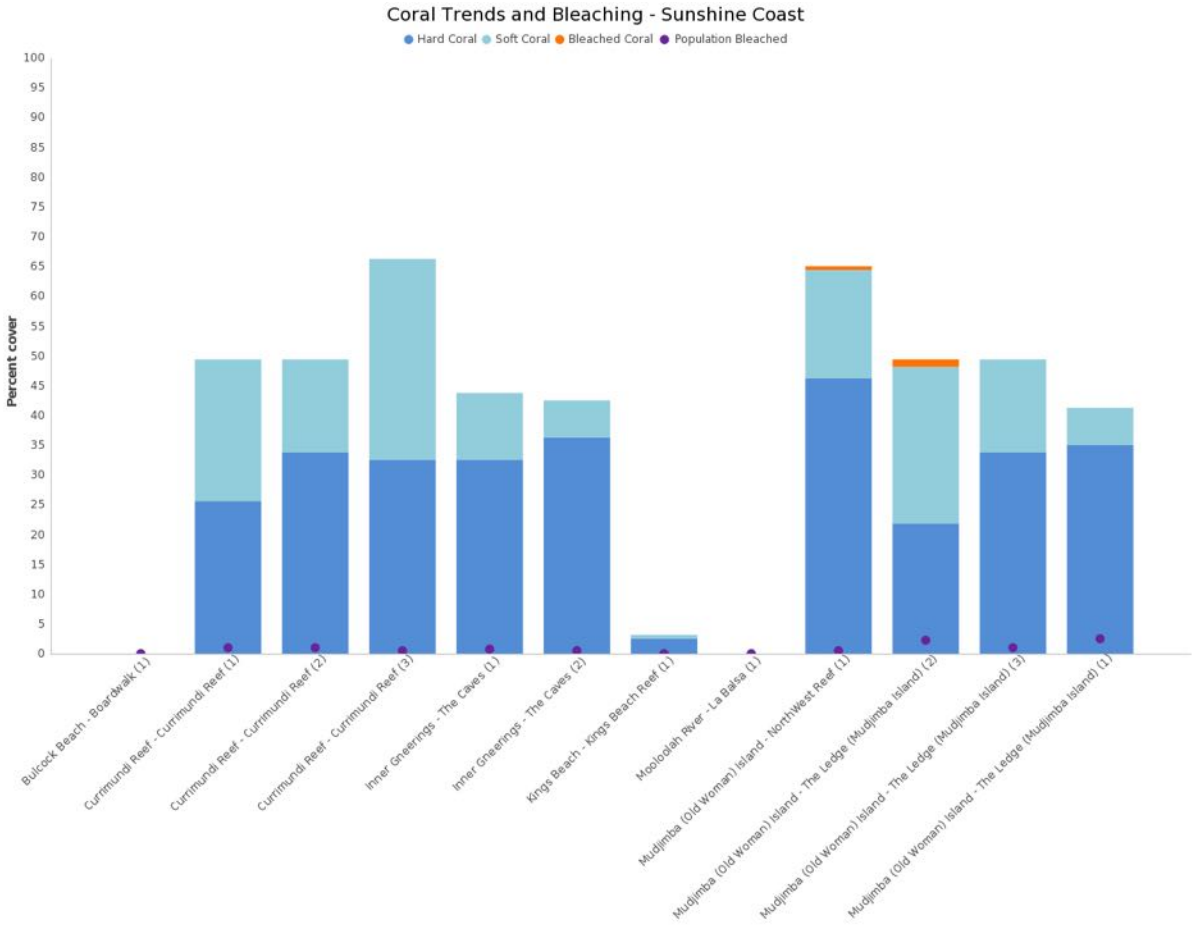


Figure 2: Percent cover of hard coral (blue), soft coral (light blue) and bleached coral (orange) for current survey year at Sunshine Coast Reef Check Australia reef health monitoring locations, as per point-intercept substrate surveys for benthic composition. Percentage of the coral population exhibiting 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 remained reasonably consistent at the majority of sites in Inner Moreton Bay, with most sites that are surveyed twice a year reporting higher levels of hard coral in winter compared to summer. Levels of bleaching remain low at all sites.

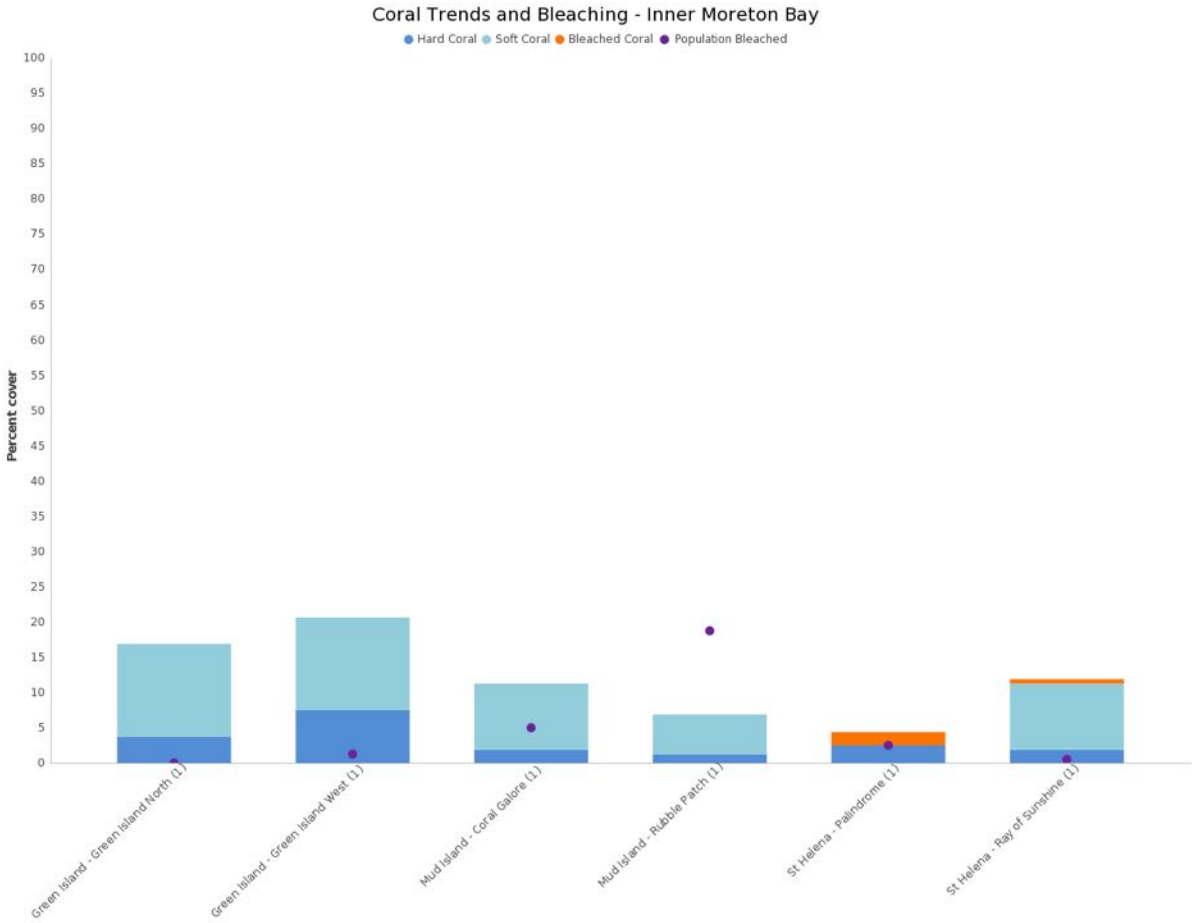


Figure 3: Percent cover of hard coral (blue), soft coral (light blue) and bleached coral (orange) for current survey year at Inner Moreton Bay Reef Check Australia reef health monitoring locations, as per point-intercept substrate surveys for benthic composition. Percentage of the coral population exhibiting bleaching (purple dot) as documented on belt transect survey for reef health impacts, is included where available.

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 increases on the previous survey at Flat rock-Shark Gulley and Shag Rock East. Shag Rock West exhibited the highest percentage of coral bleaching, with 27.5% of the population affected.

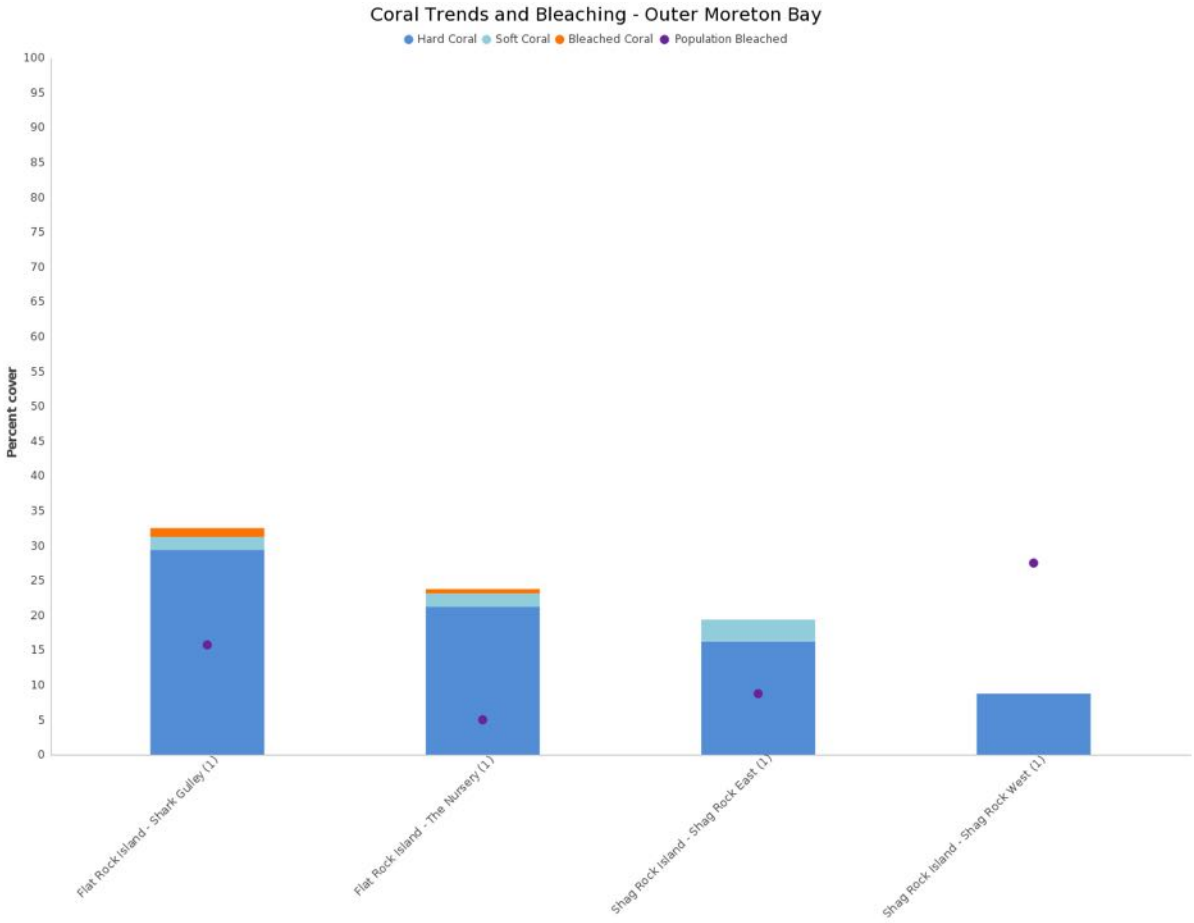


Figure 4: Percent cover of hard coral (blue), soft coral (light blue) and bleached coral (orange) for current survey year at Outer Moreton Bay Reef Check Australia reef health monitoring locations, as per point-intercept substrate surveys for benthic composition. Percentage of the coral population exhibiting 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 and Cook Island. There was a slight decrease in hard coral recorded at Palm Beach and Cook Island, with increases in bleached coral colonies noted at Palm Beach, although the percentage of the population bleached remains low.

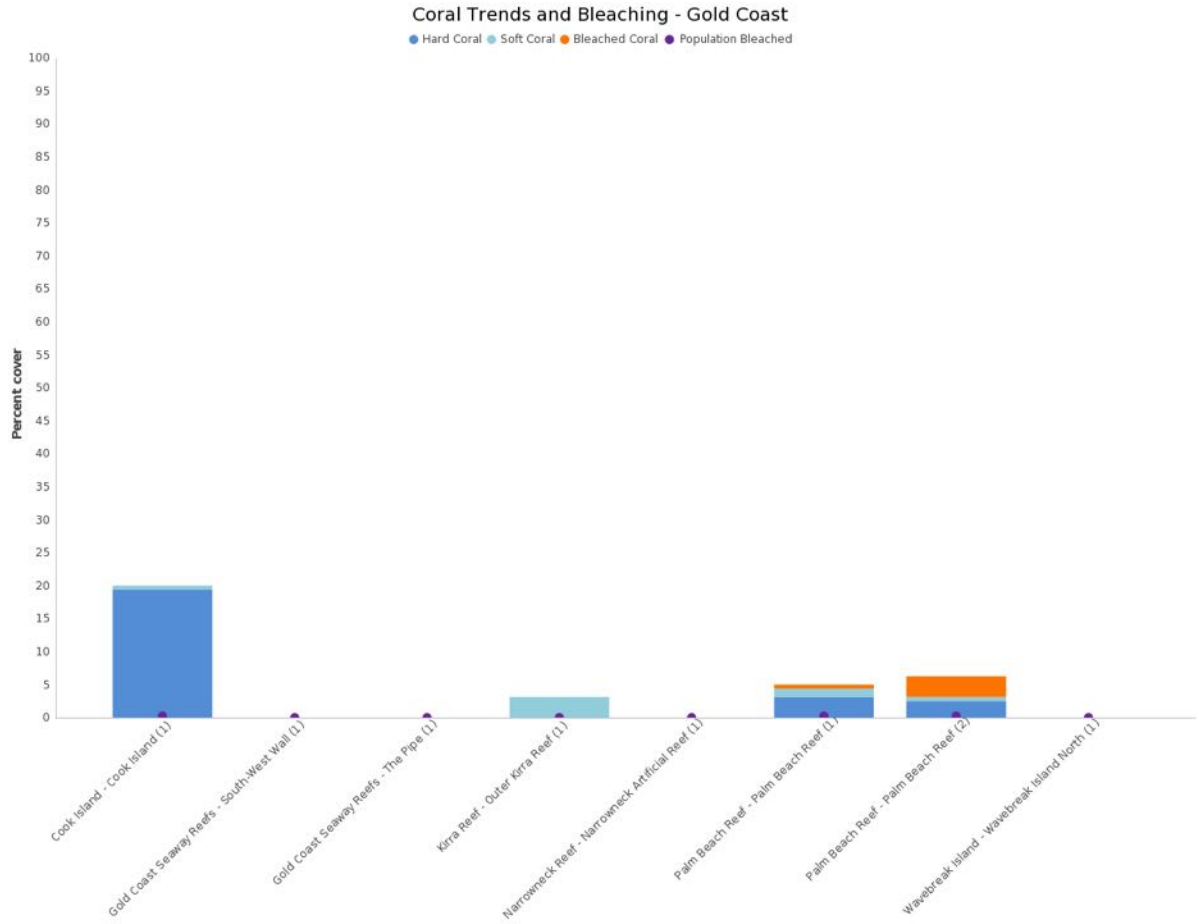


Figure 5: Percent cover of hard coral (blue), soft coral (light blue) and bleached coral (orange) for current survey year at Gold Coast Reef Check Australia reef health monitoring locations, as per point-intercept substrate surveys for benthic composition. Percentage of the coral population exhibiting 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 15 of the 32 survey sites. The highest recordings for coral damage was at Mudjimba Island The Ledge S3 with a count of 27 incidences, followed by Flat Rock – The Nursery at 21 incidences. Inner Gneerings – The Caves S1 recorded 19 incidences. A total of 132 incidences of coral damage were recorded this season, which is slightly lower than last season.

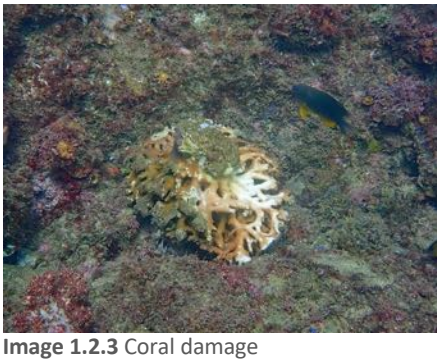


Image 1.2.3 Coral damage

1.2.4 IMPACTS: CORAL DISEASE

A total of 75 incidences of coral disease were recorded during the season. Of these, the highest recording (17) was at Mud Island, Rubble Patch during the summer surveys.

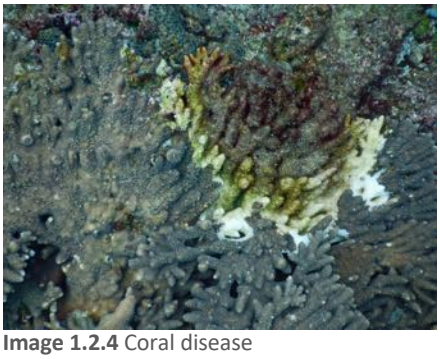


Image 1.2.4 Coral disease

1.2.5 IMPACTS: MARINE DEBRIS

There were 454 incidences of marine debris recorded this season, primarily fishing debris. The highest recordings of marine debris was 161 and this was found at Bulcock Beach. Gold Coast Seaway reefs recorded 64 and 53 and Mooloolah River 44 incidences.

Image 1.2.5 Trash

1.2.6 IMPACTS: CORAL SCARRING

Only 135 scars were recorded this season, slightly down from 141 last season. Unknown scars accounted for 90 of the scars and *Drupella* accounted for the remaining 45. The highest recording of unknown scars (27) and *Drupella* scars (15) was at Mudjimba Island The Ledge S3.

Tables 3 and 4 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 Inner Moreton Bay in 2020-2021 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. a 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	2	22.5	M	0	0	131	20	0	0	0	0
Currimundi S1	25.6	23.8	0	0	N	1	0	1	0	0	0	0	0
Currimundi S2	33.7	15.6	0	0	N	1	0	0	0	0	0	1	1
Currimundi S3	32.5	33.8	0	0	N	0.50	2	0	1	0	2	0	4
Inner Gneerings S1	32.5	11.3	17	10.6	M	0.75	9	1	0	0	19	1	4
Inner Gneerings S2	36	6	34	21.3	N	0.50	1	7	0	0	1	2	7
Kings Beach	2.5	0.6	16	37.5	M	0	0	2	0	0	0	0	0
Mooloolah River	0.0	0	47	30	M	0	0	24	20	0	0	0	0
Mudjimba Island, North West S1	46.3	18.1	0	0	N	0.50	0	3	0	0	12	0	7
Mudjimba Island, The Ledge S1	35	6.2	0	19	N	2.50	1	3	0	0	8	0	4
Mudjimba Island, The Ledge S2	21.9	26.3	2	1.25	L	2.25	0	0	1	0	1	4	1
Mudjimba Island, The Ledge S3	33.8	15.6	0	31.8	N	1	3	5	0	0	27	15	27
INNER MORETON BAY													
Amity S1	0.6	0.0	0	0	M	0	0	17	2	0	0	0	0
Amity S2	6.3	1.3	0	0	M	0	0	32	6	0	0	0	0
Green Island, North, Site 1 (Summer)	1.9	10.6	65	59.4	M	3.75	0	0	1	0	0	0	0
Green Island, North, Site 1 (Winter)	3.8	13.1	2	19.4	L	1	0	0	1	0	0	0	0
Green Island, West (Summer)	4.4	18.1	52	50	H	1.25	1	0	2	0	0	0	0
Green Island, West (Winter)	7.5	13.1	13	13.8	M	0.75	0	0	3	0	3	0	1
Mud Island, Coral Galore (Summer)	0.6	12.5	40	25	L	5	12	0	0	0	0	0	0
Mud Island, Coral Galore (Winter)	1.9	9.4	5	24.4	L	0.5	0	2	0	0	0	0	0
Mud Island, Rubble Patch (Summer)	0	0	69	43.1	M	18.8	17	3	1	0	18	0	0
Mud Island, Rubble Patch (Winter)	1.2	5.6	14	35.6	N	0	0	2	2	0	0	0	0
St Helena, Palindrome (Summer)	0.6	3.1	43	26.9	M	2.5	2	0	3	0	0	0	0
St Helena, Palindrome (Winter)	2.5	0	3	12.5	M	0.5	0	1	9	0	0	0	0
St Helena, Ray of Sunshine (Summer)	6.9	11.9	54	53.8	M	0.5	6	0	0	0	0	0	0
St Helena, Ray of Sunshine (Winter)	1.9	9.4	7	23.1	L	0.75	0	0	0	0	0	0	0

Table 4: Summary table of RCA monitoring findings for surveys conducted in Outer Moreton Bay and Gold Coast in 2020-2021 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. a 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 (#)
OUTER MORETON BAY													
Shag Rock, East	16.3	3.1	0	1.2	L	8.8	4	1	0	0	3	9	3
Shag Rock, West	8.8	0	3	1.2	L	27.5	6	0	0	0	2	0	0
Flat Rock, Shark Gulley	29.4	1.9	13	18.8	L	15.8	3	0	0	0	5	1	3
Flat Rock, The Nursery	21.3	1.9	3	3.1	N	5	1	0	2	0	21	7	13
GOLD COAST													
GC Seaway, SW Wall	0	0	0	0	H	0	0	47	6	0	0	0	0
GC Seaway, The Pipe	0	0	0	0	M	0	0	62	2	0	0	0	0
Palm Beach S1	3.1	1.3	0	1.2	N	0.25	1	0	3	0	0	2	2
Palm Beach S2	2.5	0.6	0	0.6	N	0.25	0	2	0	0	3	2	3
Narrowneck Reef	0	0	32	20.6	N	0	0	0	0	0	0	0	0
Wavebreak Island	0	0	0	0	N	0	0	5	3	0	0	0	0
Kirra Reef	0	3.1	56	39	L	0	0	0	0	0	0	0	0
Cook Island	19.4	0.6	0	0	L	0.25	5	0	0	0	7	1	10

1.2.7 INVERTEBRATE ABUNDANCE

Invertebrate surveys were carried out at all locations visited. The most abundant indicator invertebrate were urchins, with 457 individuals recorded in the 2020-2021 season. The vast majority of these were recorded at Cook Island (106), Palm Beach S1 (95), Palm Beach S2 (83) and Shag Rock West (43) and included long-spine (*Diadema* spp.) urchins, pencil urchins and collector urchins.

Drupella snails were the second most abundant invertebrate with a total of 382 recorded. The highest numbers recorded were at Kings Beach (64) and Palm Beach S1 (41). Anemones totalled 365, with 152 recorded at Palm Beach S1 and 90 at Palm Beach S2.

Across the 32 survey sites, seven banded coral shrimp, 11 lobsters, 17 giant clams and two *Trochus* snails were recorded. No Crown of Thorns Starfish (COTS), target sea cucumbers or tritons were recorded on transect during the 2020-2021 survey season.

Image 1.2.7A Collector urchin

Image 1.2.7B Anemone

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 240 sightings across all surveys. The highest number recorded was 25 at Amity Point S2. Also recorded were 34 sweetlips, 31 parrotfish, 16 snapper, 15 moray eels and four grouper.

1.2.9 RARE ANIMALS

Many rare animals were sighted during the surveys this season, some of which include wobbegong sharks, stingrays, turtles, seahorses, bamboo shark and octopuses.

Image 1.2.9 Whale spotted off Mooloolaba on the way to our survey 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. The site is a nursery for a variety of fish species in the area.

Rock (50%) was the dominant substrate recorded at this site (Figure 2.1.1), double last year but less than 2019. This survey also saw a significant increase in the sponge category with 26% compared to 9% in 2019. Nutrient indicator algae attributed 21% to the substrate, whilst sand attributed less than 1%, down from the 27% in the previous survey. A low level of silt was recorded on the transect. There were no ascidians recorded on transect in contrast to the last survey.

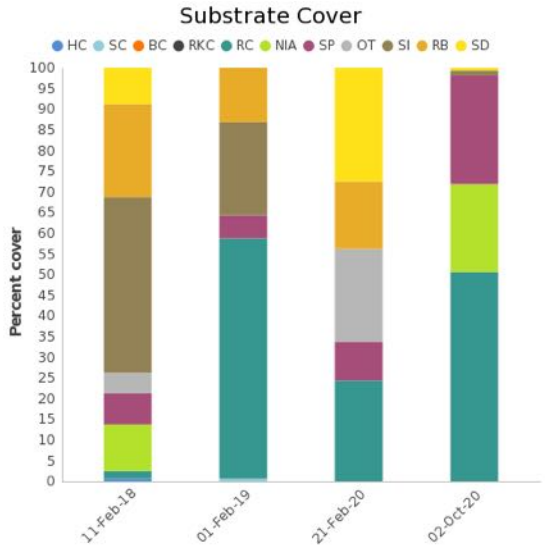


Figure 2.1.1 Benthic type and percentage cover, Bulcock Beach, The Boardwalk, Site 1, 2018-2020

One hundred and sixty-one items of marine debris were recorded; primarily fishing debris. General rubbish items were also recorded. This included a metal plate, lots of bottles, an iphone, broken pieces of fishing rods and an entire fishing rod. This is a significant increase on items recorded in the previous season (29).

Two collector urchins and a small lobster were recorded on the invertebrate survey. During the fish survey, 13 butterfly fish, one grouper, one moray eel and two snapper were recorded.

Image 2.1A Site photograph

Image 2.1B Discarded fishing net

Image 2.1C Octocoral

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 44% of the substrate (including rock with turf algae and rock with coralline algae). Hard coral made up 26% of the total substrate, slightly lower than the 2020 survey (Figure 2.2.1). Soft coral attributed 24% to the substrate composition (up 10% from 2020), with the balance being other (4%), sponge (1%) and sand (1%). Turf algae was the dominant algae, with silt not recorded.

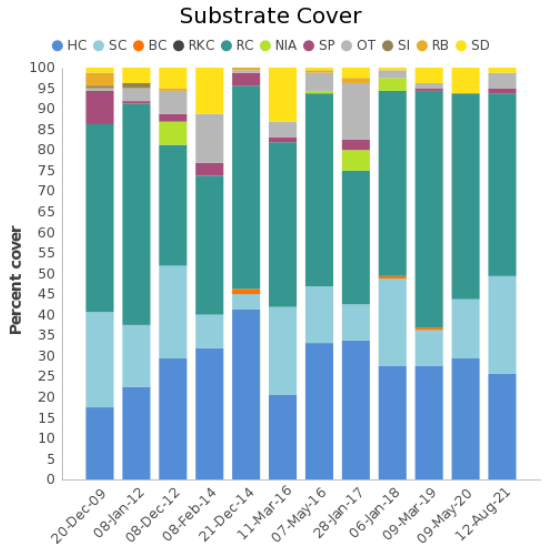


Figure 2.2.1 Benthic type and percentage cover, Currimundi Reef, Site 1, 2009-2021

Bleaching affected less than 1% of the total coral population with an average of 9% of any individual colony being bleached. Coral disease and coral damage were not recorded on the impact survey. Only one item of marine debris (fishing lure) was recorded.

One anemone (without fish), one giant clam, one lobster and five *Drupella* snails were observed on the invertebrate survey. A fish survey was conducted and 14 butterflyfish and two snapper were recorded.

Image 2.2A Site photograph

Image 2.2B Giant clam

Image 2.2C Bleached hard coral

2.3 CURRIMUNDI REEF, SITE 2

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

Rock made up 41% of the substrate (including rock with turf algae and rock with coralline algae), however hard coral made up 34% of the total substrate, which is higher than the 2020 survey (Figure 2.3.1). Soft coral attributed 16% to the substrate composition (12% more than 2020), with the balance being sponge (4%), other (2%), recently killed coral (2%) and rubble and sand at less than 1% each. Turf algae was the dominant algae.

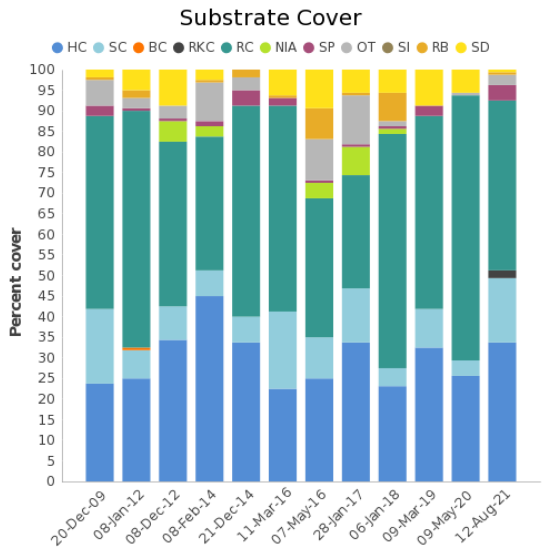


Figure 2.3.1 Benthic type and percentage cover, Currimundi Reef, Site 2, 2009-2021

Bleaching affected less than 1% of the total coral population with an average of 17% of any individual colony being bleached. One unknown scars and one *Drupella* scar were recorded on the impact survey. Items of marine debris were not recorded.

One anemone with fish, and two without and three *Drupella* snails were observed on the invertebrate survey.

A fish survey was conducted and three butterfly fish were recorded on transect.

Image 2.3A Site photograph

Image 2.3B Unknown scar

Image 2.3C Anemone and fish

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 32% of the substrate at this site, whilst soft coral made up 34% of the substrate, an increase from 2020 (Figure 2.4.1). Rock attributed 27% to the substrate composition, with the balance being sponge (4%), sand (2%) and other (anemones)(1%). Turf algae and *Rhodophyta* were the dominant algae.

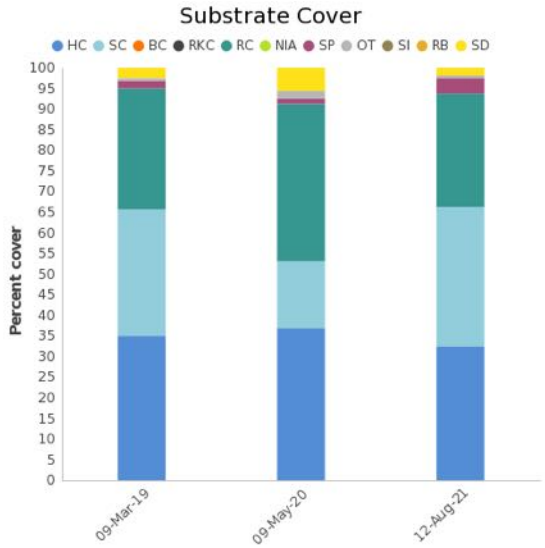


Figure 2.4.1 Benthic type and percentage cover, Currimundi Reef, Site 3, 2019-2021.

Bleaching affected less than 1% of the total coral population with an average of 16% of any individual colony being bleached. Two incidences of coral disease were observed, whilst four unknown scars, and two incidences of unknown damage were recorded on the impact survey. Only one item of marine debris (anchor) was observed on transect.

Although lower than 2020, seven anemones with fish, and 22 without, were recorded. One small giant clam and four *Drupella* snails were also observed on the invertebrate survey.

A fish survey was conducted and 12 butterfly fish (a reduction from 28 in 2020) and one sweetlip were recorded.

Image 2.4A Site Photo

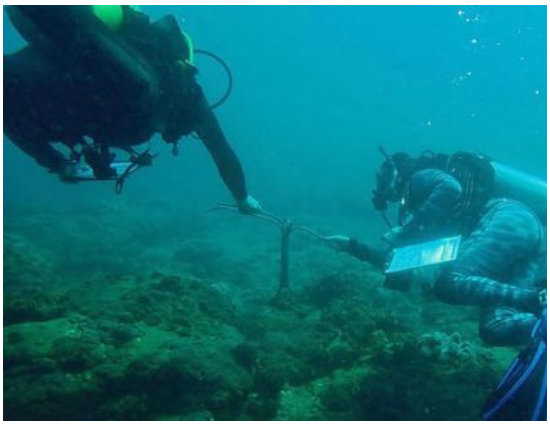


Image 2.4B Anchor removal – photo: Rachel McVeigh

Image 2.4B Giant Clam

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 (50%) was the dominant substrate but hard coral increased from 2019 to 32%. Soft coral (11%) was lower than the previous survey. Sponge attributed 2% to the substrate, sand; 4% and rubble 1% (Figure 2.5.1). Macroalgae was recorded on three of the four transects, predominately *Asparagopsis* sp.

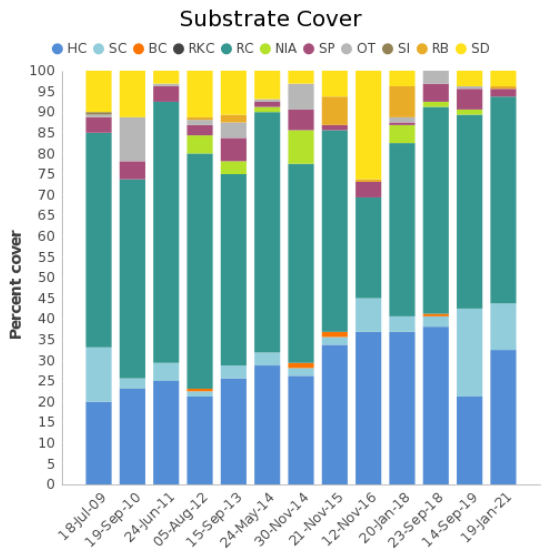


Figure 2.5.1 Benthic type and percentage cover, Inner Gneerings: The Caves, Site 1, 2009-2021

Seven *Drupella* snails and two anemones (one with fish) were recorded during the invertebrate survey.

Coral bleaching affected 1% of the total coral population, with an average of 17% of each colony showing surface bleaching. Except for unknown scars, impacts recorded increased from the previous survey.

Four scars of unknown origin, nine instances of coral disease, one *Drupella* scar, 19 instances of coral damage and four pieces of fishing line debris were recorded.

A fish survey was conducted and 11 butterfly fish, were recorded.

Image 2.5A Dominant algae – *Asparagopsis* sp.

Image 2.5B Black Butterflyfish

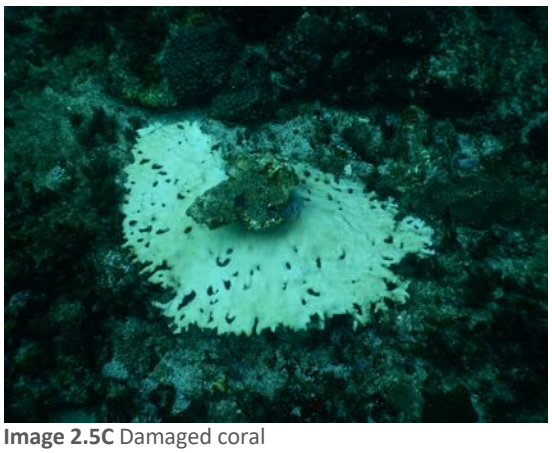


Image 2.5C Damaged coral

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 52% of the substrate (including rock with turf algae and rock with coralline algae). Hard coral made up 36% of the total substrate, with soft coral at 6% (Figure 2.6.1). Sponge (3%), sand (1%) and other (1%) made up the balance of the substrate composition. Turf algae and *Asparagopsis* were the dominant algae, with *Asparagopsis* returning to previous levels.

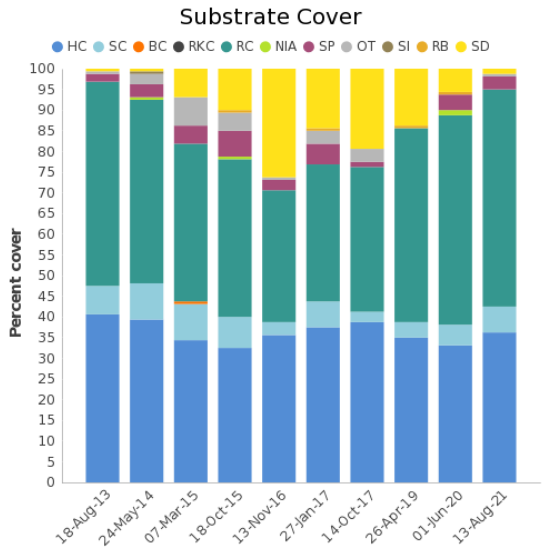


Figure 2.6.1 Benthic type and percentage cover, Inner Gneerings: The Caves, Site 2, 2013-2021.

Bleaching affected less than 1% of the total coral population with an average of 30% of any individual colony being bleached. Coral disease was observed on one coral colony, whilst two *Drupella* scars and seven unknown scars were recorded on the impact survey. Marine debris was limited to seven incidences of fishing line.

Three *Drupella* snails and one giant clam were observed on the invertebrate survey.

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

Image 2.6A Site photo

Image 2.6B *Drupella* snail and scar

Image 2.6C Dominant algae - Asparagopsis

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, however monitoring efforts have shown signs of recovery of the site over time. Continued monitoring is required to document potential changes in the future.

Rock (44%) was the dominant substrate followed by nutrient indicator algae (27%). Other (ascidians and halimeda) made up 11% of the benthos (Figure 2.7.1). Several hard and soft corals were seen during the survey, however they attributed just 3% and 1% of the total substrate respectively, due to the patchy nature of their occurence. Sand made up 14%. Sixteen counts of macroalgae were recorded, however levels of *Asparagopsis* were lower than in previous years.

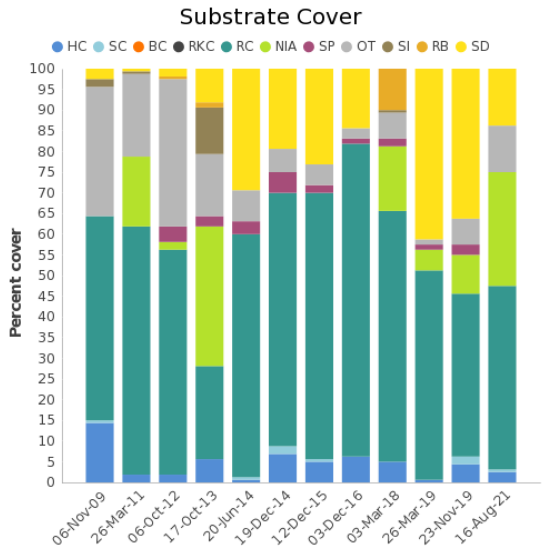


Figure 2.7.1 Benthic type and percentage cover, Kings Beach, 2009-2021

Coral bleaching was not observed, nor were other impacts to the corals. Only two items of marine debris were recorded on transect.

Sixty-four *Drupella* snails and two small trochus shells were recorded during the invertebrate survey. A fish survey was conducted and two sweetlips were recorded, although other non-target fish were also observed.

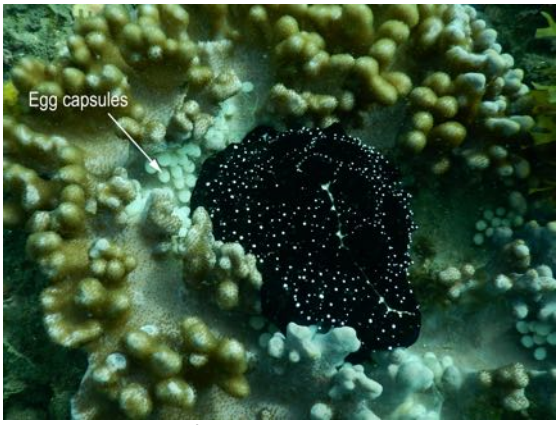


Image 2.7A Cowrie laying eggs

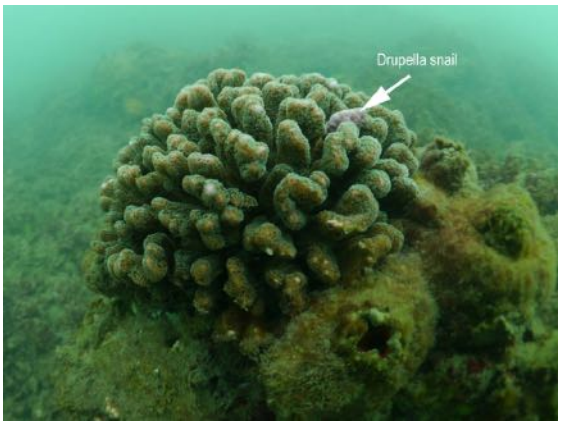


Image 2.7B Hard coral with *Drupella* snail

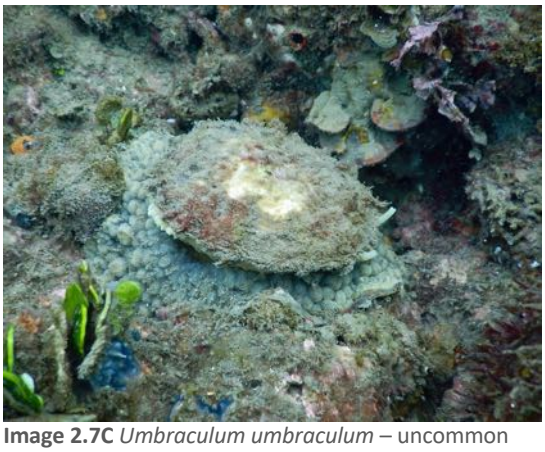


Image 2.7C *Umbraculum umbraculum* – uncommon species of sea slug.

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 has become a popular diving location for locals and visitors alike due to its easy access and protection from the wind. It is dominated by rock and sand, but levels of hard and soft corals have noticeably decreased with none recorded on transect this survey.

Levels of silt have increased to 55%, up from 23%. Rock at 32% and sand at 11% made up the other major substrate groups with nutrient indicator algae recorded at just under 1% (Figure 2.8.1). Several foliose and encrusting hard corals were seen on the transect, however were not captured within the substrate survey. Sponges and soft corals were not recorded during this survey. Forty seven counts of macroalgae were recorded (*Padina* and *Sargassum*), an increase from 2019.

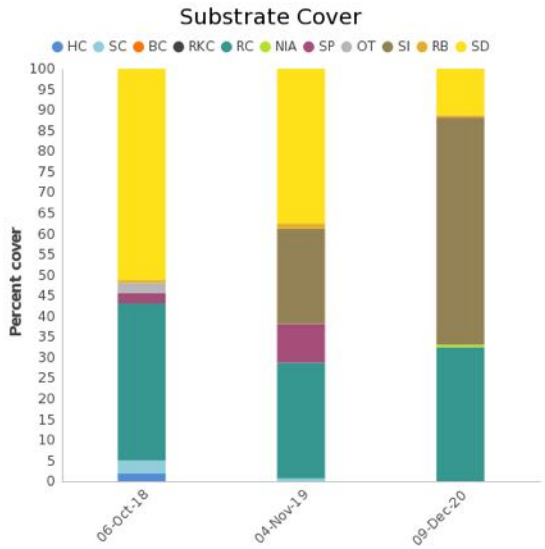


Figure 2.8.1 Benthic type and percentage cover, Mooloolah River, La Balsa North, 2018-2020.

Impacts to coral were not recorded due to the absence of coral. However, 254 pieces of fishing line debris and 20 pieces of general trash (including one anchor) were recorded.

One banded coral shrimp, and three juvenile lobster were recorded during the invertebrate survey. A fish survey was conducted, and five butterfly fish and one snapper were recorded. Numerous Bream and one stick pipefish were observed during the survey.

Image 2.8A Stick Pipefish

Image 2.8B Small hard coral and dominant algae

Image 2.8C Juvenile painted crayfish

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.

Hard coral was the dominant substrate (46%), followed by rock (28%) (Figure 2.9.1). Soft coral attributed 18% to the substrate, and increase from previous years, with sand (5%), other (1%), sponge (1%) and bleached coral (1%) making up the rest. Turf algae was the dominant algae.

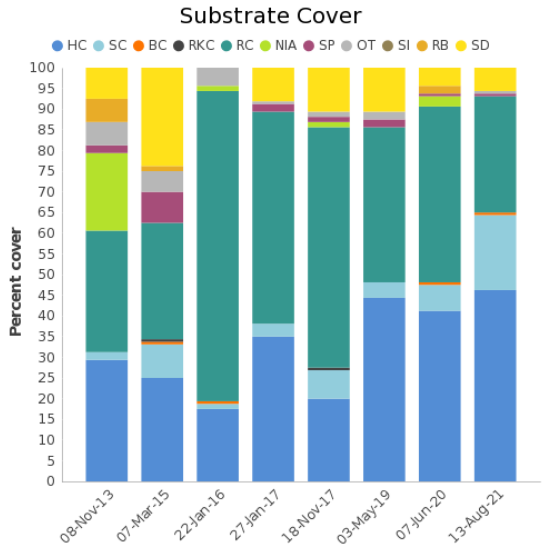


Figure 2.9.1 Benthic type and percentage cover, Mudjimba Island, Northwest Reef, Site 1, 2013-2020.

Coral bleaching was estimated to affect less than 1% of the total coral population, with an average of 9% per individual colony. Unknown coral damage was lower with 12 incidences recorded. Only seven unknown scars, two items of fishing line and one of general debris were recorded.

One anemone without fish, six *Drupella* snails and one long-spined urchin were recorded. Additional anemones with fish were observed off-transect.

A fish survey was conducted and 15 butterfly fish, were recorded.

Image 2.9A Site photo

Image 2.9B Coral damage.

Image 2.9C Coral disease

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 (35%) was the dominant substrate; followed by rock (34%) and nutrient indicator algae (19%). Soft coral (6%), other (corallimorphs and ascidians) (3%), sand (2%) and sponge (1%) made up the balance of the substrate (Figure 2.10.1).

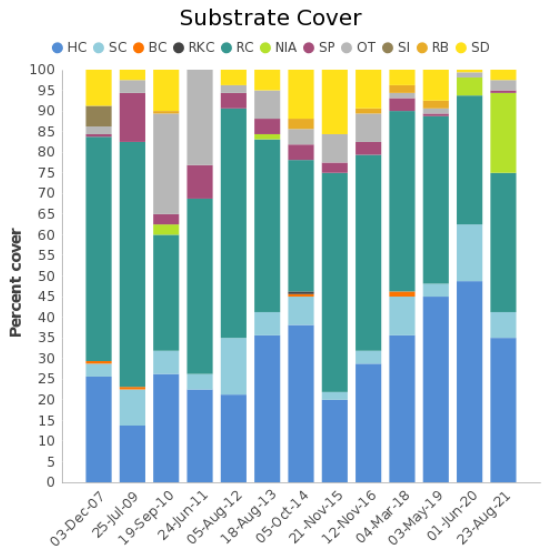


Figure 2.10.1. Benthic type and percent cover: Mudjimba Island, The Ledge, Site 1, 2007- 2021.

Coral bleaching affected 2% of the total coral population, with an average of 16% of each colony showing surface bleaching.

Eight incidences of damage of unknown origin, one of disease and four incidences of scars of unknown origin were recorded, along with three observations of fishing line and no general trash.

Only one anemone without fish was recorded on the invertebrate survey. This is down from 35 in 2020, although that year appeared to be an anomaly. *Drupella* snails were lower than 2020 with 14 recorded. A fish survey was conducted and six butterflyfish were recorded. Several turtles and wobbegong sharks were also observed.

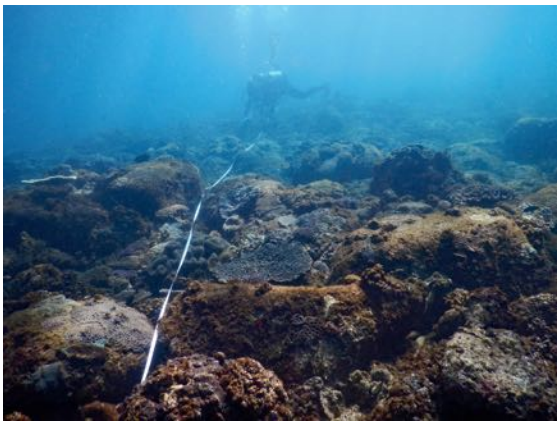


Image 2.10A Site photo

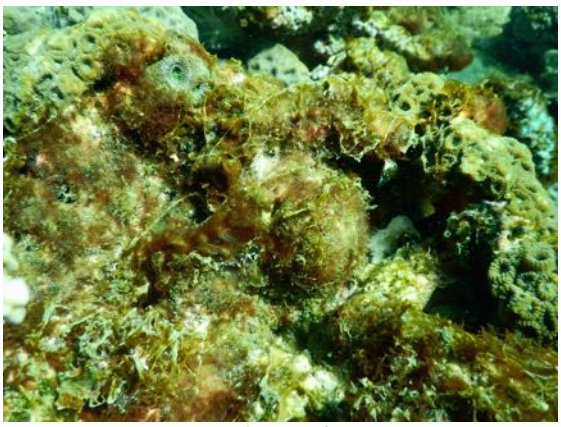


Image 2.10B Nutrient indicator algae

Image 2.10C Turtle

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.

Rock (48%) was the dominant substrate; a significant increase from the previous survey (17%) followed by soft coral (26%) and hard coral (22%) (Figure 2.11.1). Sponge attributed 2% to the substrate and bleached coral 1%. Two instances of macroalgae were recorded on the transect.

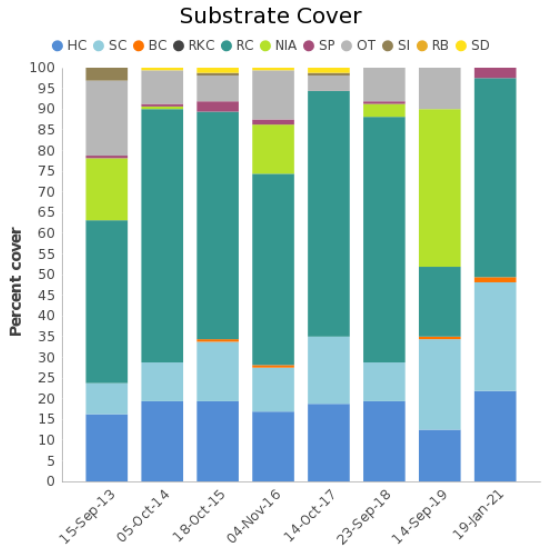


Figure 2.11.1 Benthic type and percentage cover, Mudjimba Island, The Ledge, Site 2, 2013-2021.

Coral bleaching affected 2% of the total coral population, with an average of 47% of each colony showing surface bleaching, an increase from the last survey.

Only one incidence of damage of unknown origin, one scar of unknown origin, four *Drupella* scars one piece of general trash and two pieces of fishing line were recorded.

One anemone, 2 banded coral shrimp and 15 *Drupella* snails were recorded on the invertebrate survey. A Triton shell was also observed off-transect. A fish survey was conducted and nine butterfly fish and two moray eels were recorded. Turtles were also observed.

Image 2.11A Triton shell

Image 2.11B Turtle

Image 2.11C *Bleached coral*

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 34% of the benthos, with nutrient indicator algae (NIA) making up 32%. This is a significant increase in NIA on previous years, with no or low levels recorded since 2016 when it made up 46% of the substrate. The remaining benthic cover constituents recorded were soft coral (16%), rock (14%), other (4%), and recently killed coral (<1%). Turf algae was the other dominant algae recorded.

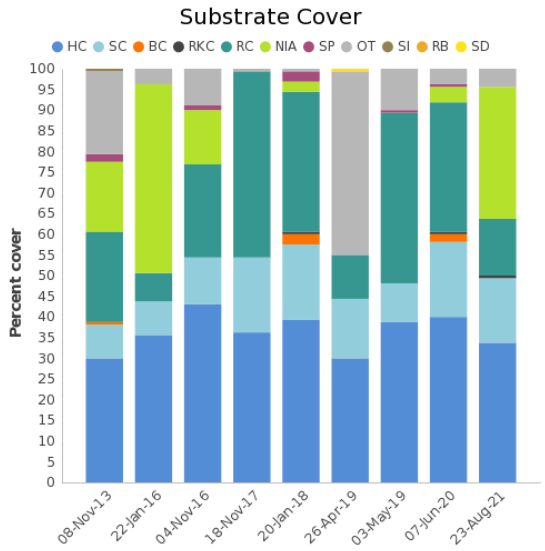


Figure 2.12.1 Benthic type and percentage cover, Mudjimba Island, The Ledge, Site 3, 2013-2021.

Coral bleaching affected <1% of the total coral population, with an average of 37% of the colony with surface bleaching.

Three incidences of coral disease, 27 of unknown damage, 27 unknown scars, 15 *Drupella* scars and five items of fishing line were recorded on the impacts survey.

On the invertebrate survey, three anemones with fish and 29 *Drupella* snails were recorded. A fish survey was carried out and two butterflyfish, and one parrotfish were recorded. However large numbers of eastern pomfred, bullseyes and yellow tail pike were present..

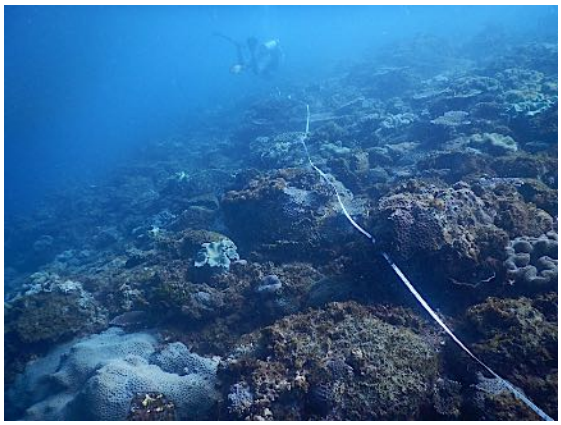


Image 2.12A Site photo

Image 2.12B Surveyor in action

Image 2.12C Mushroom 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 (76%) dominated the substrate followed by rock (15%). Silt increased to 8% and hard coral remained at 1% of the substrate (Figure 3.1.1).

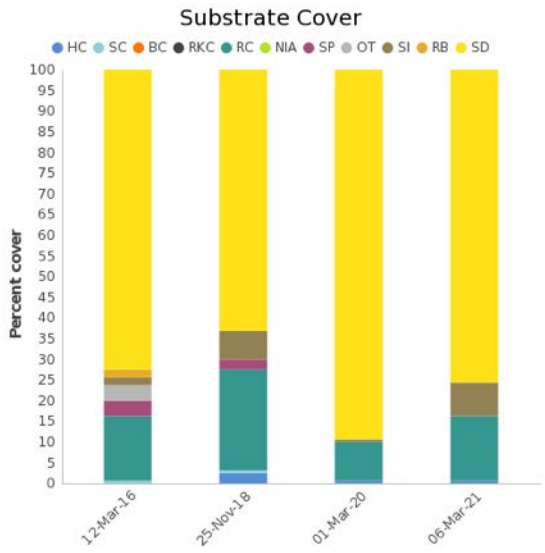


Figure 3.1.1. Benthic type and percent cover: Amity Point, Site 1, 2016- 2021.

Twenty-five urchins and three anemones were recorded during the invertebrate survey. The additional mostly small and mostly bleached anemones, some with fish, were observed in the same location as last survey, just off transect.

Coral bleaching was not observed on transect. Impacts observed during this survey were 17 counts of fishing line and two of general trash.

During the fish survey, six butterfly fish and two moray eels were recorded, with numerous wobbegong sharks observed.

Image 3.1A Small branching hard corals

Image 3.1B Moray eel and urchin

Image 3.1C Anemone with fish (off transect)

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 (42%) and silt (26%) were the dominant substrate followed by sand (15%). The balance of the substrate was made up from hard coral (6%), rubble (9%), soft coral (1%) and bleached coral (1%) (Figure 3.2.1).

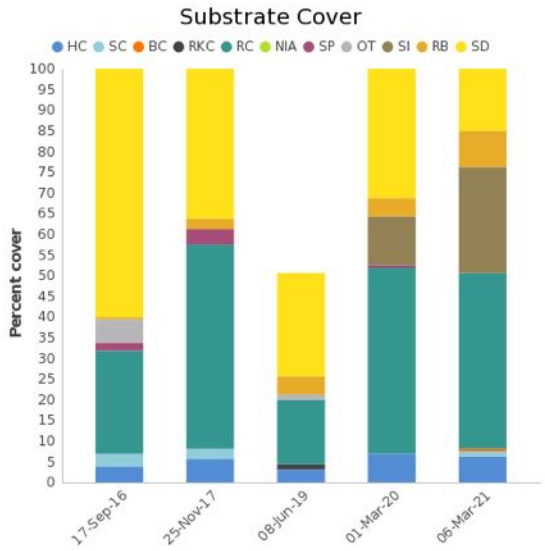


Figure 3.2.1. Benthic type and percent cover: Amity Point, Site 2, 2016- 2021.

Bleached coral was observed to be less than 1% the coral population. Thirty-nine urchins were recorded on the invertebrate survey, a decrease from previous surveys. The majority of urchins were recorded close to the boat ramp; within the first 20m of the transect. This area appears to provide the preferred habitat for this species at this location.

Thirty-two items of fishing line and six items of general trash were recorded. Other impacts were not observed during the impacts survey.

During the fish survey, one snapper, 25 butterfly fish and two moray eels were recorded, with wobbegong sharks and cuttlefish also observed.

Image 3.2A Hard coral

Image 3.2B Trash, urchins and hard coral

Image 3.2C Cuttlefish

3.3 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.

Rubble (25%) was the dominant substrate followed by rock (19%) and nutrient indicator algae (19%). Silt (15%), soft coral (11%), sand (9%) and hard coral (2%) made up the balance of substrate during the March 2021 (summer) survey. During the winter survey in July 2021, silt had reduced to 0%, with sand the dominant substrate at 42%. Rock was recorded at 20%, soft coral had increased slightly to 13%, with rubble down to 2%. Nutrient indicator algae was still at 18% whilst hard coral increased to 4% (Figure 3.3.1).

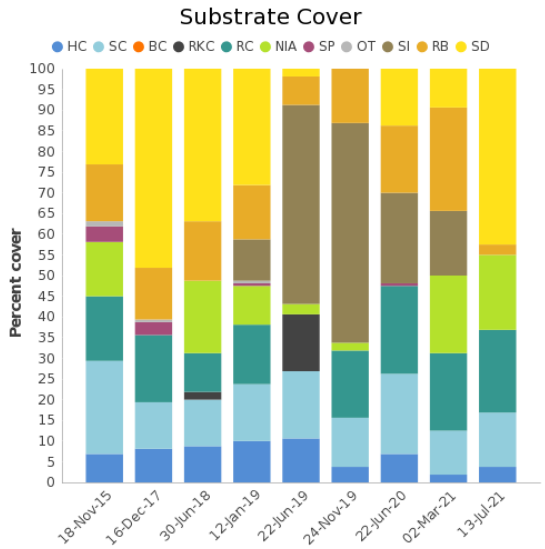


Figure 3.3.1. Benthic type and percent cover: Green Island North, Site 1, 2015 - 2021

In March 2021, 3.75% of the coral population was recorded as bleached, but this decreased to 1% in July 2021.

Coral damage was not recorded on either survey and only one item of marine debris was recorded on each survey. One *Drupella* snail recorded in the March survey and 14 *Drupella* snails recorded in the July survey were the only invertebrates observed.

Fish surveys were conducted with no target fish recorded in March 2021, however in July 2021 one butterflyfish and one parrotfish were recorded. However non-target fish were observed utilising the habitat.

Image 3.3A Site photo

Image 3.3B Massive hard coral

Image 3.3C Surveyor in action

3.4 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 (19%) was the dominant substrate followed by soft coral (18%), nutrient indicator algae (18%) and sand (16%). Rubble (13%), hard coral (4%), sponge (4%) and silt at 8% made up the balance of substrate during the March 2021 survey. Sand (51%) dominated the substrate in July 2021. Rock (21%) and soft coral (13%) were the next dominant categories. Hard coral at 8% was an increase from the summer survey and a decrease in rubble to 2% made up the balance (Figure 3.4.1).

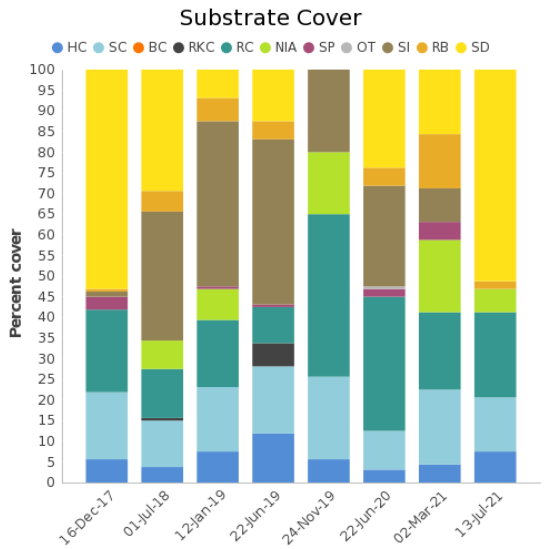


Figure 3.4.1. Benthic type and percent cover: Green Island West, Site 1, 2017 - 2021

Coral bleaching averaged 11% of each colony observed as bleached, with an average of 1% of the coral population bleached in March 2021. This increased to an average of 37% of each colony in July 2021 but remained at 1% of the coral population.

One count of coral disease and two counts of marine debris were recorded during the summer survey, whilst three counts of damage, one unknown scar and three items of general trash were recorded in winter. One butterflyfish and one parrotfish were recorded during the summer survey, and two butterflyfish, one parrotfish and three snapper were observed in winter.

Image 3.4A Site photo

Image 3.4B Massive hard coral

Image 3.4C Soft coral

3.5 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 3.6).

Surprisingly rubble made up 48% of the substrate in February 2021 (an increase from previous surveys). Sand attributed 22% of the total substrate followed by rock (16%) and soft coral (13%), with hard coral and silt at <1% each. During the winter survey Rock (40%) was the dominant substrate, followed by nutrient indicator algae (21%), sand (13%), rubble (12%), and soft coral (9%). Hard coral contributed 2% with sponge and other just over 1% each. (Figure 3.5.1).

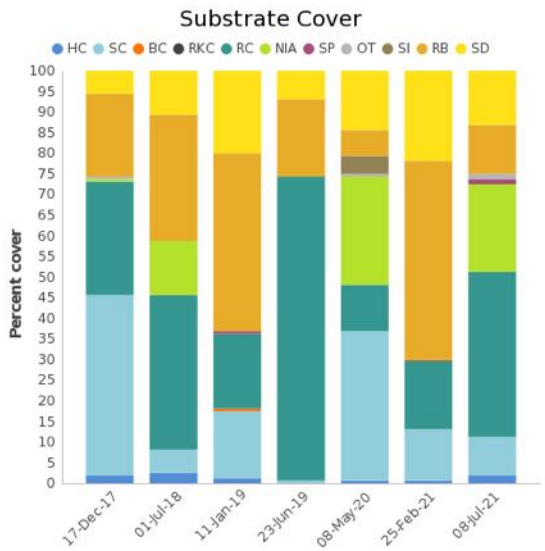


Figure 3.5.1. Benthic type and percent cover: Mud Island, Coral Galore, 2017 - 2021

Bleaching averaged 25% of coral colonies and 5% of the coral population during summer, decreasing to 10% of colonies and 1% of population in winter. Twelve incidences of coral disease were recorded in summer with one item of marine debris recorded in winter.

Twenty-eight *Drupella* snails were recorded in summer, with four recorded in winter.

Fish surveys were conducted and 19 butterfly fish, one grouper, one moral eel and one parrotfish were recorded in summer. Only three butterflyfish were recorded in winter.

Image 3.5A Site photo

Image 3.5B Soft coral and sea slugs

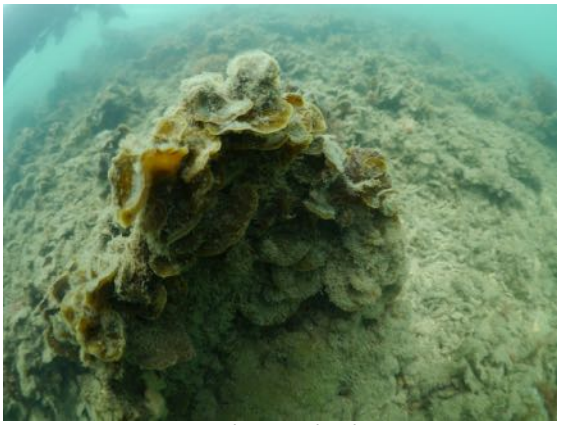


Image 3.5C Dominant algae - *Lobophora*

3.6 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 and soft coral were not detected on substrate transect during the summer survey, but were observed within the impacts transect belt. Rubble made up 85% of the substrate, with sand making up 13%. Rock at 2% made up the balance in summer. During the winter survey, rock dominated at 31%, followed by nutrient indicator algae (27%). Rubble made up 21%, sand 11%, with soft coral at 6%, other at 3% and hard coral just over 1%. (Figure 3.6.1).

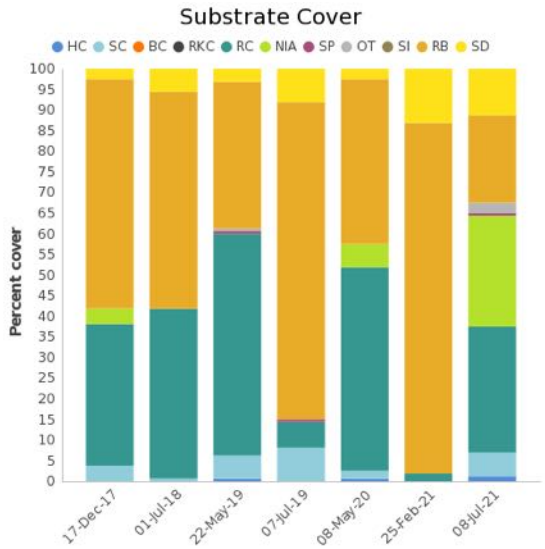


Figure 3.6.1. Benthic type and percent cover: Mud Island, Rubble Patch, 2017 - 2021

Bleaching averaged 15% of each colony and 18% of the population in summer. Eighteen incidences of unknown coral damage and 17 of disease were recorded on the impact survey and four items of marine debris. The only impacts recorded in winter were two items of fishing line and two of general debris. Bleaching was not observed. Two *Drupella* snails were observed in summer and seven in winter during the invertebrate survey.

Fish surveys were conducted and four butterflyfish and two snapper were recorded in summer, with three butterflyfish recorded in winter.

Image 3.6A Dominant algae

Image 3.6B Hard coral

Image 3.6C Marine debris - rope

3.7 ST HELENA, PALINDROME

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

Rubble dominated (74%) during the summer survey. Sand (11%), silt (9%), soft coral (3%), rock (2%) and hard coral at just under 1% made up the balance of the substrate. Silt dominated in winter (72%), with sand and nutrient indicator algae both contributing 11%. Rubble made up only 2%, bleached coral 2% and hard coral 2%.(Figure 3.7.1).

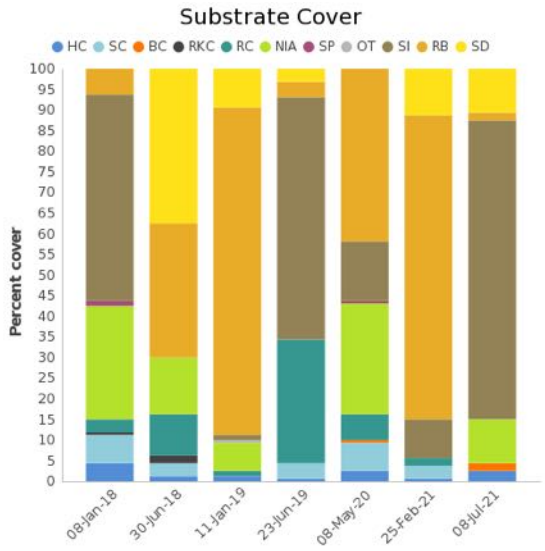


Figure 3.7.1. Benthic type and percent cover: St Helena Island, Palindrome, 2018 - 2021

Coral bleaching averaged 20% of coral colonies and 2% of the population in summer. Two incidences of disease and three items of marine debris were also recorded. Bleaching decreased to 2% of colonies and 1% of the population in winter. Ten items of marine debris were recorded.

Fish surveys were conducted and one parrotfish was recorded during the winter survey but wobbegong sharks and bream were observed during summer.

Image 3.7A Site photo

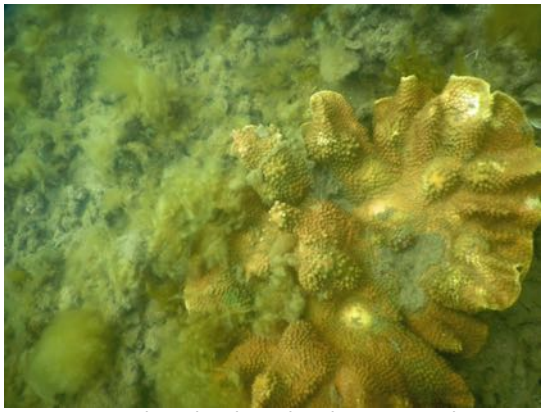


Image 3.7B Foliose hard coral and nutrient indicator algae

Image 3.7C Massive hard coral

3.8 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.

During the summer survey rubble made up 26% of the substrate, with nutrient indicator algae making up a further 20%. Sand attributed 19%, silt 13%, soft coral 12%, hard coral 7%, with rock at 2% and sponge at just under 1% making up the balance of the substrate. Sand (49%) dominated the winter survey, with rock and nutrient indicator algae both at 19%, whilst soft coral was lower than summer at 9% as was hard coral at 2%. Rubble and sponge both contributed less than 1% (Figure 3.8.1).

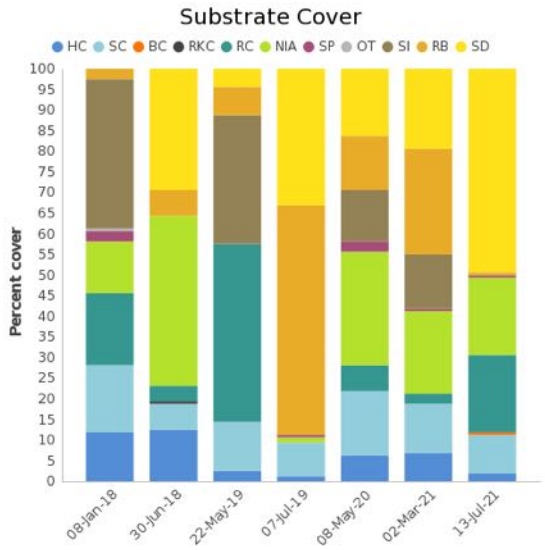


Figure 3.8.1. Benthic type and percent cover: St Helena Island, Ray of Sunshine, 2018 - 2021

Bleaching affected less than 1% of the total coral population with an average of 7% of any individual colony being bleached during summer, with six incidences of coral disease recorded. Bleaching increased to an average of 26% of individual colonies but remained at 1% of the population during winter. No other impacts were recorded during winter. One *Drupella* snail was recorded in summer and five in winter.

Fish surveys were conducted and four butterfly fish and four parrotfish were recorded in summer, with one parrotfish recorded in winter.

Image 3.8A Site photo

Image 3.8B Bleached hard coral

Image 3.8C Non-target pufferfish

4.0 OUTER MORETON BAY SITE

4.1 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.

Rock (64%) was the dominant substrate followed by hard coral (16%). Other (8%) and sand (4%) were followed by soft coral (3%), sponge (1%), rubble (2%) and nutrient indicator algae (2%) (Figure 4.1.1).

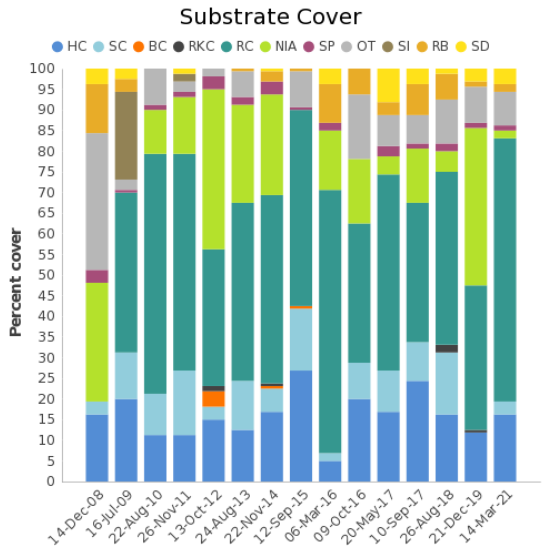


Figure 4.1.1. Benthic type and percent cover: Shag Rock Island East, 2008 - 2021

Coral bleaching was observed an average of 19% of individual colonies and 8% of the population.

Three incidences of coral damage, four incidences of coral disease, nine *Drupella* scars, three scars of unknown origin and one piece of marine debris were recorded during the impacts survey. Twenty-nine urchins, 14 anemones, four giant clams and 21 *Drupella* snails were recorded during the invertebrate survey.

During the fish survey, six butterfly fish and eight sweetlip were recorded, with wobbegong sharks, also observed.

Image 4.1A Site photo

Image 4.1B Wobbegong

Image 4.1C Stingray

4.2 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 (57%) was the dominant substrate followed by rubble (16%). Sand (15%) and hard coral (9%) were followed by other (2%) and recently killed coral (1%) (Figure 4.2.1).

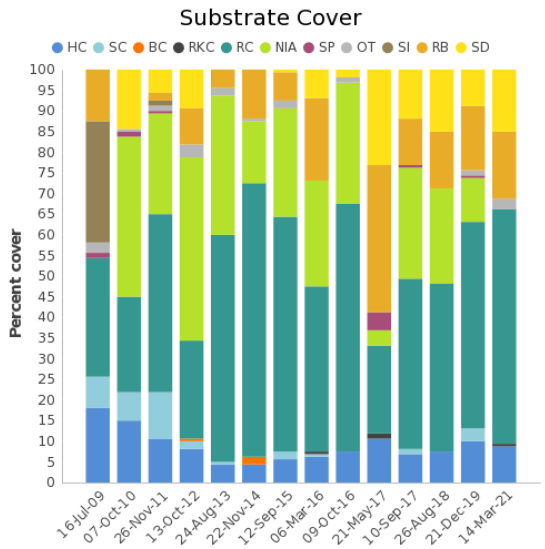


Figure 4.2.1. Benthic type and percent cover: Shag Rock Island West, 2008 - 2021

Coral bleaching was observed on average of 26% of individual coral colonies and 27% of the population.

Two incidences of coral damage and six incidences of coral disease were recorded on the impacts survey. Marine debris was not recorded

The invertebrate survey recorded 43 urchins, one anemone and 30 *Drupella* snails. One giant clam was also recorded.

During the fish survey, five butterfly fish, four sweetlip, one moray eel, two parrotfish and one snapper were recorded.

Image 4.2A Bleached coral

Image 4.2B Bamboo shark and Wobbegong shark

Image 4.2C Gold-spotted sweetlips

All photos by Rachel McVeigh.

4.3 FLAT ROCK, SHARK GULLEY

This site was established in 2009 and is comprised of rocky ridges and gullies with encrusting and branching hard corals and benthic invertebrates. It has a depth of 9m on the seaward side of the fringing reef, above a common gathering area for Grey Nurse Sharks.

Rock (52%) was the dominant substrate followed by hard coral (29%). Sponge, soft coral and rubble each contributed 2%. Bleached coral (1%) and other (1%) made up the balance of the substrate (Figure 4.3.1).

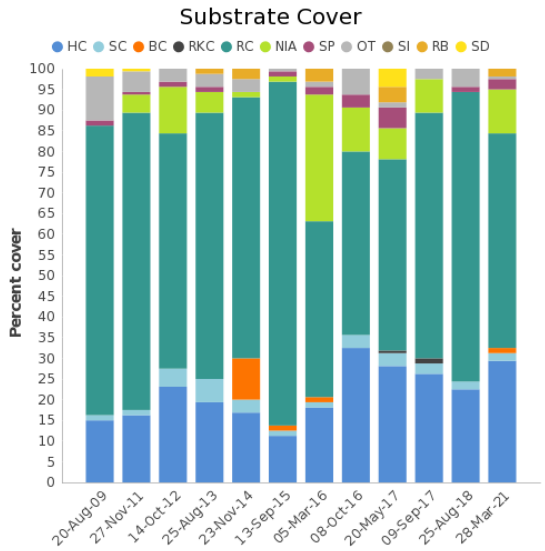


Figure 4.3.1. Benthic type and percent cover: Flat Rock, Shark Gulley, 2009 - 2021

Coral bleaching averaged 35% of the coral surface and 16% of the coral population.

Five incidences of coral damage, three incidences of coral disease, three unknown scars and one *Drupella* scar were recorded on the impacts survey. Marine debris was not recorded

The invertebrate survey recorded ten urchins, eight anemones, one lobster, ten *Drupella* snails and six giant clams.

During the fish survey, 13 butterfly fish, one sweetlip, one snapper and one parrotfish were recorded, with wobbegong sharks and octopus also observed.

Image 4.3A Site Photo

Image 4.3B *Drupella* scar and snails

Image 4.3C Octopus

4.4 FLAT ROCK, THE NURSERY

This site is on the leeward side of Flat Rock where the flat rocky slope meets the rocky boulders. It is a popular diving site and located within a fully protected marine park. The site sits at a depth of 6m and was established in 2008.

Rock (60%) was the dominant substrate followed by hard coral (21%). Rubble made up 7% and sponge 4%. Soft coral, recently killed coral, and other each contributed 2%. Nutrient indicator algae (1%) and bleached coral (1%) made up the balance of the substrate (Figure 4.4.1).

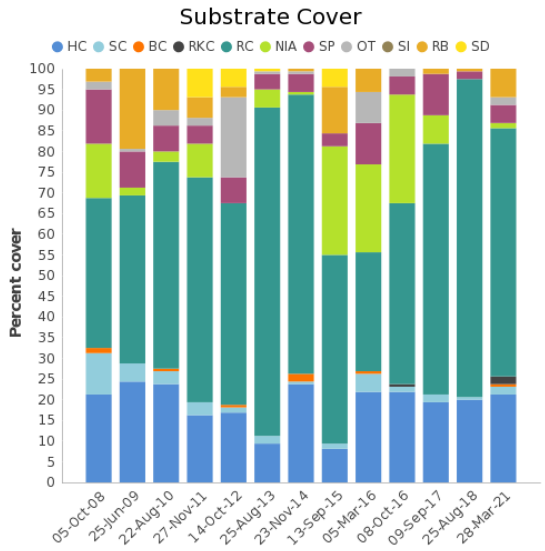


Figure 4.4.1. Benthic type and percent cover: Flat Rock, The Nursery, 2008 - 2021

Coral bleaching averaged 10% of the coral surface and 5% of the coral population.

Twenty-one incidences of coral damage, one incidences of coral disease, 13 unknown scars and seven *Drupella* scars were recorded on the impacts survey. Two items of marine debris were recorded.

The invertebrate survey recorded seven urchins, 13 anemones, 14 *Drupella* snails and three giant clams.

During the fish survey, nine butterflyfish, one sweetlip and one moray eel were recorded, with wobbegong sharks, bamboo sharks and octopus also observed.

Image 4.4A Site Photo

Image 4.4B Pencil urchin

Image 4.4C Soft corals

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 3% of the benthos, and soft corals 1% (Figure 5.1.1). Rock made up the majority of the substrate at 68%. Sand (19%), sponge (5%), other, nutrient indicator algae, bleached coral and recently killed coral at 1% each made up the balance.

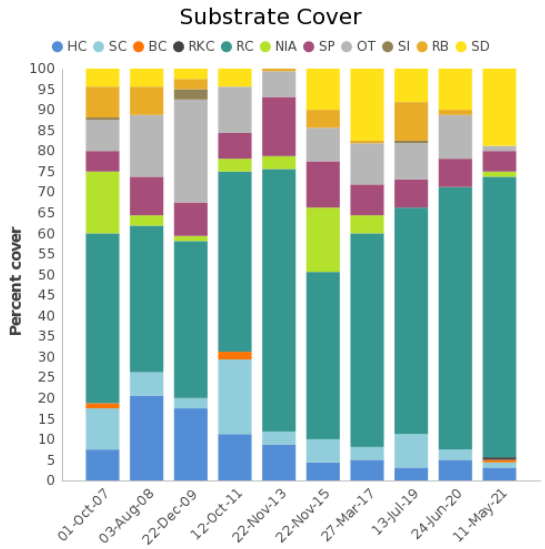


Figure 5.1.1. Benthic type and percent cover: Palm Beach Reef, Site 1, 2007 - 2021

Only one incidence of coral bleaching was recorded at an average of 5% of the coral surface. Two unknown scars, two *Drupella* scars and one incidence of coral disease were recorded. Three items of marine debris were recorded.

One hundred and fifty two anemones, 41 *Drupella* snails, two collector urchins, 45 *Diadema* urchins and 48 pencil urchins were recorded on the invertebrate survey. Twelve butterflyfish and three sweetlips were recorded on the fish survey. Numerous octopus were also observed.

Image 5.1A Octopus

Image 5.1B Urchin, anemone and hard coral

Image 5.1C Unknown scar

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.

Rock remained the dominant substrate at 79%. Hard coral accounted for 2% of the benthos and sponge 9% (Figure 5.2.1). Sand and bleached coral each made up 3%, with other at 2%, soft coral at 1% and nutrient indicator algae at 1% making up the balance of the substrate.

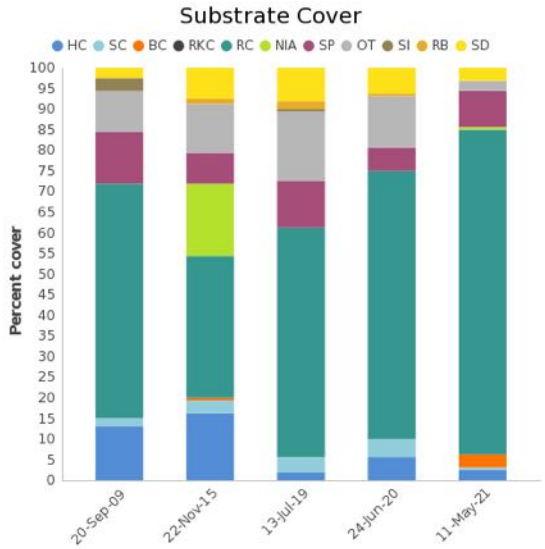


Figure 5.2.1. Benthic type and percent cover: Palm Beach Reef, Site 2, 2009 - 2021

Coral bleaching was only recorded on one transect with an average of 30% of the coral colony, and 1% of the population bleached. Two *Drupella* scars, three unknown scars and three incidences of coral damage were recorded. Two items fishing line were also recorded on the impacts survey.

Ninety anemones were recorded on the invertebrate survey, a reduction from 2019. One lobster, 24 *Drupella* snails, two collector urchins, 37 *Diadema* urchins and 44 pencil urchins were also recorded.

Target fish were limited to 13 butterflyfish, one sweetlips and one moray eel, but octopus and wobbegongs were also observed.

Image 5.2A Collector urchin

Image 5.2B Wobbegong

Image 5.2C *Hard coral with Drupella snails*

5.3 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.

Silt (54%) was the dominant substrate; followed by rock (27%), sand (19%) and rubble (1%) (Figure 5.3.1). This is a further increase in silt from 2020 and the highest level recorded at this site. Macroalgae was not recorded on the transect.

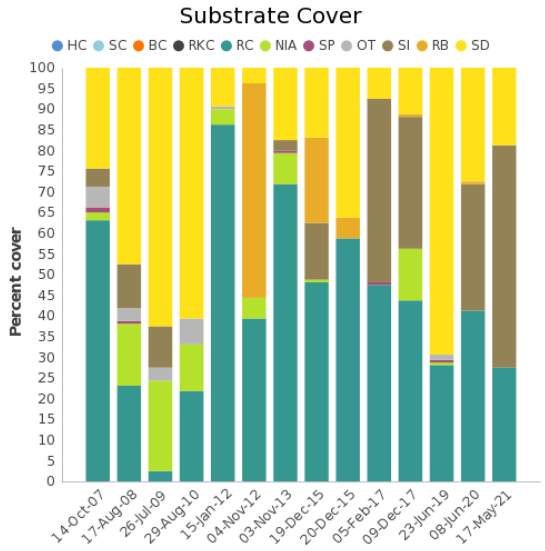


Figure 5.3.1. Benthic type and percent cover: Gold Coast Seaway, South-West Wall, 2007 - 2021

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

Fishing line again represented the largest impact, with 47 incidences recorded and six observations of general trash. During the invertebrate survey, four banded coral shrimp were recorded.

A fish survey was conducted and one butterfly fish, one moral eel, two snapper and one sweetlip were recorded. Large schools of tarwhine and luderick were also observed along with a number of nudibranchs observed on the hydroids.

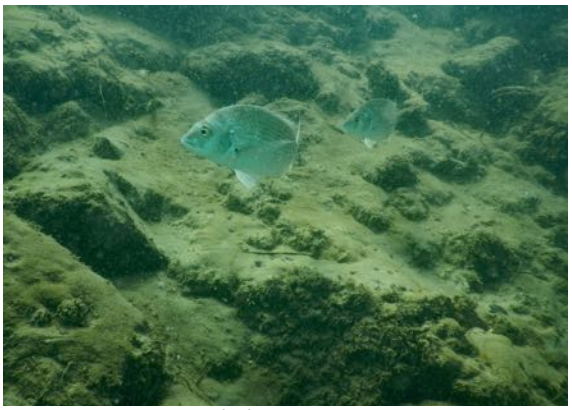


Image 5.3A Bream and silt

Image 5.3B Burrowing anemone

Image 5.3C Moray eel

5.4 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.

Silt (57%) was the dominant substrate; followed by sand (26%) and rock (17%) (Figure 5.4.1). This is an increase in silt from 2020 but comparable to 2019.

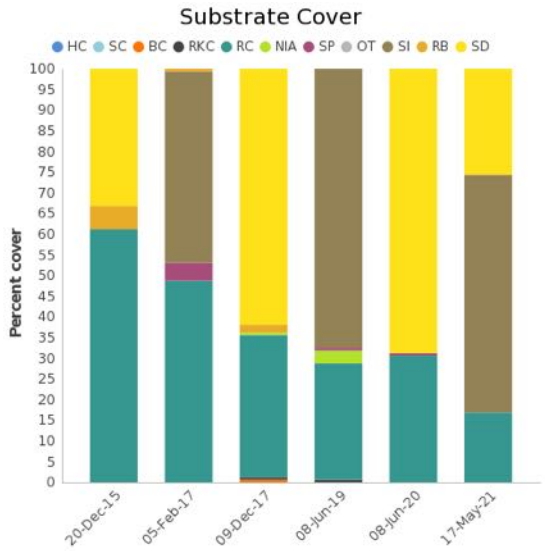


Figure 5.4.1. Benthic type and percent cover: Gold Coast Seaway, The Pipe, 2015 - 2021

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

Fishing line represented the largest impact, with 64 incidences recorded. General trash was limited to two items.

During the invertebrate survey, one juvenile lobster was recorded.

A fish survey was conducted and nine butterflyfish, one moral eel and one sweetlips were recorded.

Schools of small fish were observed amongst the rocks in this area.

Image 5.4A Site photo

Image 5.4B Hydroid with nudibranch

Image 5.4C Some of the removed fishing debris

5.5 NARROWNECK REEF; SITE 1

This artificial reef is characterised by high cover of macro algae over the geotextile bags. It has lots of fish life and lots of black crinoids. The site is sensitive to wave action due to its proximity to the shore and surf zone.

Sand (60%) was the dominant substrate; followed by rock (27%) and other (ascidians and crustose algae) (13%) (Figure 5.5.1).

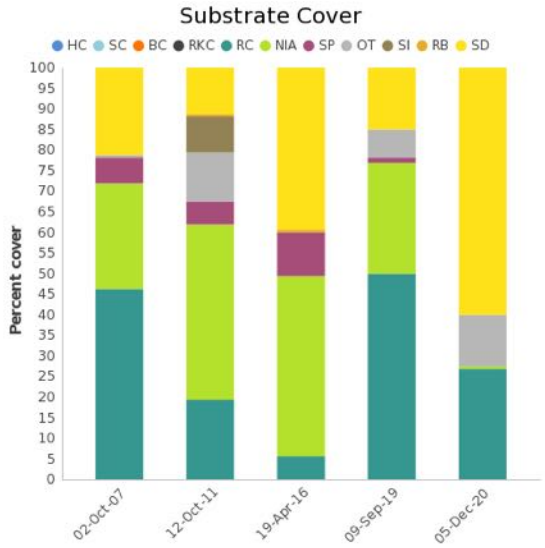


Figure 5.5.1. Benthic type and percent cover: Narrowneck Reef, 2007 - 2020

Coral bleaching was not recorded and coral was not recorded during the survey. The site is dominated by macro algae with sargassum, turf algae and dictyota being the most observed.

Impacts were not observed but during the invertebrate survey, one juvenile lobster was recorded.

A fish survey was conducted and only one butterflyfish was recorded, but several wobbegong sharks were observed along with numerous egg masses from the sea slug *Hydatina physis*.

Schools of small fish were also observed at the site.

Image 5.5A Site photo

Image 5.5B Featherstars

Image 5.5C Wobbegong shark

5.6 WAVEBREAK ISLAND; SITE 1

Wavebreak Island is located within the seaway. The site is a rocky scree starting at 5m, to a depth of around 12m. The site wraps around the end of the rock groin and is characterised by sponges, small corals and a variety of fish.

Rock (64%) was the dominant substrate; followed by sand (32%) and sponge (3%). Other contributed 1% (Figure 5.6.1).

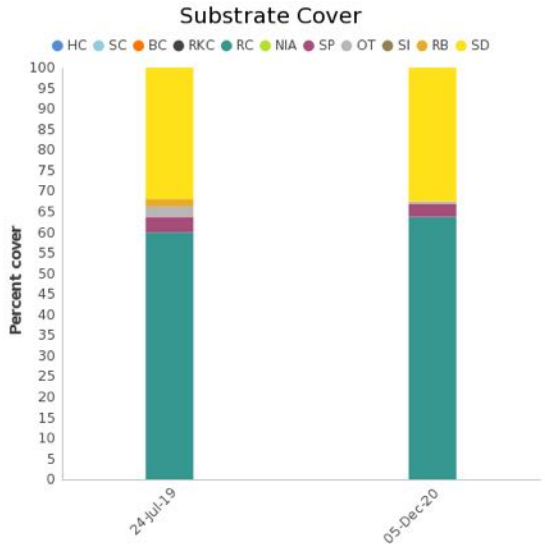


Figure 5.6.1. Benthic type and percent cover: Wavebreak Island, 2019 - 2020

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

Fishing line represented the largest impact, with five incidences recorded, including an entire fishing rod. General trash was limited to three items.

During the invertebrate survey, one juvenile lobster was recorded.

A fish survey was conducted and one butterflyfish and one moral eel were recorded.

Schools of bream were observed amongst the rocks in this area, particularly on the southern side of the rock wall.

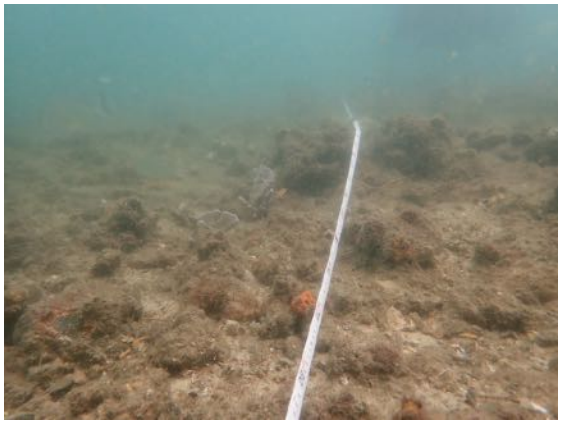


Image 5.6A Site photo

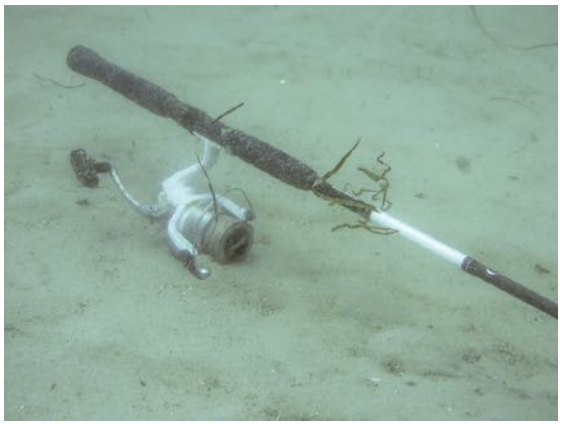


Image 5.6B Complete fishing rod

Image 5.6C School of bream

5.7 KIRRA REEF; SITE 1

Kirra reef is a collection of nearshore rocky outcrops located a few hundred metres offshore from Kirra Beach. The site was included in our program in 2015 to monitor the condition of the reef due to exposure to increased sand levels from the Tweed River Entrance Sand Bypassing project since 1995.

Rock (59%) was the dominant substrate; followed by sand (28%). Nutrient indicator algae (4%), soft coral (3%), sponge (3%), rubble (2%), and other (1%) made up the balance of the substrate (Figure 5.7.1).

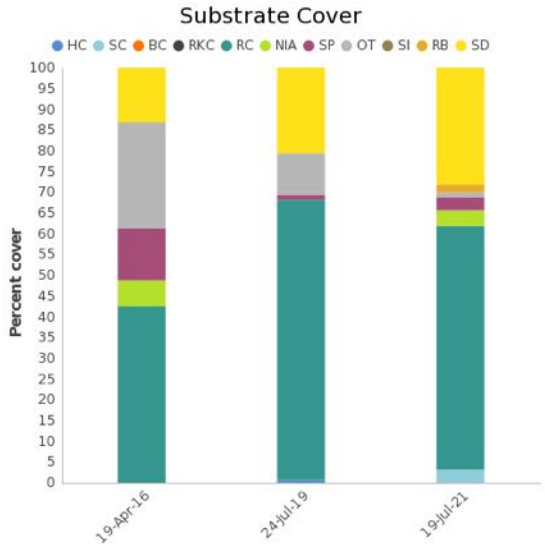


Figure 5.7.1. Benthic type and percent cover: Kirra Reef, 2016 - 2021

Coral bleaching was not recorded, with only soft coral recorded during the survey.

No items of marine debris were recorded.

During the invertebrate survey, four anemones with fish were recorded, along with three collector urchins, 72 long-spined urchins and seven pencil urchins. This represents a reduction in anemones and increase in urchins from 2019.

A fish survey was conducted and six butterflyfish, one moral eel, two parrotfish, nine snapper and one sweetlips were recorded.

A bamboo shark and several wobbegong sharks were also observed.

Image 5.7A Site photo

Image 5.7B Urchins and small lionfish

Image 5.7C Dominant algae

5.8 COOK ISLAND; SITE 1

The monitoring site at Cook Island was set up in 2019 as it was considered a place of interest due to its proximity to Gold Coast Reefs and the potential for larval recruitment to occur from this location. The survey site sits at 7m on the northern side of the island, near the turtle sanctuary.

Rock, including rock covered with coralline algae and turf algae (75%) was the dominant substrate; followed by hard coral (19%). Sponge (2%), other (ascidians and anemones) (2%), recently killed coral (1%) and soft coral (1%) made up the balance of the substrate (Figure 5.8.1).

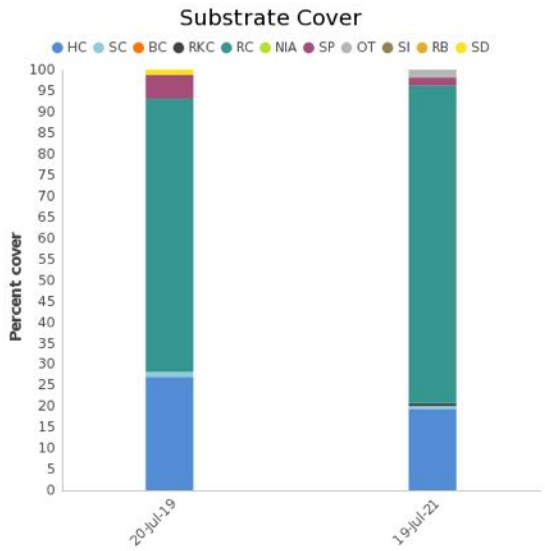


Figure 5.8.1. Benthic type and percent cover: Cook Island, 2019 - 2021

Coral bleaching affected less than 1% of the coral population. Seven incidences of coral damage, five of coral disease, one Drupella scar and ten unknown scars were recorded on the impact survey. Marine debris was not recorded.

During the invertebrate survey, 17 anemones with fish and 26 without fish were recorded along with 17 Drupella snails, 13 collector urchins, one pencil urchin and 92 long-spined urchins.

During the fish survey nine butterflyfish, two grouper, 17 parrotfish, one snapper, and 11 sweetlips were recorded.

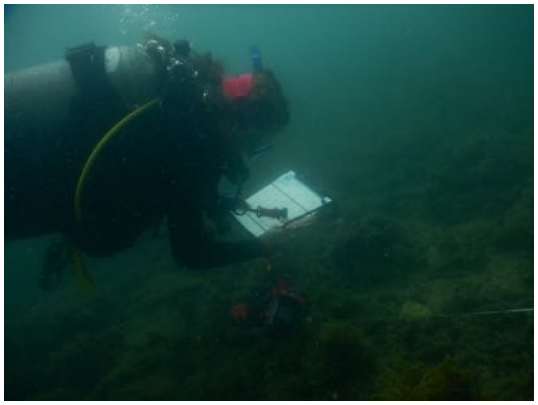
Image 5.8A Site photo

Image 5.8B Anemones with fish

Image 5.8C *Drupella* snails and scars

6.0 TEAM PHOTOS



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

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