Reef Check Australia

Heron Island Reef Health Report 2021

Reef Check Australia

www.reefcheckaustralia.org

This report should be cited as: J. Salmond, J. Schubert and C. Roelfsema. Reef Check Australia 2021 Heron Island Reef Health Report. Reef Check Foundation Ltd.

Reef Check Australia

Heron Island Reef Health Report 2021

A huge thank you and congratulations to the 2021 Heron Reef Research Teams and support team (from left to right):
Maria Kottermair, Chris Roelfsema, Carolina Castro, Kat Markey (with Lucia), Richard Chang, Diana Kleine, Stuart Phinn, Josh Passenger, Jodi Salmond, Jenni Calcraft and Julie Schubert

Image from Chris Roelfsema
Front Cover Image from Jordan Ivey

This project was made possible by in-kind support and advice from
The University of Queensland's Remote Sensing Research Centre, Heron Island Research Station and Heron Island Resort.

This report should be cited as: J. Salmond, J. Schubert and C. Roelfsema.
Reef Check Australia 2021 Heron Island Reef Health Report. Reef Check Foundation Ltd.

TABLE OF CONTENTS

1.0 PROJECT INTRODUCTION

Reef Check Australia's (RCA) monitoring program is a peer-reviewed, volunteer reef health monitoring program that trains volunteers to collect data on reef composition, abundance of indicator organisms (invertebrates and fish) and reef health impacts, using a globally standardized protocol (Done et al., 2017, Hill and Wilkinson, 2004).

RCA monitoring sites were established on Heron Island in 2011, when RCA was invited to collaborate by the University of Queensland's Remote Sensing Research Centre (RSRC). This makes 2021, the 10th year of RCA monitoring at Heron Island. The RSRC team has been cataloging the benthic composition of Heron Reef annually since 2001 via geo-referenced photo transects (Roelfsema et al 2010, Roelfsema et al 2021). This and other field data, in combination with satellite imagery, is used to create and validate benthic habitat maps (Roelfsema et al 2018). RCA survey data augments this substantial spatial dataset by offering further information on impact severity and abundance of key organisms, as well as allowing field-based comparisons of benthic composition.

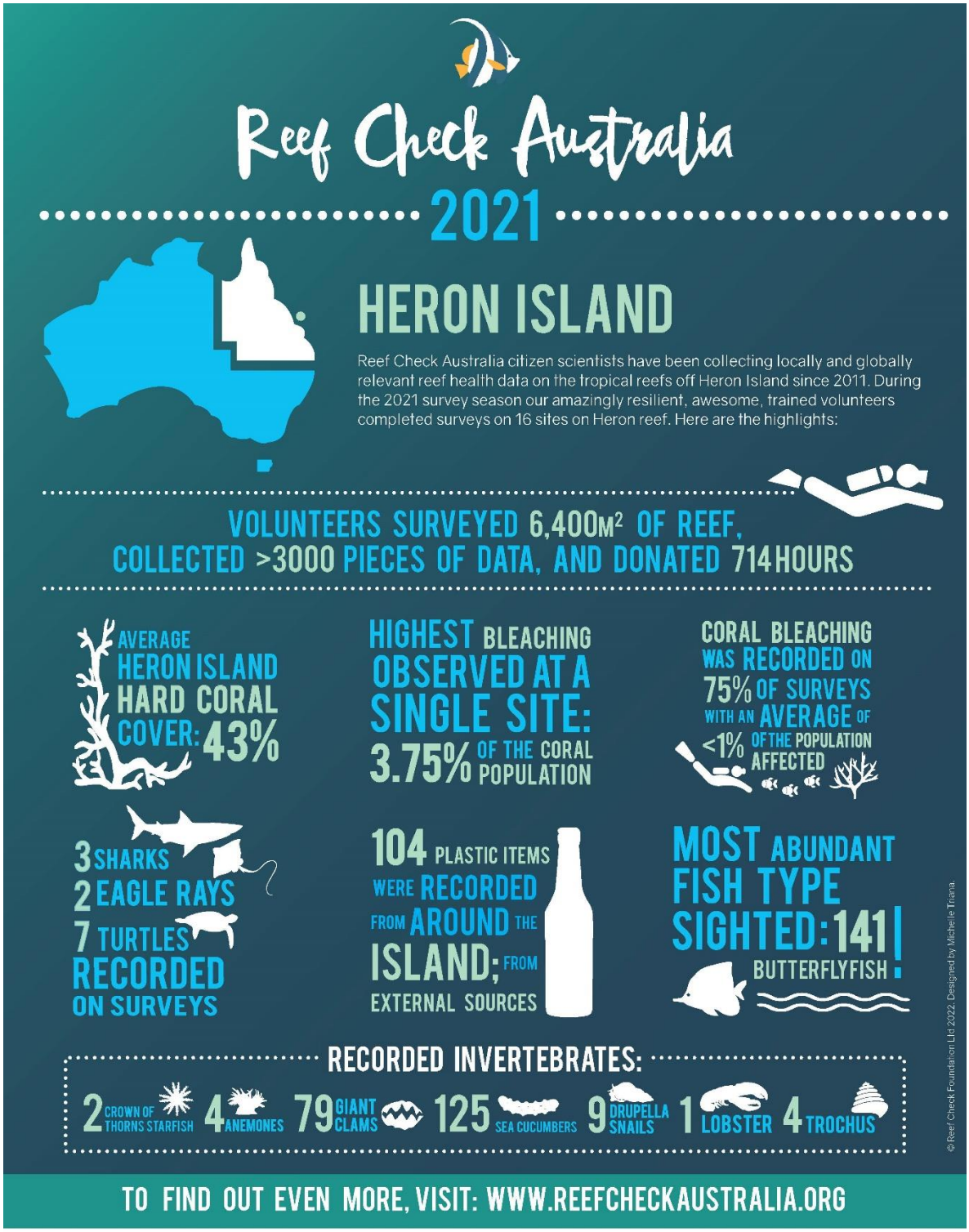
Even though Heron's reefs are intensely studied, with hundreds of researchers visiting the University of Queensland's Research Station annually, there are limited programs that consistently document long-term reef health. Hence the RSRC and RCA initiative can offer a valuable perspective on these reefs, combining a variety of techniques for long-term (20 years and 10 years respectively), cohesive studies. Since the RCA Heron Reef program started in 2011 in partnership with the University of Queensland's RSRC, additional sites have been added to allow for a more representative collection of survey locations around the island. A total of 17 RCA Heron Reef Sites are now monitored as part of the long-term monitoring program.

On our 10th year of surveys Reef Check Australia's survey teams monitored 16 of the 17 sites (nine reef slope sites and seven reef flat sites) around Heron Reef. Substrate line transects, in addition to invertebrate and impact belt transects, were conducted at each site. Fish surveys were completed at all 16 sites in 2021. Underwater cameras were used to document visual evidence of key site features, reef impacts and invertebrates. Summary findings for the 16 surveys conducted around Heron Island are presented in this report.

This project demonstrates the value of collaborative citizen-science initiatives as a powerful tool to contribute useful information for science, management and education initiatives. It is intended to continue the long-term monitoring program at Heron Island. This will provide important information in regard to the Health Status of the reef for Marine Park Managers, Island managers, researchers and resource users (including staff and guests), and the broader community.

The Heron Reef RCA dataset has been used as annual supplementary marine condition information for the Fitzroy Basin Report Card by the Fitzroy Partnership for River Health (https://riverhealth.org.au/). Environmental report cards are designed to distil complex scientific knowledge, and through long-term monitoring, determine status and trend of catchment and marine health. Additionally, the percent cover of hard and soft coral averaged across monitoring sites for each year has been scored using Reef Plan Reporting standardised scales, which provides regionally relevant reef health information for the Reef Plan Marine Monitoring Program (https://eatlas.org.au/).

2.0 SUMMARY OF FINDINGS



Our Heron island reef health surveys were made possible from the generous support from Reef Check Australia volunteer participants, and:

2.1 Key findings from the 2021 surveys:

- Total average hard coral cover across all sites was 43%; this is consistent with previous years and a 1% increase from 2020. Hard coral cover ranged from zero percent (at Stevo's Carbonara) to 76% at Gorgonian Hole. Seven sites had coral cover greater than 50%, three site had between 25-50% cover and five sites had less than 25% coral cover.
- Most sites had low or zero levels of soft coral (present at nine of 16 sites, ranging from 1% at Harry's Bommie to 6% at Halfway).
- Crown of Thorns starfish (two) were observed at Harry's Bommie.
- Indicator sea cucumbers were recorded in higher abundances on sandy inshore reef flat sites. Seven snorkel sites had sea cucumbers, whilst only four of the dive sites had sea cucumbers present.
- Giant clams were recorded on all but two sites (Gorgonian Hole and Stevo's Carbonara). White Wedding and Heron Bommie again had the highest abundance with 15 and 12 counts recorded respectively per 400m².
- Coral scarring from unknown causes was reported at all of the nine reef crest sites, with the highest record of 25 counts per 400m² at Harry's Bommie. An average of 11.2 counts per 400m² were recorded for all sites where scarring was present.
- Debris was not recorded at any of the survey sites.
- Hard coral damage was recorded at all except Stevo's Carbonara. The highest abundance (36 counts) was recorded at Gorgonian Hole.
- Coral bleaching was recorded on 12 sites, but in relatively low levels. The highest population bleaching was recorded at Halfway (3.75% of the population; 7.5% of each colony on average). Libby's Lair had the highest individual colony bleaching average (37.50%) with population bleaching levels of just 0.5%. Total average coral population bleaching across all sites was 0.68%, a decrease on previous records.
- Coral disease was recorded at four of the 16 sites. A decrease from 2020. Of these, Heron Bommie had the highest counts of disease, with 8 incidents recorded per 400m². Two sites recorded only 1 count of disease whilst the third site had three counts.
- Refer to Appendix A for comparative graphical representation of 2021 results for all survey locations.

3.0 INTRODUCTION

3.1 Reef Check Australia Overview

Trained Reef Check Australia (RCA) volunteers have been monitoring reef health around Australia since 2001. Annual surveys provide long-term data sets that can be used for local and regional reef management that can be compared to Reef Check data around the world. This temporal information can help reveal important patterns over time.

The Reef Check program is intended to supplement government and academic monitoring efforts, filling spatial and temporal gaps in reef monitoring. It also provides an opportunity for community members to play an active role in reef monitoring, education and conservation. Broad-scale reef data from Reef Check can act as an early warning system for changes in the health of coral habitats.

3.2 Reef Check Methodology

Reef Check uses a globally standardised protocol to collect data on 25 categories of substrate cover, as well as the abundance of 14 indicator invertebrates and 10 reef health impacts (Hill and Wilkinson, 2004). Reef Check surveys are conducted along a transect line marked by a graduated tape measure and laid at a constant depth. The transect length that is surveyed is 80 m, divided into four 20 m sections, each separated by 5 m (Figure 1a). This design allows for data comparisons within sites using the four independent replicates, as well as between sites.

The substrate survey collects information about the percentage cover of bottom-dwelling (benthic) organisms and substrate on the reef using a point-intercept method. A survey diver records the substrate type (Table 1) that is directly below the tape measure every 50 cm along each of the four 20 m sections interval (Figure 1b).

Invertebrate and impact surveys are conducted along the same transect line using a 5 m wide belt transect methodology. Divers search for indicator invertebrates and reef impacts on each 20 m replicate for 7 - 10 minutes using a u-shaped search pattern (Figure 1a). The 14 invertebrate indicators have been selected based on their economic and/or ecological importance. Reef health indicators include ten reef impacts, focusing on issues that may be addressed through management strategies. Similarly, fish surveys are conducted along a 5 m tunnel (Figure 1c).

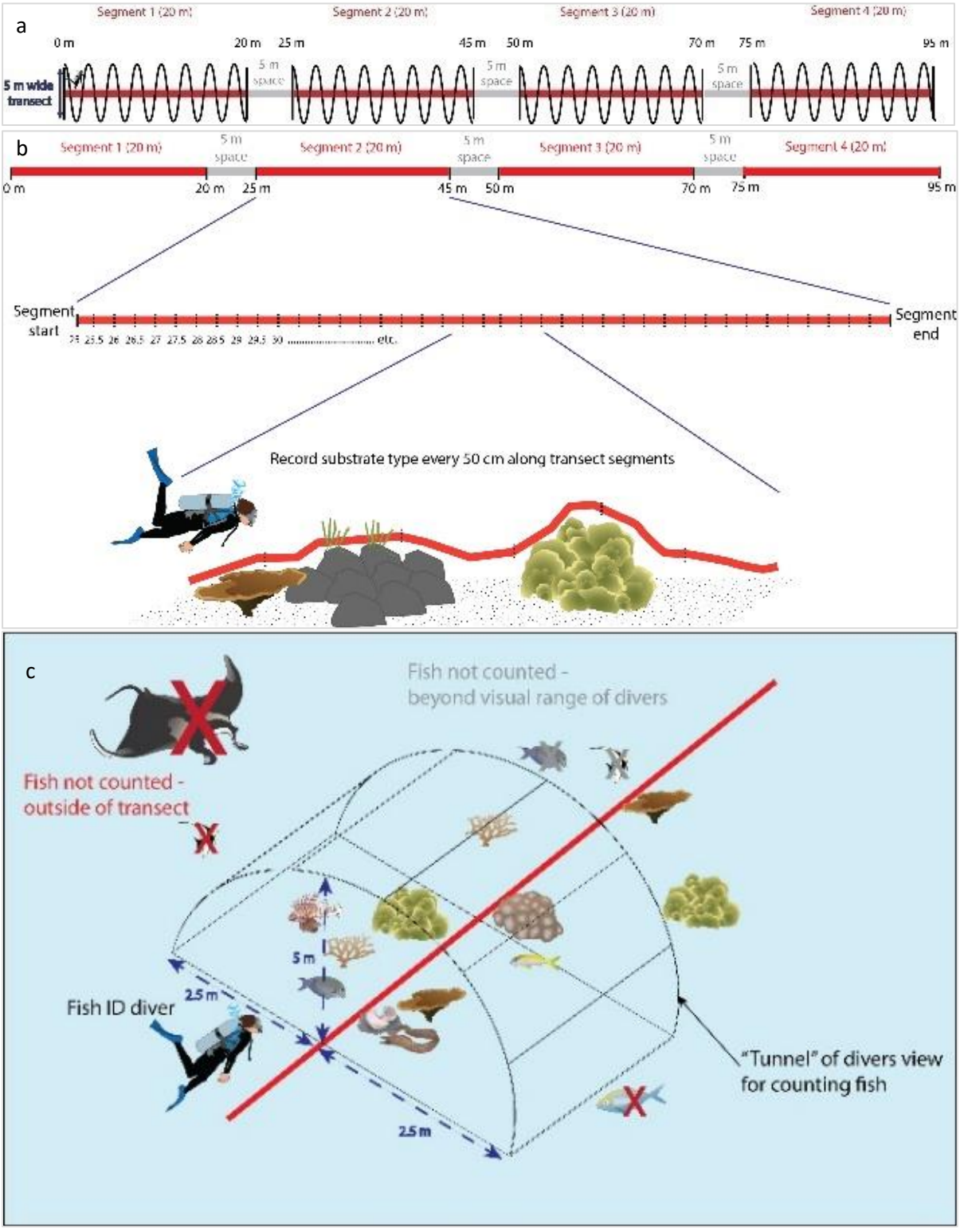


Figure 1: Reef Check survey methodology based on Hill and Wilkinson, 2004 showing (a) line intercept and belt survey transect layout consisting of 4 x 20 m replicates, (b) line intercept substrate survey protocol showing data collection points at 50 cm intervals, and (c) diagram of the belt transect tunnel for fish surveys (Image by Roelfsema et al, 2014).

Table 1. Codes for Reef Check Australia substrate categories

Hard Coral	HCBR: Branching Hard Coral
	HCF: Foliose Hard Coral
	HCM: Massive Hard Coral
	HCE: Encrusting Hard Coral
	HCP: Plate Hard Coral
	HC: All other growth forms
	HCB: Bleached Hard Coral
Soft Coral	SCL: Leathery Soft Coral
	SCZ: Zooanthids
	SC: Other Soft Coral (ornate)
	SCB: Bleached Soft Coral
Recently Killed Coral	RKCTA: Recently killed coral with Turf Algae
	RKCNIA: Recently Killed Coral with Nutrient Indicator Algae
	RKC: Recently Killed Coral (bare)
Rock	RCTA: Rock covered with Turf Algae
	RCCA: Rock covered with Coralline Algae
	RC: Rock (not covered with algae)
Sponge	SPE: Encrusting Sponge
	SP: All other Sponges

There are a total of 17 sites at Heron Reef monitored by Reef Check Australia which were established to allow for a detailed representation of Heron Island reef habitats, and were selected to represent diverse management and use areas - six sites are located in protected Green zones, six are located in general use areas, and five are located in a scientific research zone (allows extraction for experimental and educational purposes). During the 2021 RCA surveys, 16 sites were revisited. Unfavourable weather resulted in one site not being surveyed.

Reef Check transects are co-located with UQ Remote Sensing Research Centre survey sites. At these survey sites, geo-referenced benthic photo transects (Roelfsema et al 2021) are conducted annually as part of a coral reef monitoring research project that started in 2001. The research project involves using the collected benthic field data in combination with high spatial resolution satellite imagery to create and validate benthic community maps of Heron Reef (e.g. Roelfsema et al 2013).

Additionally, CoralWatch Coral Health Chart surveys were collected at survey sites to specifically assess coral colour as an indicator of coral stress (Siebeck et al 2006).

3.3 Heron Island: Location and Demographics

Heron Island (0.62 km^2) is a coral cay located on the southern section of the Great Barrier Reef, approximately 80 km off the coast of Gladstone, Queensland with a 27 km^2 platform reef. The surrounding waters are divided into one of three management designations, including Marine National Park (Green Zone), Conservation Park or Scientific Research zones (Figure 2).

Heron Island hosts the Heron Island Resort and the University of Queensland's Research Station (HIRS). Heron Island Resort is a popular location for scuba diving and snorkelling that accommodates up to 200 guests and 100 staff members. The HIRS is a heavily utilised research station with visiting universities, schools, and researchers from Australia and the world, accommodating up to 150 people. The fringing reefs are well-utilised for snorkel and dive tourism as well as reef research. However, these activities may be having some unintended impacts. Factors such as extensive development in the nearby Gladstone region, and similar to other coral reefs, global climate change, also pose threats to this marine ecosystem. Thus routine monitoring of this reef is essential. The 17 RCA survey sites are shown in Figure 2 and a summary of site demographics is represented in Table 2.

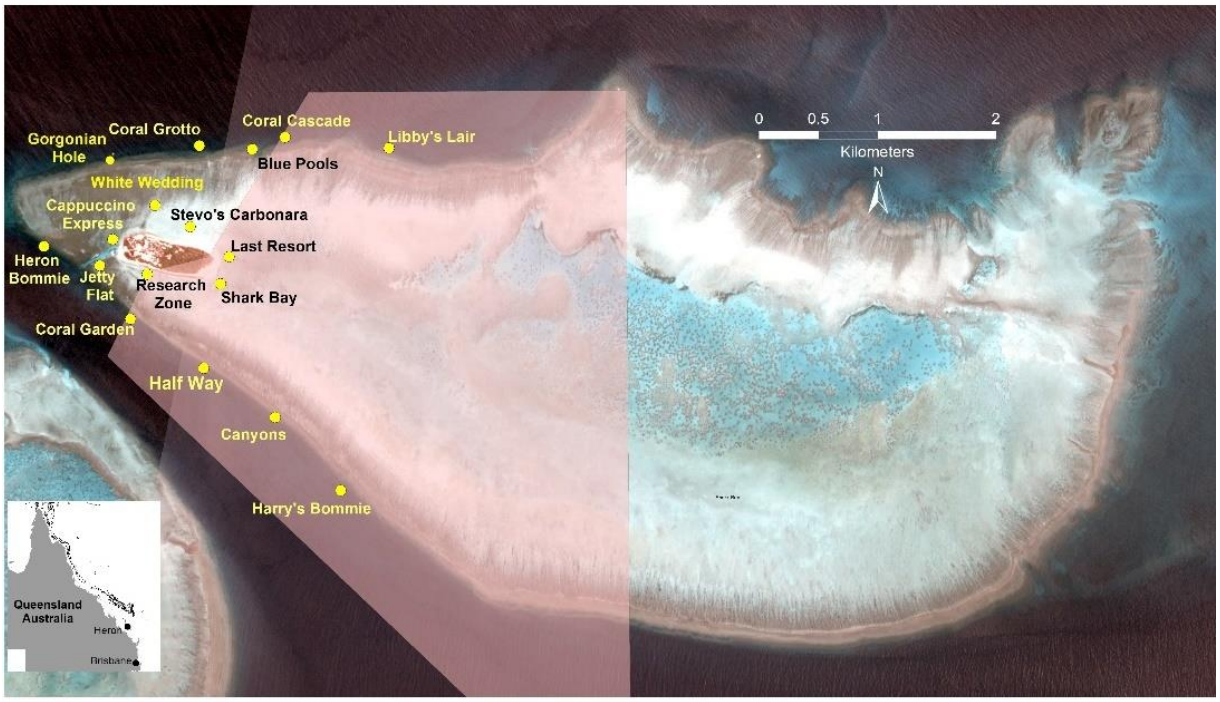


Figure 2. RCA field sites and the conservation zone overlaid on the Planet Dove image acquired on 9 November 2018 over Heron Reef, Southern Great Barrier Reef, Australia (Image source: Planet Ltd).

Table 2. RCA Heron Island monitoring locations, with depth, hard coral cover for the current survey year, designation of site (Marine National Park, Conservation Park, or Scientific Zone), habitat type and survey years.

Site	Depth (m)	HC %	Site Designation	Habitat Type	Year Surveyed										
					2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Blue Pools	5	79	Conservation Park	Reef Slope				■			■			■	
Canyons	5	76	Scientific Zone	Reef Slope			■	■	■	■	■	■	■	■	■
Cappuccino Express	2	18	Marine National Park	Sandy reef flat with micro atolls			■	■	■	■	■	■	■	■	■
Coral Cascade	6	60	Conservation Park	Reef Slope			■	■	■		■	■	■	■	■
Coral Gardens	5	70	Marine National Park	Reef Slope	■		■	■	■	■	■	■	■	■	■
Coral Grotto	6	61	Conservation Park	Reef Slope	■		■	■	■	■	■	■		■	■
Gorgonian Hole	6	69	Conservation Park	Reef Slope								■	■	■	■
Halfway	6	26	Scientific Zone	Reef Slope				■	■	■	■	■		■	■
Harry's Bommie	9	65	Scientific Zone	Reef Slope	■		■	■	■	■	■	■	■	■	■
Heron Bommie	5	61	Marine National Park	Reef Slope	■		■	■	■	■	■	■	■	■	■
Jetty Flat	2	31	Marine National Park	Reef flat with micro atolls	■	■	■	■	■	■	■	■	■	■	■
Last Resort	2	3	Conservation Park	Sandy reef flat			■	■	■	■	■	■	■	■	■
Libby's Lair	6	72	Conservation Park	Reef Slope									■	■	■
Research Zone	1	9	Scientific Zone	Sandy Reef Flat	■	■	■	■	■	■	■	■	■	■	■
Shark Bay	2	11	Scientific Zone	Sandy reef flat	■	■	■	■	■	■	■	■	■	■	■
Stevo's Carbonara	2	0	Marine National Park	Sandy reef flat with micro atolls						■	■	■	■	■	■
White Wedding	1	7	Marine National Park	Sandy reef flat				■	■	■	■	■	■	■	■

4.0 SUMMARY 2021 SURVEY REPORT

A summary of the findings for the 2021 RCA monitoring is shown in Table 3. Information includes: average hard coral cover (%), total macro algae abundance, abundance of invertebrates (collector urchin, sea cucumbers, giant clams, Triton, *Trochus, Drupella* snails, anemones), abundance of reef impacts (*Drupella* scars, unknown scars, coral damage, average coral bleaching of population percentage, average coral bleaching percentage for colony surface), and silt levels (N=none, L=low, M=medium, H=high). Categories are listed as abundance counts unless otherwise specified. The information represents data collected over a standard survey as described in section 3.2.

Table 3: Summarised RCA findings for Heron Reef survey sites in 2021.

Site	Substrate		Invertebrates								Impacts								
	Hard Coral Coverage (%)	Macro Algae (#)	Edible Sea Cucumbers (#)	Giant Clam (#)	Triton (#)	Trochus (#)	Drupella Snail (#)	Anemone (#)	Lobster (#)	Crown of Thorns Starfish (#)	Drupella Scar (#)	Unknown Scar (#)	COTS Scar (#)	Coral Damage (#)	Coral Disease (#)	Coral Bleaching Population (%)	Coral Bleaching Colony (%)	Marine debris (#)	Silt Level*
Canyons	73.13	0	1	9	0	0	2	1	0	0	0	17	0	6	0	0	0	0	L
Cappuccino Express	15	0	31	6	0	0	1	1	0	0	0	8	0	3	0	0.25	5	0	L
Coral Cascade	66.87	0	0	3	0	1	0	0	0	0	0	13	0	9	0	0.5	11.75	0	N
Coral Gardens	63.13	0	0	2	0	0	0	0	0	0	0	12	0	13	0	0.75	23.75	0	L
Coral Grotto	68.75	0	1	0	0	1	0	1	1	0	0	6	0	23	0	0.5	21.75	0	N
Gorgonian Hole	75.63	0	1	1	0	0	3	1	0	0	2	12	0	36	1	0	0	0	N
Halfway	30	0	0	3	0	1	0	0	0	0	0	14	0	5	3	3.75	7.5	0	L
Harry's Bommie	63.13	0	0	5	0	0	0	0	0	2	0	25	8	6	1	0.25	25	0	L
Heron Bommie	46.87	0	0	13	0	0	1	0	0	0	1	15	0	13	8	0.25	10	0	L
Jetty Flat	35.63	0	2	1	0	0	0	0	0	0	0	9	0	5	0	0.25	1.25	0	L
Last Resort	5.63	1	29	4	0	0	0	0	0	0	0	0	0	2	0	0.25	5	0	L
Libby's Lair	75.63	0	2	1	0	0	0	0	0	0	0	9	0	8	0	0.5	37.5	0	N
Research Zone	7.50	4	4	2	0	1	0	0	0	0	0	0	0	5	0	0.25	9.25	0	N
Shark Bay	7.50	18	45	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	N
Stevo's Carbonara	0	6	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N
White Wedding	8.75	1	7	23	0	0	2	0	0	0	0	3	0	1	0	0.75	8.5	0	L

* N=none, L=low, M=medium, H=high

To illustrate broad-spatial scale trends in the RCA data collected during the 2021 surveys, the data from each individual site was overlaid on ESRI image sourced through QGIS. Firstly, the percentage of hard coral coverage and bleaching incidence are depicted in Figure 3.

Figure 3. RCA hard coral cover and population level bleaching data for the 2021 surveys. Map created using QGIS software with an Esri basemap image acquired 16 December 2021.

For 2021, bleaching was recorded on 12 of the 16 sites. Slightly higher levels of coral population bleaching were recorded on the deeper reef slope offshore sites of Heron Island (average of 0.9%), with higher average coral colony bleaching also detected (average 19% compared to 6% for shallow reef flat inshore sites). The highest average population bleaching across a single site was Half Way (Doug's Place) with 3.75%.

Figure 4 shows the hard-coral data compared to the incidence of scars.

Figure 4. RCA hard coral cover and scar data for the 2021 surveys. Map created using QGIS software with an Esri basemap image acquired 16 December 2021.

Instances of unknown scars were recorded at 12 of the 16 sites. Ten or more scars were recorded on seven of the nine reef slope sites per 400m². The highest number of scars on reef flat sites was nine at Jetty Flat. Crown of Thorns Starfish (CoTS) scars were observed at Harry's Bommie. Drupella scars were only observed at two sites. The highest level of coral scars was recorded at Harry's Bommie (25).

Figure 5 summarises the incidence of coral disease to hard coral cover recorded on the 2021 surveys.

Figure 5. RCA hard coral cover and coral disease data for the 2021 surveys. Map created using QGIS software with an Esri basemap image acquired 16 December 2021.

Instances of coral disease were recorded on transect at four of the 16 sites, well below 2020 numbers. The highest count of coral disease was recorded at Heron Bommie (8 counts), down from 67 counts in 2020. Over coral disease was down from 2020.

Coral damage is summarised relative to the percentage of hard coral cover in Figure 6.

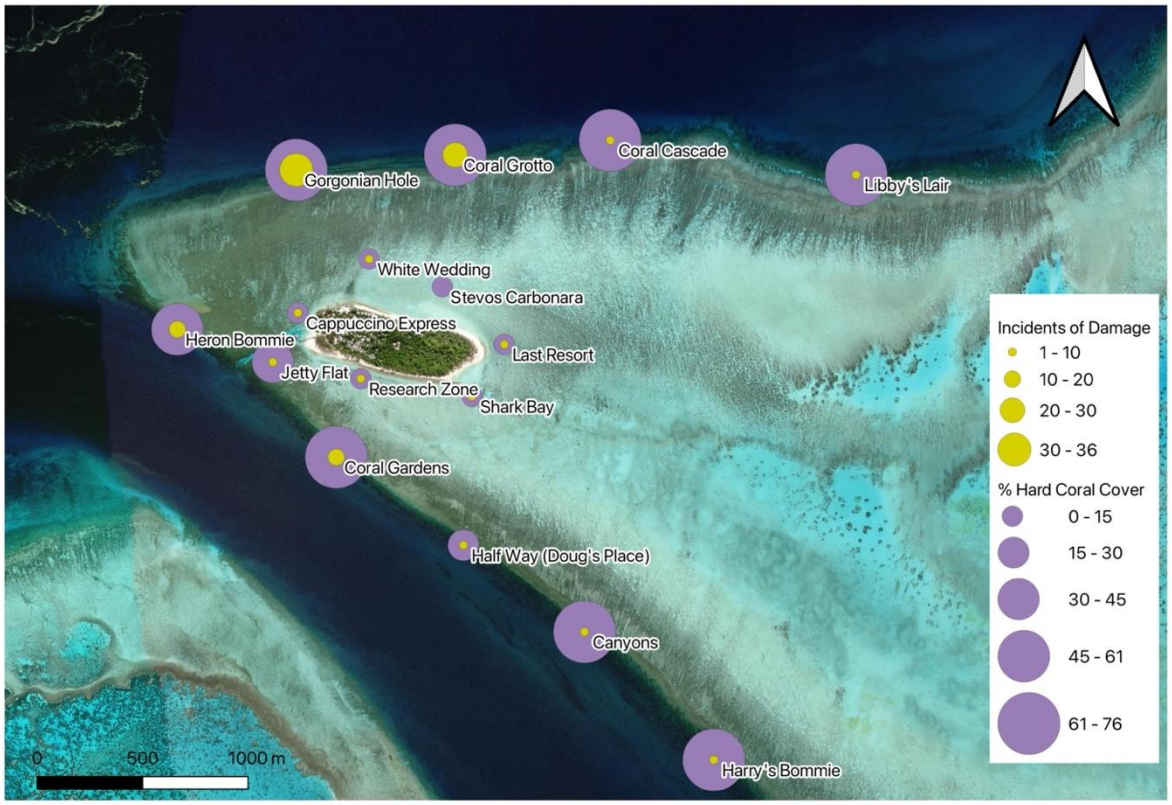


Figure 6. RCA hard coral cover and coral damage data for the 2021 surveys. Map created using QGIS software with an Esri basemap image acquired 16 December 2021.

Fifteen of the 16 sites had instances of coral damage. The average coral damage for all 15 sites was 9 counts per 400m². Higher than average counts of coral damage was recorded for Gorgonian Hole, Coral Grotto, Coral Gardens and Heron Bommie (36, 23, 13 and 13 counts per 400m² respectively), whilst the remaining sites had less than 10 counts. No coral was recorded at Stevo's Carbonara and therefore coral damage was also not recorded.

Invertebrate surveys record the abundance of indicator invertebrates along each transect. Figure 7 and Figure 8 show the abundance of giant clams and indicator sea cucumbers respectively, for each survey site along with the percentage of hard coral cover.

Figure 7. RCA hard coral cover and giant clam abundance for the 2021 surveys. Map created using QGIS software with an Esri basemap image acquired 16 December 2021.

A higher average distribution of giant clams was recorded on inshore reef flat sites compared to deeper reef slope sites (7 and 4 counts per 400m² respectively). Heron Bommie (southern reef slope) and White Wedding (northern reef flat) had the highest recorded numbers of giant clams with 12 and 15 (respectively) found on transect. Gorgonian Hole and Stevo's Carbonara were the only sites with no giant clams recorded on transect.

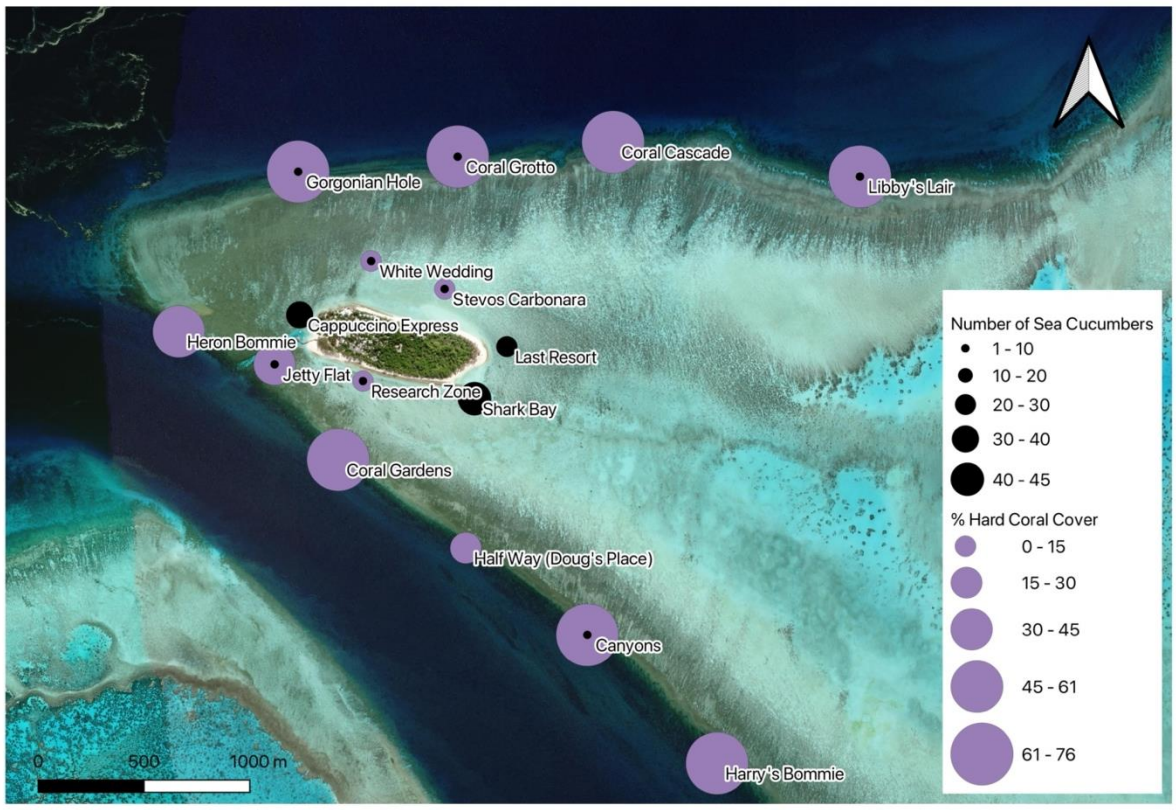


Figure 8. RCA hard coral cover and abundance of sea cucumber for 2021 surveys. Map created using QGIS software with an Esri basemap image acquired 16 December 2021.

Target sea cucumbers were recorded at 11 of the 16 sites. The highest numbers of sea cucumbers were recorded on shallow near shore, sandy reef flat areas. The highest count of target sea cucumbers was at Shark Bay (45 per 400m^2), followed by Cappuccino Express (31 per 400m^2) and Last Resort (29 per 400m^2). These locations are consistent with the findings in 2020. All the shallow near shore sites had target sea cucumbers.

5.0 INDIVIDUAL SITE REPORTS

5.1 Canyons

Canyons is situated along the reef slope, on the southern side of Heron Island. This site is characterised by a series of shallow canyons cutting into the edge of the reef, with scattered bommies out deeper, away from these ridges (Image 1).

Hard coral represented 73% of the total substrate cover (Figure 9). Rock (including rock with turf algae and rock with calcareous algae was the next greatest contributor to substrate at 22% cover. Rubble made up 2.5%, recently killed coral just over 1% and nutrient indicator algae, just under 1%.

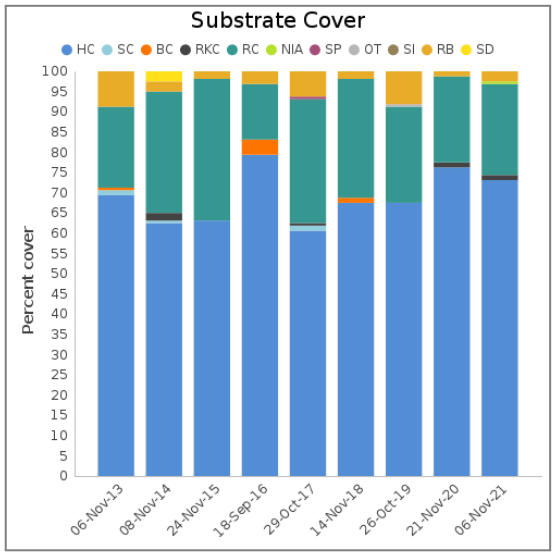


Figure 9. Benthic type and percent cover: Canyons, 2013 – 2021.

Four giant clams, two Drupella snails, one sea cucumber and one anemone (Image 2) were recorded on the invertebrate survey.

Bleaching was not recorded during the impact survey in 2021, although hard coral cover remained consistent.

Six counts of coral damage and 17 unknown scars (image 3) were recorded.

A fish survey was conducted and 15 butterflyfish, four snapper, two humphead parrotfish and nine other parrotfish were recorded.

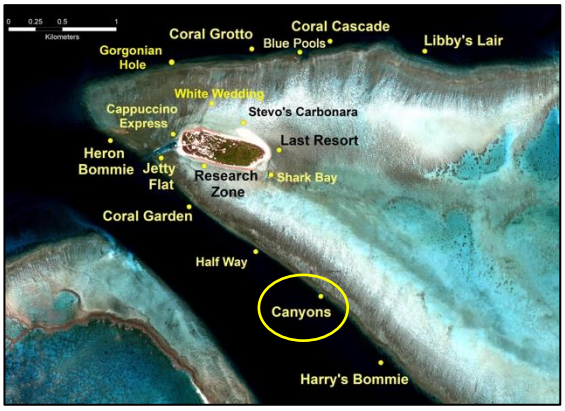


Image 1: Site Location – represented by circle

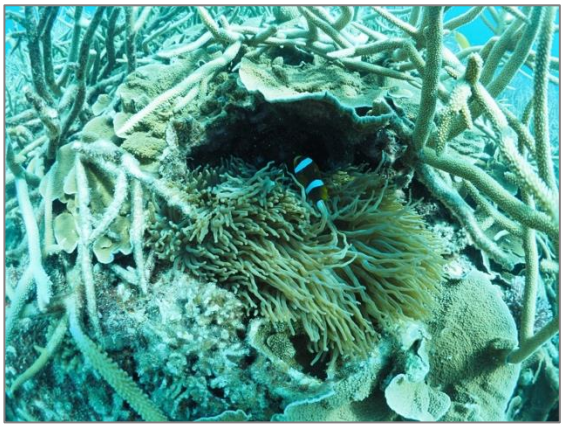


Image 2: Anemone with fish

Image 3: Unknown scar

5.2 Cappuccino Express

Cappuccino Express is on the reef flat. The site is characterised by small coral atolls and sandy patches and is prone to strong currents (Image 4). This reef area is easily accessible on snorkel and often visited by tourists as it is situated close to the resort.

Hard Coral represented 15% of the total substrate at this site (Figure 10). Rock was again the greatest contributor to substrate, making up 54%. Sand constituted 14%, rubble attributed 12%, recently killed coral was less than 1%, whilst "other" (Halimeda) was 3%.

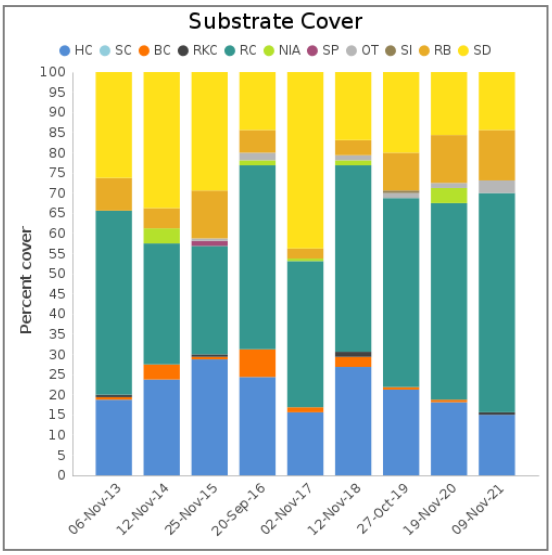


Figure 10. Benthic type and percent cover: Cappuccino Express, 2013 - 2021.

Five giant clams, 31 sea cucumbers (an increase on 2020) (Image 5), one anemone and one Drupella snail were recorded on the invertebrate survey.

Coral bleaching was only recorded on one transect with an average 20% of the coral surface bleached, but only 1% of the population.

Eight incidents of unknown scars and three counts of coral damage was recorded.

A fish survey was conducted and one Barramundi Cod, one Moray eel, six snapper, one parrotfish, and 13 butterflyfish were recorded.

Image 4: Site Location – represented by circle

Image 5: Pinkfish; Target Sea Cucumber

Image 6: Parrotfish

5.3 Coral Cascades

Coral Cascades is situated on the reef slope on the northern side of Heron Reef (Image 7) Coral Cascades is a dive site often utilised by tourists and researchers alike. It is characterised by a high abundance of hard coral, hence the name.

Hard coral (Image 8) cover represented 67% of the substrate at this site (Figure 11). Rock (including rock with turf algae and rock with coralline algae) constituted 22% of the substrate, soft coral; 3% , rubble 2% and "other" (Halimeda) 6%.

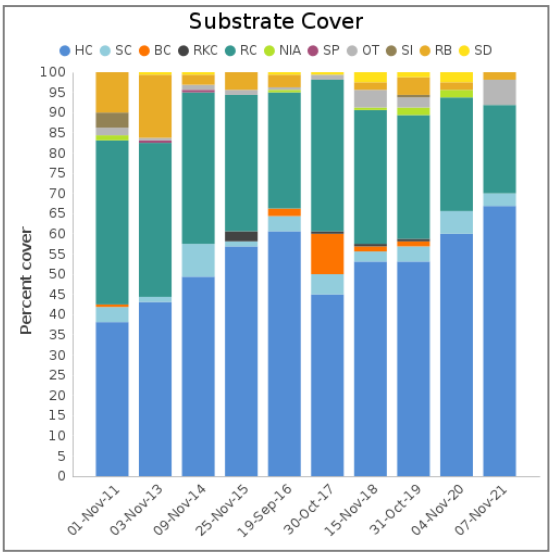


Figure 11. Benthic type and percent cover: Coral Cascades, 2011 - 2021.

One giant clams was the only invertebrate recorded on the survey.

Bleaching was recorded on just 0.50% of the coral population, with an average 12% of each affected coral surface bleached.

Other reef impacts recorded at this site included nine counts of coral damage and 13 unknown scars.

A fish survey was conducted and eight parrotfish, nine butterflyfish, three barramundi cod, 12 coral trout, one grouper, one humphead parrotfish and four snapper were recorded.

Image 7. Site Location – represented by circle

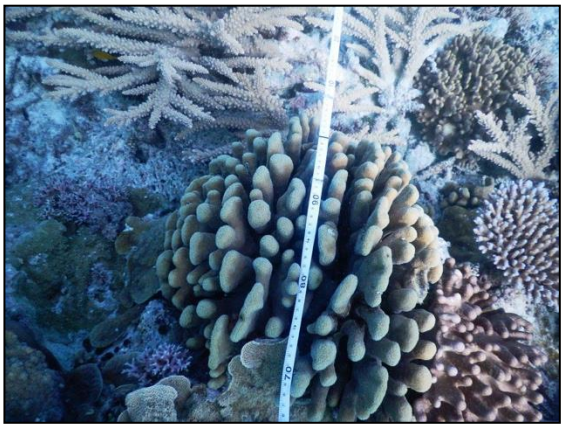


Image 8: Hard coral

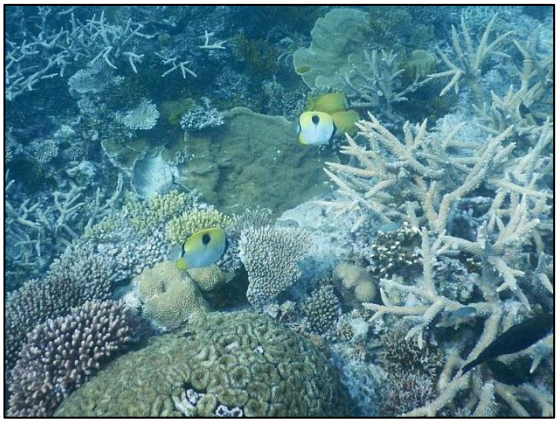


Image 9: Butterflyfish

5.4 Coral Gardens

Coral Gardens is located on the southern side of Heron Island on the reef slope. It is characterised by high hard coral cover; particularly branching growth forms (Image 10). It is a popular dive destination for the resort.

Hard coral accounted for 63% of the benthos at this site and is made up almost exclusively of branching coral growth forms (Image 11). Rock (including rock with turf algae and rock with calcareous algae) accounted for 29%, rubble constituted 5%, soft coral 2%, nutrient indicator algae 2% and recently killed coral <1% of total substrate (Figure 12).

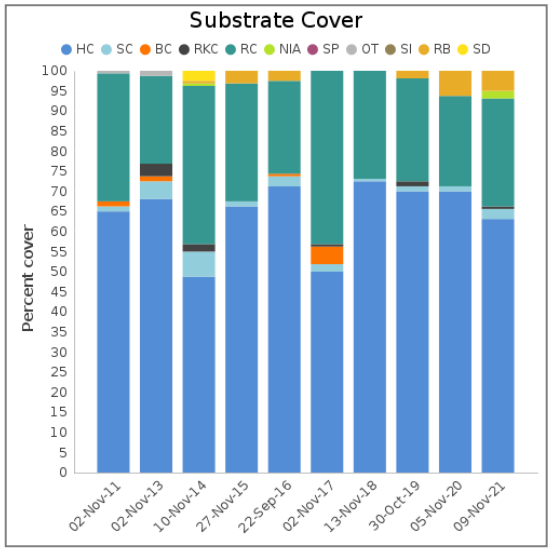


Figure 12. Substrate type and percent cover at Coral Gardens, 2011 - 2021.

One Giant Clam was the only target invertebrates recorded on the invertebrate survey.

Bleaching was recorded on less than 1% of the coral population, with an average of 24% of each affected coral surface bleached. This figure is lower than 2020.

Reef Impacts recorded at Coral Gardens were 12 unknown scars (Image 12), and 13 of coral damage.

A fish survey was conducted and five butterflyfish, five parrotfish, one coral trout, and two snapper were recorded.

Image 10: Site Location – represented by circle

Image 11: Transect photo

Image 12: Unknown scar

5.5 Coral Grotto

Coral Grotto is located on the reef slope on the northern side of Heron Island (image 13). It is characterised by high hard coral cover.

Hard coral accounted for 69% of substrate (Figure 13). Rock constituted 24% of substrate cover, soft coral 2% (Image 14), rubble 4% and recently killed coral < 1%.

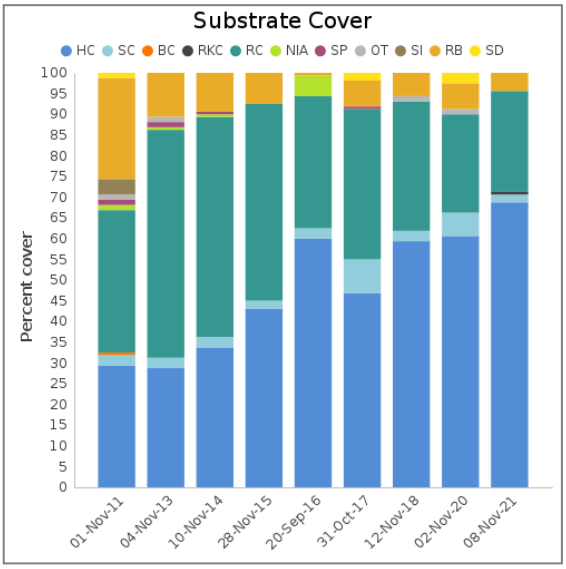


Figure 13: Benthic type and percent cover: Coral Grotto, 2011 - 2021.

Six giant clams, one sea cucumber, one anemone (Image 15), one lobster and one trochus were recorded for the invertebrate survey.

Coral bleaching affected an average of 22% of the coral surface, but <1% of the coral population. Six unknown scars and 23 incidences of coral damage were recorded.

A fish survey was conducted and ten butterfly fish, four coral trout, one barramundi cod, one bumphead parrotfish and three other parrotfish were recorded.

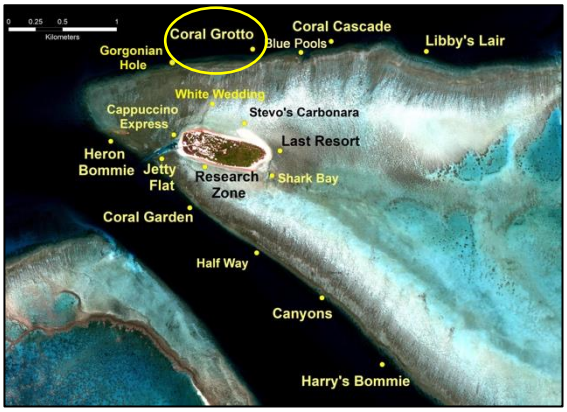


Image 13. Site Location – represented by circle

Image 14. Site Photo

Image 15: Anemone

5.6 Gorgonian Hole

Gorgonian Hole is located on the reef slope on the northern side of Heron Island (Image 16). It is characterised by high hard coral cover, particularly branching growth forms (Image 17).

Hard coral accounted for 76% of substrate (Figure 14). Rock constituted 19% of substrate cover and soft coral and "other" at 2%, with sponge and rubble at less than 1% each.

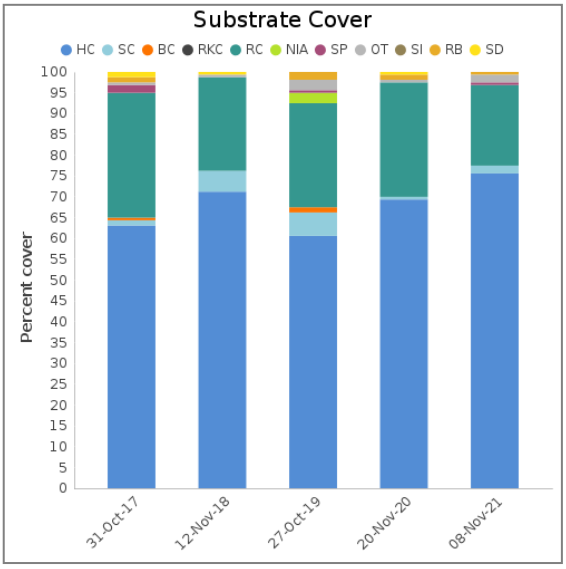


Figure 14: Benthic type and percent cover: Gorgonian Hole, 2017 - 2021.

One sea cucumber, one anemone and three Drupella snails were recorded for the invertebrate survey.

Coral bleaching was not recorded this survey, although hard coral levels remained high

Coral damage, at 36 incidences was higher than the previous year, with 12 unknown scars (Image 18), one count of coral disease and two Drupella scars also recorded.

A fish survey was conducted and 13 butterfly fish, four parrotfish, two snapper, six coral trout, one humphead parrotfish and three grouper were recorded.

Image 16. Site Location – represented by circle

Image 17. Site Photo

Image 18: Unknown Scar

5.7 Half Way

Half Way is located is located on the southern side of Heron Island, on the reef slope, halfway between Canyons and Coral Garden (Image 19). It is characterised by hard coral cover, but was observed to have a large amount of historically damaged coral.

Rock (rock with turf algae and rock with calcareous algae, which includes dead coral with algae) accounted for 44% of the total substrate. Hard coral cover at this site accounted for 30% of substrate cover, soft coral 6%, rubble 16%, nutrient indicator algae 4% and sand just under 1% (Figure 15).

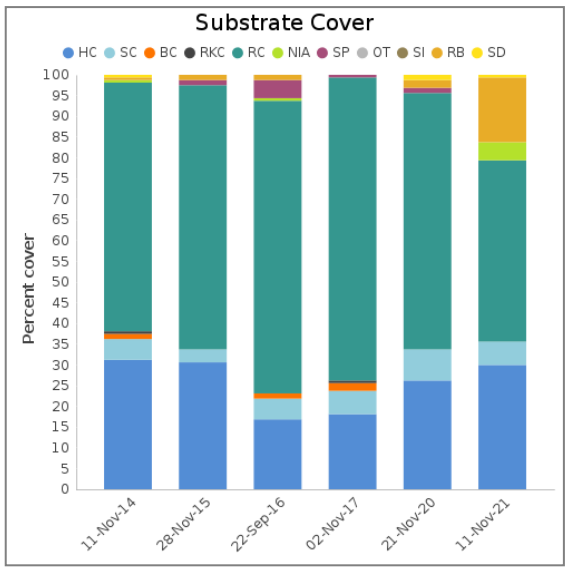


Figure 15. Benthic type and percent cover: Half Way, 2014 - 2021.

Four giant clams (Image 20) and one Trochus were recorded during the invertebrate survey.

Coral bleaching (Image 21) affected approximately 4% of the total coral population, with an average of 7.5% of each colony showing surface bleaching.

Five incidents of coral damage, 14 of unknown coral scars and three of disease were recorded on the impact survey.

A fish survey was conducted and six butterflyfish, five coral trout and three parrotfish were recorded.

Image 19. Site Location – represented by circle

Image 20. Giant clam

Image 21. Patch bleaching

5.8 Harry's Bommie

Harry's Bommie is located on the southern side of Heron Island, on the reef slope. It is characterised by large coral bommies and high hard coral cover, particularly branching growth forms (Image 22).

Hard coral cover at this site accounted for 63% of substrate cover (similar to previous years), consisting predominantly of branching coral. Rock (rock with turf algae and rock with calcareous algae) accounted for 33% of the total substrate, with soft coral attributing just over 1%, rubble 2% and nutrient indicator algae making up <1% (Figure 16).

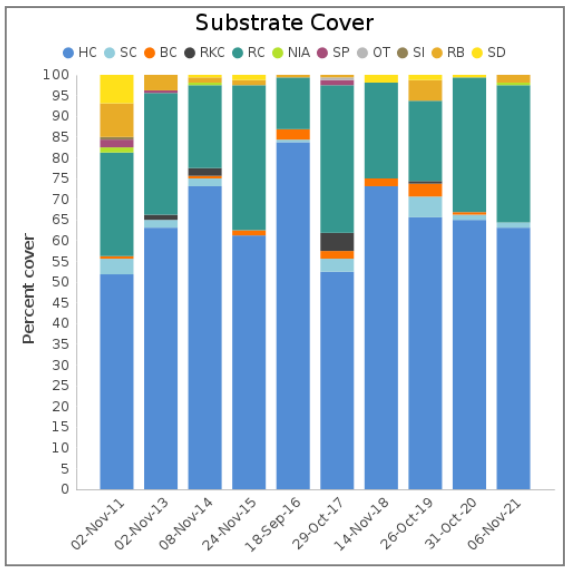


Figure 16. Benthic type and percent cover: Harry's Bommie, 2011 - 2021.

Five giant clams and two crown-of-thorns starfish (Image 23) were recorded during the invertebrate survey.

Coral bleaching (Image 24) affected less than 1% of the total coral population, with an average of 25% of each colony showing surface bleaching.

Unknown coral scars ranked as the highest impact at 25 counts. Coral damage numbered six. There were eight crown-of-thorns starfish scars and one incident of coral damage recorded on the impact survey.

A fish survey was conducted and eleven butterflyfish, two coral trout, one bumphead parrot fish, one other parrotfish, two snapper and three sweetlips were recorded.

Image 22. Site Location – represented by circle

Image 23. Crown-of-Thorns starfish

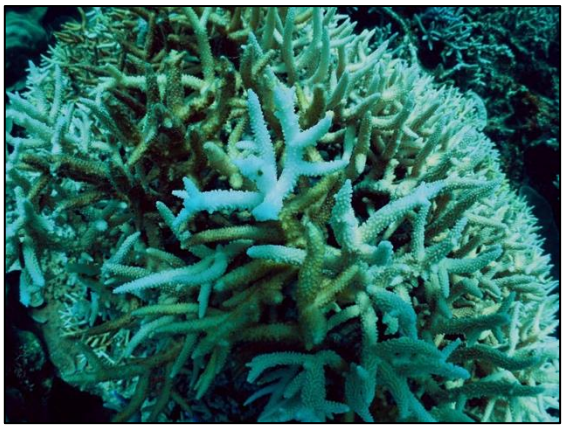


Image 24. Bleached coral

5.9 Heron Bommie

Heron Bommie is located on the southwest of Heron Island fringing reef slope (Image 25). It is characterised by a large coral bommie and high hard coral cover, particularly branching growth forms. Heron Bommie is a popular dive site with the resort due to its close proximity and high coral cover.

Hard coral represented 47% of the substrate (Figure 17). Rock (including rock with turf algae and rock with calcareous algae) constituted 30% of substrate cover. Other (Halimeda) attributed 10%, sand 6%, rubble 3%, soft coral 2% with sponge and nutrient indicator algae each at <1%.

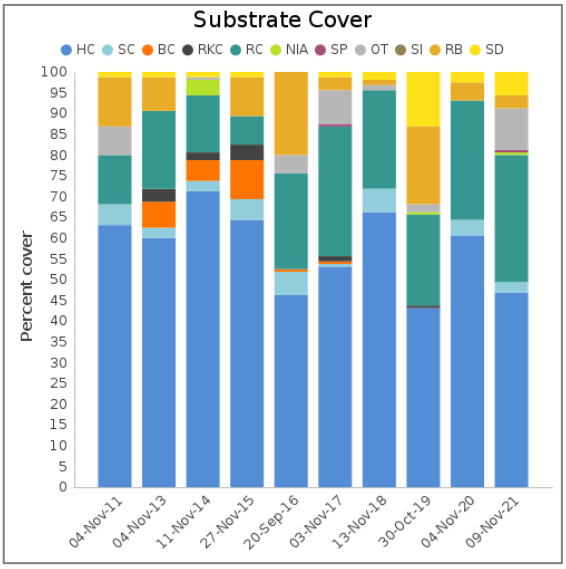


Figure 17. Benthic type and percent cover: Heron Bommie, 2011- 2021.

Twelve giant clams and one Drupella snail were recorded on the invertebrate survey.

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

Coral disease decreased from 67 counts in 2020 to eight counts on this survey. There were 15 counts of unknown scars, 13 incidents of coral damage and one Drupella scar.

A fish survey was conducted and one barramundi cod, eight butterflyfish, two coral trout, one grouper, six snapper and two sweetlip (Image 26) were recorded. A turtle was also observed on transect (Image 27).

Image 25. Site Location – represented by circle

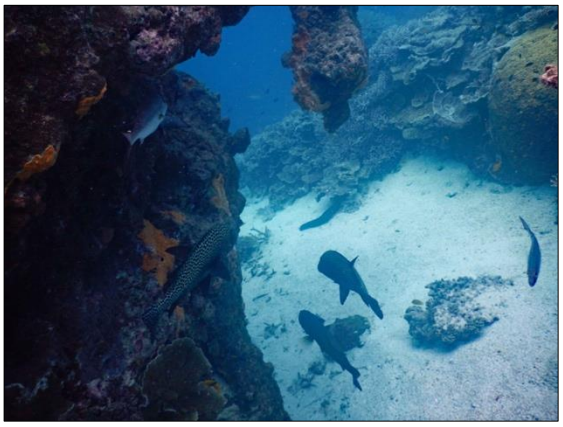


Image 26. Sweetlips

Image 27. Turtle

5.10 Jetty Flat

Jetty flat is located on the south-western side of Heron Island, on the southeast reef flat near the boat channel. It is a shallow site often visited by snorkelers due to its location and ease of access. It is characterised by large areas of branching corals with flat, eroded tips (due to tidal extremes) and sandy patches (Image 28).

Hard corals accounted for 36% of the benthos (Figure 18, Image 29). Rock (including rock, rock with turf algae and rock with calcareous algae) constituted 59% of the substrate, rubble made up 3%, sand just over 1% and soft coral less than 1%.

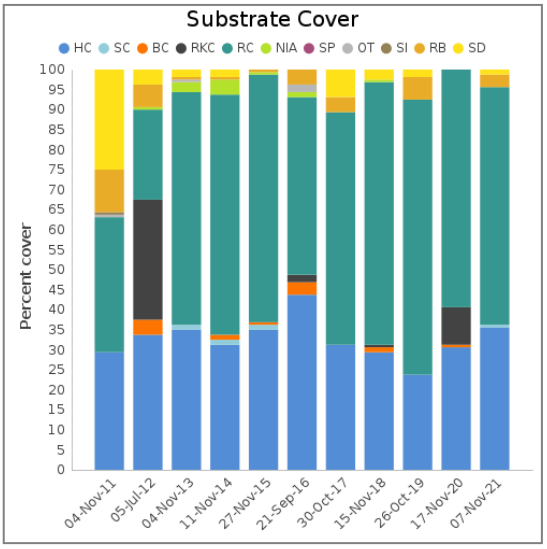


Figure 18. Benthic type and percent cover: Jetty Flat, 2011 - 2021.

Four giant clams and two sea cucumbers were recorded on the invertebrate survey.

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

Reef impacts recorded included five counts of coral damage and nine unknown scars.

A fish survey was conducted and ten butterflyfish, three grouper, two parrotfish and two snapper were recorded. Numerous sharks, rays (Image 30) and turtles were observed off-transect.

Image 28. Site Location – represented by circle

Image 29. Site Photo

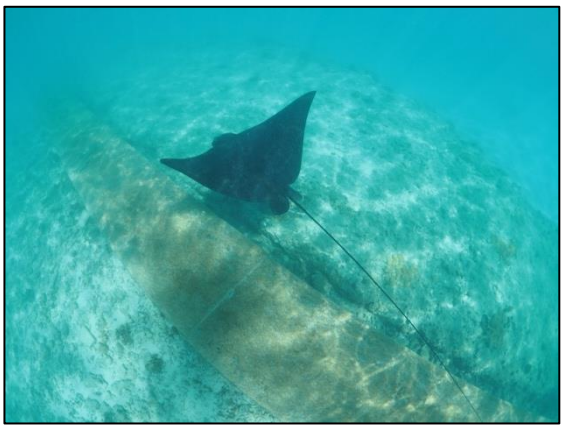


Image 30. Eagle ray

5.11 Last Resort

Last Resort is a lagoonal site accessible on snorkel, located at the north-east corner of the island (Image 31). It is frequented by tourists as it is a popular spot for shark and ray sightings.

Hard corals accounted for 6% of the benthos (Figure 19). Rock (including rock with turf algae and rock with calcareous algae) constituted 24% of the substrate, whilst sand contributed 63% (Image 32). Nutrient indicator algae attributed just over 1%, down from 2020, and rubble 6%. Only one count of macro algae was recorded.

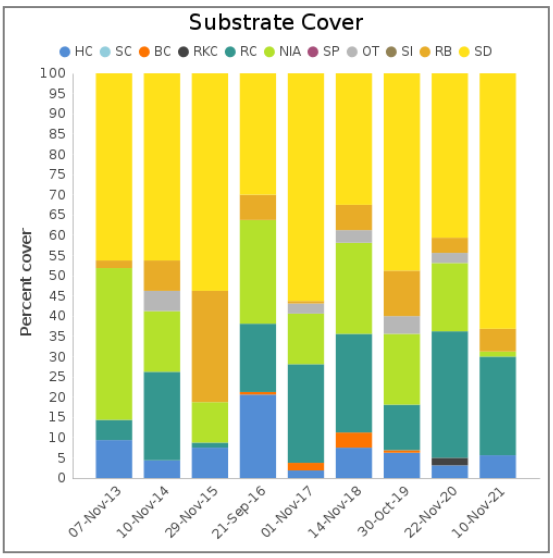


Figure 19. Benthic type and percent cover: Last Resort, 2013 - 2021.

Twenty nine sea cucumbers (Image 33) and seven giant clams were recorded on the invertebrate survey.

Coral bleaching affected <1% of the coral population and an average of 5% of each coral surface affected.

Two counts of coral damage were recorded.

A fish survey was conducted and five snapper and two butterflyfish were recorded.

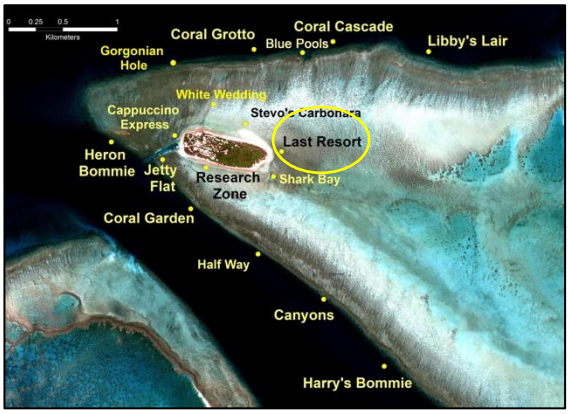


Image 31. Site Location – represented by circle

Image 32. Site Photo

Image 33. Prickly Greenfish (sea cucumber).

5.12 Libby's Lair

Libby's Lair is located on the northern side of Heron Island, on the northeast reef slope. It is characterised by high coral diversity and deep gullies (Image 34).

Hard coral accounted for 76% of the benthos, (Figure 20 and Image 35). Rock (encompassing both rock with turf algae and rock with coralline algae) made up 17% of the substrate, with soft coral 2%, sand at 2%, rubble just over 1% and sponge and other contributing just under 1% each.

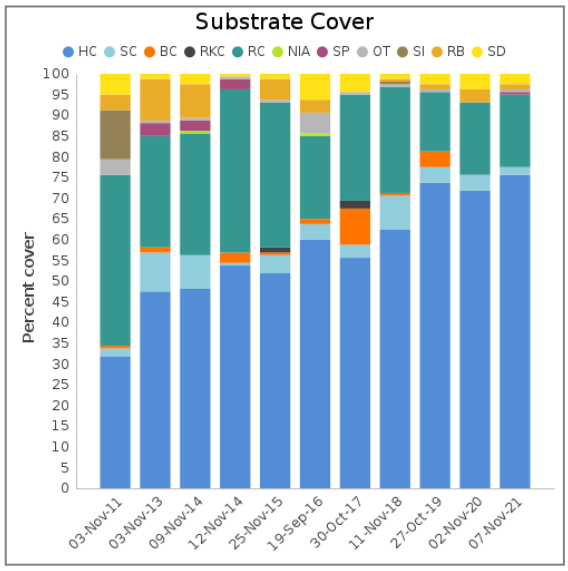


Figure 20: Benthic type and percent cover: Libby's Lair, 2011 - 2021.

One giant clam and two sea cucumbers were recorded on the invertebrate survey.

Coral bleaching was recorded with 0.5% of the population bleached and an average of 37.5% of the coral surface bleached. Impacts recorded included eight incidents of coral damage and nine unknown scars.

A fish survey was conducted and 13 butterflyfish, 12 snapper, three coral trout (Image 36), one grouper and six parrotfish were recorded.

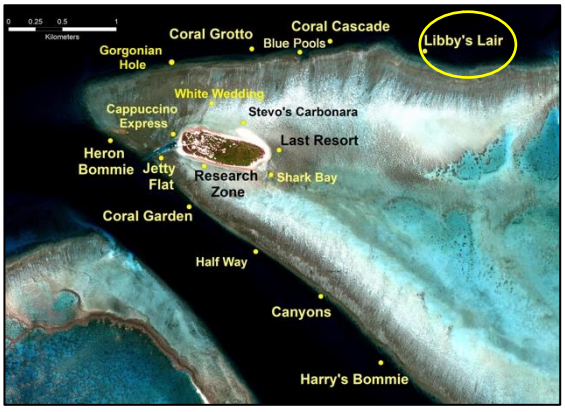


Image 34. Site Location – represented by circle

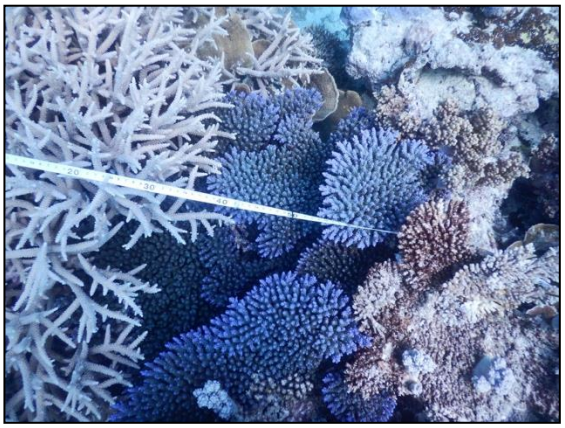


Image 35. Hard coral

Image 36. Coral trout

5.13 Research Zone

The Research Zone site is located on the southern side of Heron Island, within the scientific zone (Image 37). This area is designated for the harvesting of samples for scientific and educational purposes. It is a shallow site utilised by both researchers and tourists on snorkel due to its accessibility.

An increase in sand (66% of the substrate) was recorded this year (Figure 21). Rock (including rock with turf algae and rock with coralline algae) contributed 13% of the substrate, hard coral just over 7% and rubble 9%. Nutrient indicator algae attributed 2% to the benthos and "other" just over 3%. Four counts of macro algae (Padina, Image 38) were recorded.

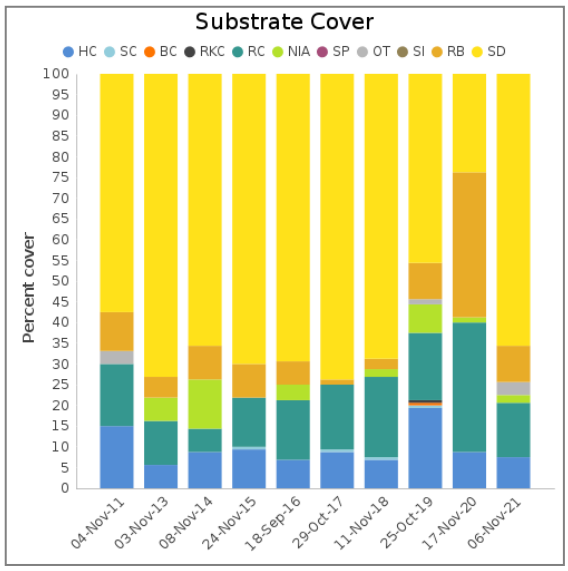


Figure 21. Benthic type and percent cover: Research Zone 2011 - 2021.

Seven sea cucumbers, four giant clams and one Trochus were recorded on the invertebrate survey.

Coral bleaching affected 0.25% of the coral population with an average of 9% of the surface of each affected coral.

Five incidents of coral damage were recorded on the impact survey.

A fish survey was conducted and six butterflyfish, three grouper and seven parrotfish were recorded. Stingrays were also observed (Image 39).

Image 37. Site Location – represented by circle

Image 38. Dominant algae, *Padina* spp.

Image 39. Stingray

5.14 Shark Bay

The Shark Bay site is located on the eastern side of Heron Island. It is a shallow site frequented by tourists on snorkel due to its accessibility, and shallow depth. This reef area is a popular spot for shark and ray sightings (Image 40).

Hard coral accounted for 8% of the benthos at this sandy (50%) reef flat location (Figure 22, Image 41). Rock (including rock with turf algae and rock with calcareous algae) attributed 26%, rubble 3% and other 4%. Nutrient indicator algae made up 9% of the substrate and 18 counts of macro algae were recorded.

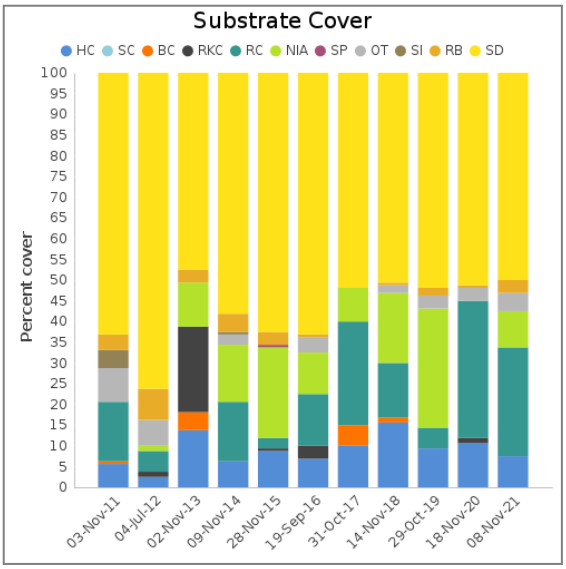


Figure 22. Benthic type and percent cover: Shark Bay, 2011- 2021.

Forty five sea cucumbers (again the highest count) and six giant clams were recorded during the invertebrate survey.

Coral bleaching was not recorded.

Impacts were limited to two incidents of coral damage (Image 42) recorded on the impacts survey.

A fish survey was conducted and 17 butterflyfish and two snapper were recorded.

Image 40. Site Location – represented by circle

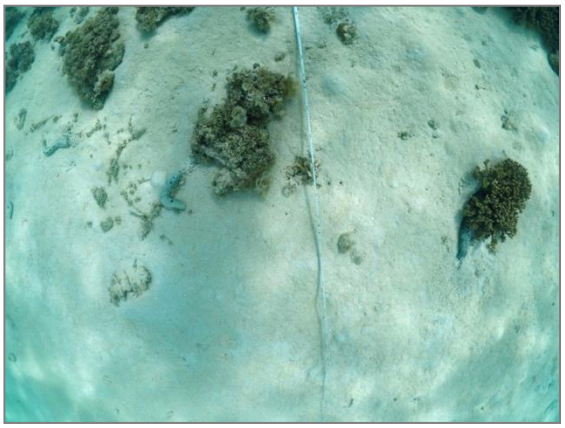


Image 41: Site Photo

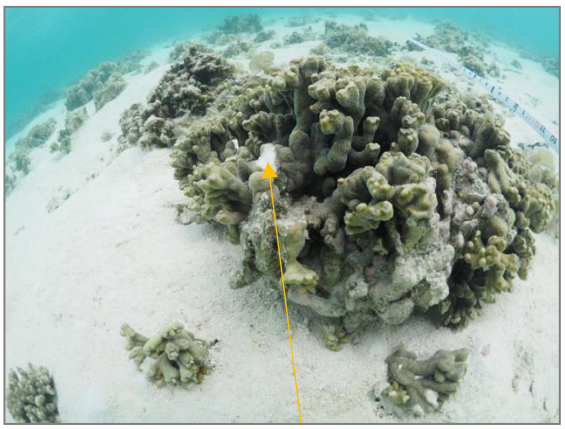


Image 42: Coral damage

5.15 Stevo's Carbonara

Stevo's Carbonara is located on the reef flat on the northern side of the island (Image 43). It is close to the resort and regularly frequented by tourists on snorkel and also reef walkers.

Hard coral was not recorded on substrate transect in 2021 (Figure 23). Sand again dominated the substrate at 79%. "Other" (primarily Halimeda) made up 14%, with rock at 6% and rubble and nutrient indicator algae (Image 44) just under 1% each. Six counts of macro algae were recorded on transect (Image 45).

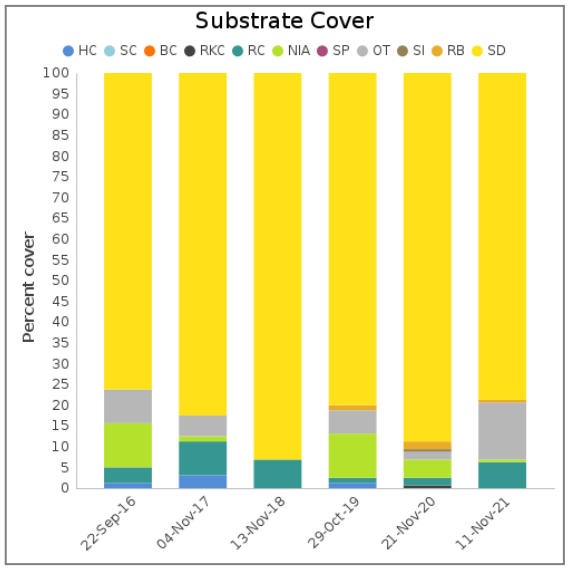


Figure 23. Benthic type and percent cover: Stevo's Carbonara, 2016 - 2021.

Two sea cucumbers were the only target invertebrates recorded on the invertebrate survey.

Impacts were not observed during the impacts survey.

A fish survey was conducted and one butterflyfish was recorded.

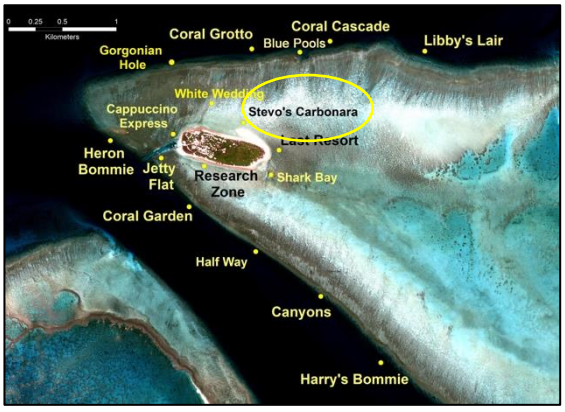


Image 43. Site Location – represented by circle

Image 44: *Philinopsis lineolata* (sea slug) with nutrient indicator algae

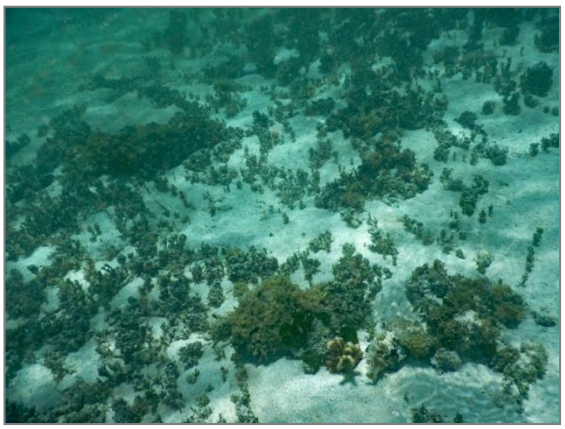


Image 45: Dominant algae

5.16 White Wedding

White Wedding is located on the reef flat on the northern side of the island (Image 46). It is close to the resort and regularly frequented by tourists on snorkel and also reef walking.

Hard coral accounted for 9% of the benthic substrate (Figure 24). Rock (consisting of rock, rock with turf algae and rock with calcareous algae) made up 17% and sand 59%. Rubble attributed 6% to the substrate composition. One count of macro algae was recorded.

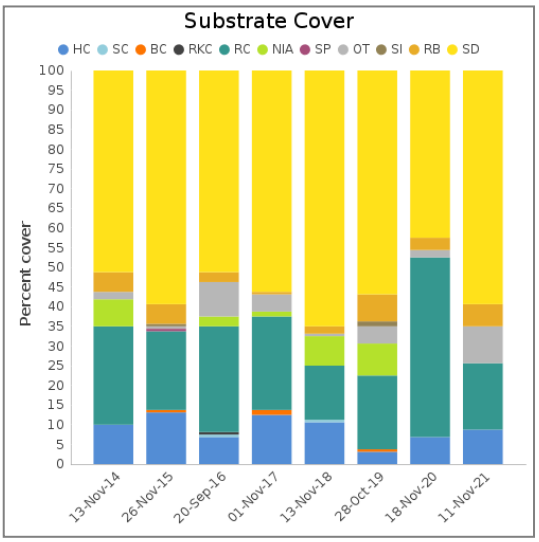


Figure 24. Benthic type and percent cover: White Wedding 2014-2021.

Fifteen giant clams (Image 47), two Drupella snails (Image 48) and seven sea cucumbers were recorded on the invertebrate survey.

Coral Bleaching affected <1% of the coral population and an average of 8% of the surface of affected coral colonies.

One incident of coral damage and three unknown scars were recorded on the impact survey.

A fish survey was conducted and two butterflyfish and four snapper were recorded.

Image 46. Site Location – represented by circle

Image 47: Giant clams

Image 48: Drupella snails

6.0 FURTHER INFORMATION

For more information on Reef Check Australia, survey methods, sites and previous reports, please go to www.reefcheckaustralia.org.

6.1 References

- Hill J, Wilkinson C. 2004. Methods for ecological monitoring of coral reefs: A resource for managers. Version 1. Australian institute of Marine Science. p. 117 p.
- Done T, Roelfsema C, Harvey A, Schuller L, Hill J, Schlappy ML, Lea A, Bauer-Civiello A, Loder J. 2017. Reliability and utility of citizen science reef monitoring data collected by reef check australia, 2002-2015. Marine Pollution Bulletin. 117(1-2):148-155.
- J Salmond, A Lea, J Loder, C Roelfsema and J Passenger (2014), Reef Check Australia Heron Reef Health Report 2014.
- J Salmond, J Loder, C Roelfsema, R Host and J Passenger (2016), Reef Check Australia 2015 Heron Reef Health Report.
- J. Salmond, J. Loder, C. Roelfsema, and J. Passenger (2017), Reef Check Australia 2016 Heron Reef Health Report.
- J. Salmond, J. Loder, C. Roelfsema, and J. Passenger (2017), Reef Check Australia 2017 Heron Island Reef Health Report.
- J. Salmond, J. Passenger, E. Kovacs, C. Roelfsema and D. Stetner (2018), Reef Check Australia 2018 Heron Island Reef Health Report.
- J. Salmond, J. Passenger, E. Kovacs, and C. Roelfsema (2019), Reef Check Australia 2019 Heron Island Reef Health Report.
- QGIS Development Team, 2020. QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org
- Roelfsema, C.M., and S.R. Phinn (2010). Calibration and Validation of Coral Reef Benthic Community Maps: Integration of Field Data with High Spatial Resolution Multi Spectral Satellite Imagery. Journal of Applied Remote Sensing, Vol. 4, 043527
- Roelfsema, C.M., S.R. Phinn, S. Jupiter, J. Comley, S. Albert, and P. Mumby (2013) Mapping Coral Reefs at Reef to Reef-System scales (10-600 km2) using OBIA Driven Ecological and Geomorphic Principles. Special issue on coral reefs in International Journal of Remote Sensing.
- Roelfsema, Chris M; Thurstan, Ruth; Flower, Jason; Beger, Maria; Gallo, Michelle; Loder, Jennifer; Kovacs, Eva M; Gomez Cabrera, K-Le; Lea, Alex; Ortiz, Juan; Brunner, Dunia; Kleine, Diana (2014): Ecological Assessment of the Flora and Fauna of Point Lookout Dive Sites, North Stradbroke Island, Queensland. *UniDive, The University of Queensland Underwater Club, Brisbane, Australia*, "http://doi.pangaea.de/10013/epic.45045.d001" hdl:10013/epic.45045.d001
- Roelfsema, C., E. Kovacs, P. Roos, D. Terzano, M. Lyons and S. Phinn (2018). "Use of a Semi-Automated Object Based Analysis to Map Benthic Composition, Heron Reef, Southern Great Barrier Reef." Remote Sensing Letters 9(4): 324-333. Doi: 10.1080/2150704X.2017.1420927
- Roelfsema, C. M., E. Kovacs, K. Markey, J. Vercelloni, A. Rodriguez-Ramirez, S. Lopez-Marcano, M. Gonzalez-Revero, O. Hoegh-Guldberg and R. S. Phinn (2021). "Benthic and coral reef community field data for Heron Reef, Southern Great Barrier Reef, Australia, 2002-2018." Scientific Data. https://www.nature.com/articles/s41597-021-00871-5
- Siebeck UE, Marshall NJ, Kluter A and Hoegh-Guldberg O (2006) Monitoring coral bleaching using a colour reference card. Coral Reefs 25:453-460

Image 49: Crown-of-thorns Starfish

APPENDIX A COMPARATIVE ISLAND WIDE GRAPHS FOR 2021 DATA