

Reef Check Australia

Heron Island

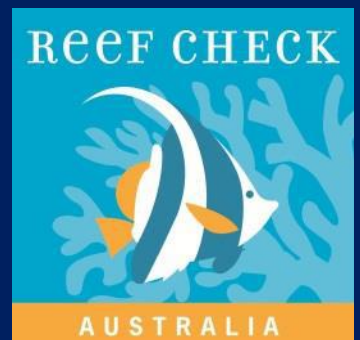
Reef Health Report 2016



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Heron Island Reef Health Report 2016



Reef Check Australia
greatly appreciates all of the people and organizations
who have helped to make this year's project possible.



Gladstone Ports Corporation

Growth, Prosperity, Community.

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Remote Sensing
RESEARCH CENTRE

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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. RCA monitoring sites were established on Heron Island in 2011.

Reef Checks ongoing monitoring at Hereon Reef was initiated by UQ's Remote Sensing Research Centre (RSRC) in 2011 as a joint annual collaboration. The RSRC team has been monitoring benthic composition of Heron Reef annually since 2001, using geo-referenced photo transects and other field data to create and validate habitat maps using satellite image data. Data from RCA augments this substantial dataset by offering further information on impact severity and abundance of key organisms, as well as allowing a field-based comparison of benthic composition.

Summary findings for 15 Reef Check Australia surveys conducted around Heron Island from September 17 to 24, 2016 are presented in this report. This project is intended to continue as part of the long-term monitoring program at Heron Island, with the goal of providing important information in regards to the Health Status for Marine Park Managers, Island managers, researchers and resource users (including staff and guests) and the broader community.

Heron Reef is uniquely situated to provide valuable reef health information, as it is a relatively isolated reef system, yet situated nearby to areas with extensive coastal development and also subject to potential global effects from climate change. The system has already proven that it is not immune to marine health threats, with up to 21% of sea birds on the Island found to ingest marine debris (Verlis et al; 2013) and a decline in the number of sea turtles in recent years due to flood impacts on seagrass beds. RCA surveys have also shown fluctuations in disease and bleaching impact abundance since 2011. Yet, undeniably, this system hosts incredible examples of iconic Australian reef systems and has been highlighted by Jacques Cousteau as one of his top ten dives.

Heron Reefs are highly studied, with hundreds of researchers visiting the Island annually through the University of Queensland's Research Station. Yet, 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, cohesive studies.

This project demonstrates the value of collaborative citizen-science initiatives as a powerful tool to contribute useful information for science, management and education initiatives.



2.0 SUMMARY OF FINDINGS

Reef Check Australia survey teams' monitored 15 fringing reef sites around Heron Island over the period of September 17 to 24. Substrate line transects in addition to invertebrate and impact belt transects were conducted at each site. Fish surveys were not completed in 2016. In 2016, nine GBRMPA Rapid Health Impact Surveys (RHIS) were also conducted in addition to Coral Watch and REEFSearch surveys at all sites. Underwater cameras were used to document visual evidence of key site features, reef impacts and invertebrates.

Since the RCA Heron Reef program started in 2011 in partnership with the University of Queensland's Remote Sensing Research Centre, additional sites have been added to allow for a more representative collection of survey locations around the island. A total of 16 RCA Heron Reef Sites are now monitored as part of a long term monitoring program. A summary of key findings for the 2016 RCA season are listed below.

- Total average hard coral cover across all sites was 40.4%; this is consistent with 2015 and 2014 results (39.5% and 37.6% consecutively). Hard coral cover ranged from 1% to 84% across monitoring sites. Six sites had coral cover greater than 50%, two sites had between 25-50% cover and seven sites had less than 25% coral cover.
- Most sites had low levels of soft coral (present at 8 of 15 sites and averaging 1.6% coverage).
- Indicator sea cucumbers were found in higher abundances on sandy inshore sites. All snorkel sites (7) had sea cucumbers (with an average of 18 per site). Just two dive sites (Harrys Bommie and Libbys Lair) had sea cucumbers present (1 at each).
- Giant clams were found on all sites except Coral Garden and Shark Bay. White Wedding had the highest abundance with 20 (per 400m²).
- *Trochus* snails were recorded at Cappuccino Express (1), Coral Gardens (1), Halfway (3) and White Wedding (1).
- Coral scarring from unknown causes was reported at 13 of the 15 sites, with the highest record of 19 counts per 400m² at Jetty Flat. An average of 4.5 counts per 400m² were recorded for all other sites.
- Hard coral damage was recorded at 14 out of 15 sites. The highest abundance (29 counts) was recorded at Jetty Flat in 2016 (23 counts in 2015 and 19 in 2014).
- Low levels of coral bleaching occurred on all sites. The highest population bleaching was recorded at Cappuccino Express with bleaching impacting 15.3% of the coral population (with 19.3% of each colony bleached on average). Last Resort and Canyons had the highest individual colony bleaching average (47.5% and 47.4% consecutively) with population bleaching levels of 5% and 4.3%. Total average coral population bleaching across all sites was 4.5%-an increase from 1.7% in 2015.
- Coral disease was recorded at 9 of the 15 sites. Of these, five had less than ten incidents recorded. Coral Gardens had the highest counts of disease, with 50 incidents recorded per 400m² - an increase from 2015 levels (8 counts), but still significantly less than 2014 levels (106 counts) in 2014. Canyons, Harry's Bommie and Heron Bommie all had high counts of coral disease, with 27, 24 and 23 per 400m² respectively. Average coral disease counts across all other sites was 9.7 per 400m².
- Community outreach citizen science initiatives for 2016: Building on experience from previous years, the team conducted: An island wide clean-up with guests and researchers (8), REEFSearch and Coral Watch reef walk with island guests (25), citizen science presentation to resort guests (30) and to research station guests (60-70).

3.0 INTRODUCTION

3.1 Reef Check Australia Overview

Trained Reef Check Australia (RCA) volunteers have been monitoring the ecological health of coral reefs around Australia since 2001. Annual surveys provide regionally-specific long-term data sets that can be used for local and regional reef management and are part of the globally standardised Reef Check program comparing reef health on a worldwide scale. These multiple levels of 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, providing a globally relevant data set and providing 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.

Reef Check surveys include quantitative data about substrate cover, as well as abundance of key invertebrate species and target fish species. RCA also documents natural and anthropogenic impacts that affect 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. 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 80m, divided into four 20m sections, each separated by 5m. This design allows for data comparisons within sites using the 4 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. The diver records the substrate type that is directly below the tape measure every 0.5m along each of the four 20m sections interval.

Table 1. Codes and distribution of 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 (digitate, columnar, etc.) HCB: Bleached Hard Coral |
| Soft Coral | SCL: Leathery Soft Coral SCZ: Zooanthids SC: Other Soft Coral (tree or flower shaped) SCB: Bleached Soft Coral |
| Recently Killed Coral | RKCTA: Recently killed coral with Turf Algae RKCNI: 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 |

The invertebrate & impacts survey is conducted along the same transect line using a 5m wide belt transect methodology. Divers spend 7-10 minutes on each 20m replicate using a u-shaped search pattern to look for indicator invertebrates and reef impacts. The 14 invertebrate indicators have been selected based on their economic and/or ecological importance. Reef health indicators include 10 (both human and natural) reef impacts, focussing on issues that may be addressed through the right strategies.

The 16 Reef Check Australia monitoring sites were established to allow for a detailed representation of reefs surrounding Heron Island. The sites were selected to represent diverse management and use areas on Heron Reef. Six are located in protected Green zones, five are located in general use areas and five are located in a scientific research zone that allows extraction for experimental & educational purposes. During the 2016 RCA surveys, 15 of these 16 sites were revisited.

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 2010) 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).

Coral Health Chart surveys were also collected at each site to specifically assess coral colour as an indicator of coral stress (www.coralwatch.org) (Siebeck et al 2006).

REEFSearch surveys were conducted at 15 survey locations. Rapid Health Impact Surveys were also conducted at nine locations around the island by trained RCA volunteers (<http://www.gbrmpa.gov.au>) to ensure the use of a diverse array of data collection tools.

3.3 Heron Island

Heron Island (.62km²) is a coral cay located on the southern section of the Great Barrier Reef, approximately 80km off the coast of Gladstone, Queensland. The island sits on a 27km² platform reef. The waters surrounding Heron Island are divided into one of three management designations, including Marine National Park (Green Zone), Conservation Park or Scientific Research zones.

Heron Island plays host to both 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- and the HIRS is a heavily utilised research station with visiting schools, researchers and universities from Australia and the world. HIRS can accommodate up to 150 people.

The fringing reefs are well-utilised for snorkel and diving tourism as well as reef research. These activities may be having some unintended impacts. Factors such as extensive development in the nearby Gladstone region and global climate change may also pose threats to this marine ecosystem.

3.4 Site Location Map

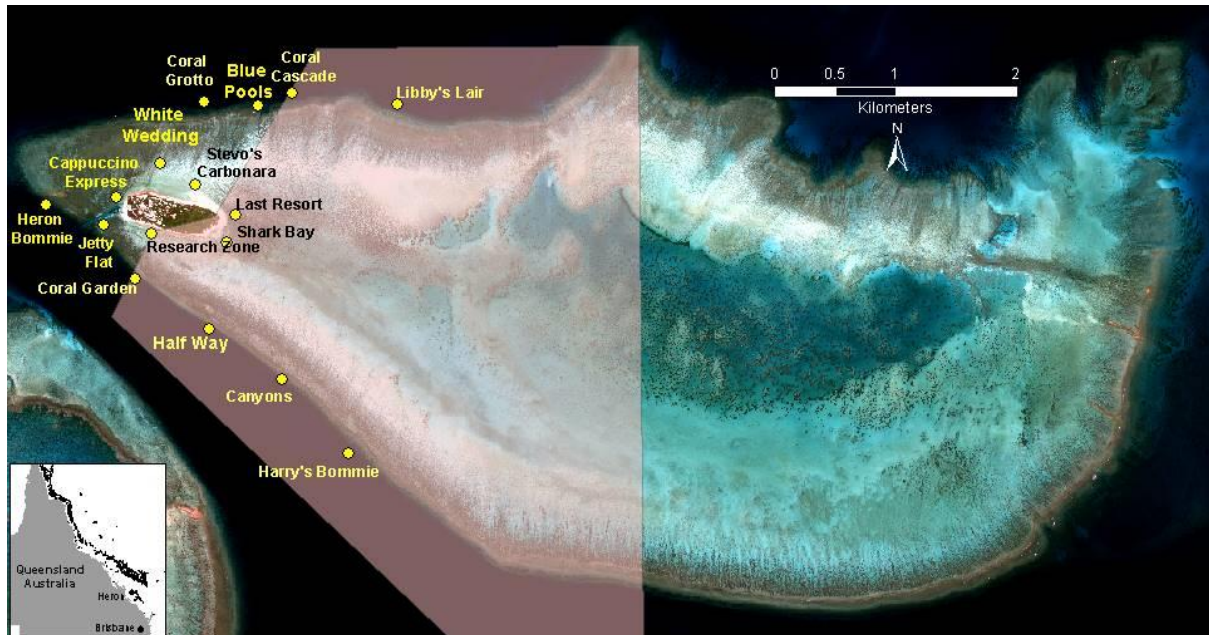


Image 1. Reef Check field sites and the conservation zone overlaid on the WorldView 2 pan sharpened image acquired on 1 November 2011 over Heron Reef (Image source: Digital Globe).

Table 2. Table of RCA monitoring locations on Heron Island, including site depth, average hard coral cover, site designation (Marine National Park, Conservation Park, or Scientific Zone), habitat type and the years in which each site was surveyed.

| Site | Depth (m) | HC % at site | Site Designation | Habitat Type | Year(s) Site Surveyed |
|--------------------|-----------|--------------|-------------------|-----------------------------------|------------------------------------|
| Blue Pools | 5 | 44 | Conservation Park | Reef slope | 2014 |
| Canyons | 5 | 70 | Scientific Zone | Reef slope | 2013, 2014, 2015, 2016 |
| Cappuccino Express | 2 | 27 | Marine Natl Park | Sandy reef flat with micro atolls | 2013, 2014, 2015, 2016 |
| Coral Cascade | 6 | 50 | Conservation Park | Reef slope | 2013, 2014, 2015 |
| Coral Garden | 5 | 65 | Marine Natl Park | Reef slope | 2011, 2013, 2014, 2015, 2016 |
| Coral Grotto | 6 | 40 | Conservation Park | Reef slope | 2011, 2013, 2014, 2015, 2016 |
| Halfway | 6 | 27 | Scientific Zone | Reef slope | 2014, 2015, 2016 |
| Harry's Bommie | 9 | 68 | Scientific Zone | Reef slope | 2011, 2013, 2014, 2015, 2016 |
| Heron Bommie | 5 | 65 | Marine Natl Park | Reef slope | 2011, 2013, 2014, 2015, 2016 |
| Jetty Flat | 2 | 36 | Marine Natl Park | Reef flat with micro atolls | 2011, 2012, 2013, 2014, 2015, 2016 |
| Last Resort | 2 | 7 | Conservation Park | Sandy reef flat | 2013, 2014, 2015, 2016 |
| Libby's Lair | 6 | 50 | Conservation Park | Reef slope | 2011, 2013, 2014, 2015, 2016 |
| Research Zone | 1 | 9 | Scientific Zone | Sandy reef flat | 2011, 2012, 2013, 2014, 2015, 2016 |
| Shark Bay | 2 | 8 | Scientific Zone | Sandy reef flat | 2011, 2012, 2013, 2014, 2015, 2016 |
| Stevos Carbonara | 2 | 1 | Marine Natl Park | Sandy reef flat with micro atolls | 2016 |
| White Wedding | 1 | 10 | Marine Natl Park | Sandy reef flat | 2014, 2015, 2016 |

4.0 Summary Survey Report

Table 3. Summary table of RCA monitoring findings for each of the 14 surveys conducted on Heron Reef comparing 2015 with 2014 findings. 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 %, average coral bleaching for colony surface %); and silt levels (N=none, L=low, M=medium, H=high). Categories are listed as abundance counts unless otherwise specified. The above information depicts information collected over a standard survey as described in section 3.2.

| | Substrate | | Invertebrates | | | | | | Impacts | | | | | | | |
|--------------------|-------------------------|-----------------------|--------------------------|----------------|------------|-------------|--------------------|-------------|-------------------|------------------|------------------|-------------------|-------------------|--------------------------------|----------------------------|------------|
| | Hard Coral Coverage (%) | Macro Algae Total (#) | Edible Sea Cucumbers (#) | Giant Clam (#) | Triton (#) | Trochus (#) | Drupella Snail (#) | Anemone (#) | Drupella Scar (#) | Unknown Scar (#) | Coral Damage (#) | Coral Disease (#) | Marine Debris (#) | Coral Bleaching Population (%) | Coral Bleaching Colony (%) | Silt Level |
| Canyons | 79 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 27 | 0 | 4 | 47 | L |
| Cappuccino Express | 24 | 0 | 23 | 6 | 0 | 0 | 0 | 0 | 0 | 6 | 2 | 8 | 0 | 15 | 19 | L |
| Coral Cascade | 61 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 4 | 0 | 4 | 27 | L |
| Coral Garden | 71 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 3 | 7 | 50 | 0 | 0.3 | 1.3 | N |
| Coral Grotto | 60 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 0 | 0 | 1 | 31 | L |
| Halfway | 17 | 6 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 8 | 3 | 2 | 0 | 1 | 28 | N |
| Harry's Bommie | 84 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 5 | 3 | 24 | 0 | 7 | 13 | N |
| Heron Bommie | 46 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 8 | 6 | 23 | 0 | 5 | 18 | L |
| Jetty Flat | 44 | 0 | 4 | 7 | 0 | 0 | 0 | 0 | 0 | 19 | 29 | 4 | 1 | 5 | 13 | N |
| Last Resort | 72 | 18 | 16 | 2 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 0 | 0 | 5 | 48 | L |
| Libby's Lair | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 15 | 0 | 0 | 2 | 26 | L |
| Research Zone | 7 | 5 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 2 | 9 | 0 | 0 | 3 | 16 | N |
| Shark Bay | 7 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 1 | 3 | 0 | 5 | 6 | L |
| Stevo's Carbonara | 1 | 0 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0.3 | 1 | M |
| White Wedding | 7 | 0 | 14 | 14 | 0 | 1 | 0 | 0 | 0 | 13 | 2 | 0 | 0 | 10 | 15 | L |

To illustrate broad-spatial scale trends in the Reef Check data collected during the 2015 surveys the Reef Check data from each individual site was overlayed on a high spatial resolution pan sharpened WorldView 2 image (acquired 1 10 October 2014, source Digital Globe).

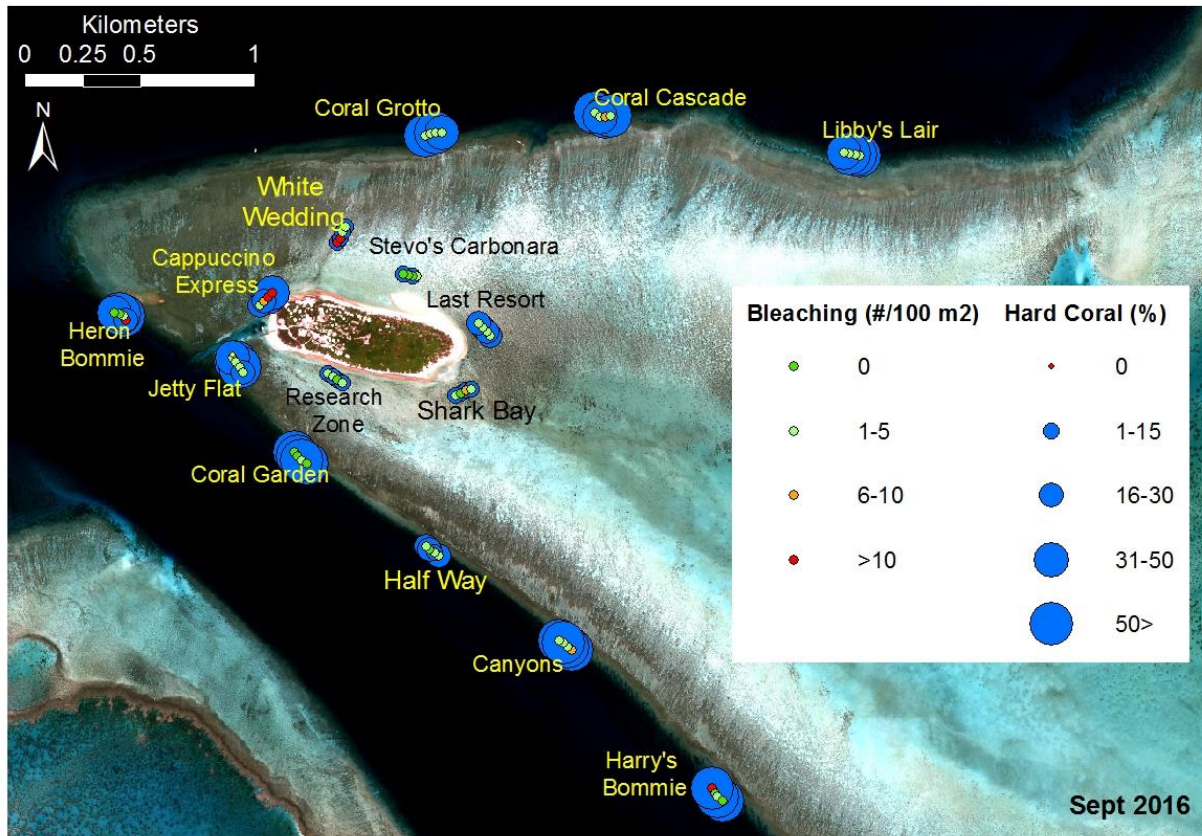


Figure 1. Map of Heron Island with Reef Check hard coral cover and population level bleaching data for 2016 surveys, overlayed on Worldview 2, satellite image (acquired 1 10 October 2014, source Digital Globe). Each survey site is represented by four circles, each displaying summary data for one of the four 100m² areas that makes up a full 400m² transect.

Coral bleaching levels increased from 2015 to 2016. The 2016 data indicates low level bleaching recorded at all 15 sites. Higher levels of coral bleaching were recorded on the northern side of Heron Island (average of 5.3% coral population and 23.2% coral colony bleaching for northern sites compared to 3.5% coral population and 17.7% colony bleaching for southern sites) despite higher coral cover found on the southern side of the island). This is an increase from 2015 bleaching levels recorded (1.8% coral population bleaching for northern sites compared to an average of 1.3% for southern sites. Coral Garden, Halfway and Stevos Carbonara were the only sites to have less than <1% of the coral population bleached. The highest average bleaching across a single site was Cappuccino Express with 15.3%- an increase from 5.7% recorded in 2015. Shallow inshore sites had an average bleached coral population twice that of deeper, reef crest/slope sites (6.2% compared to 3%).

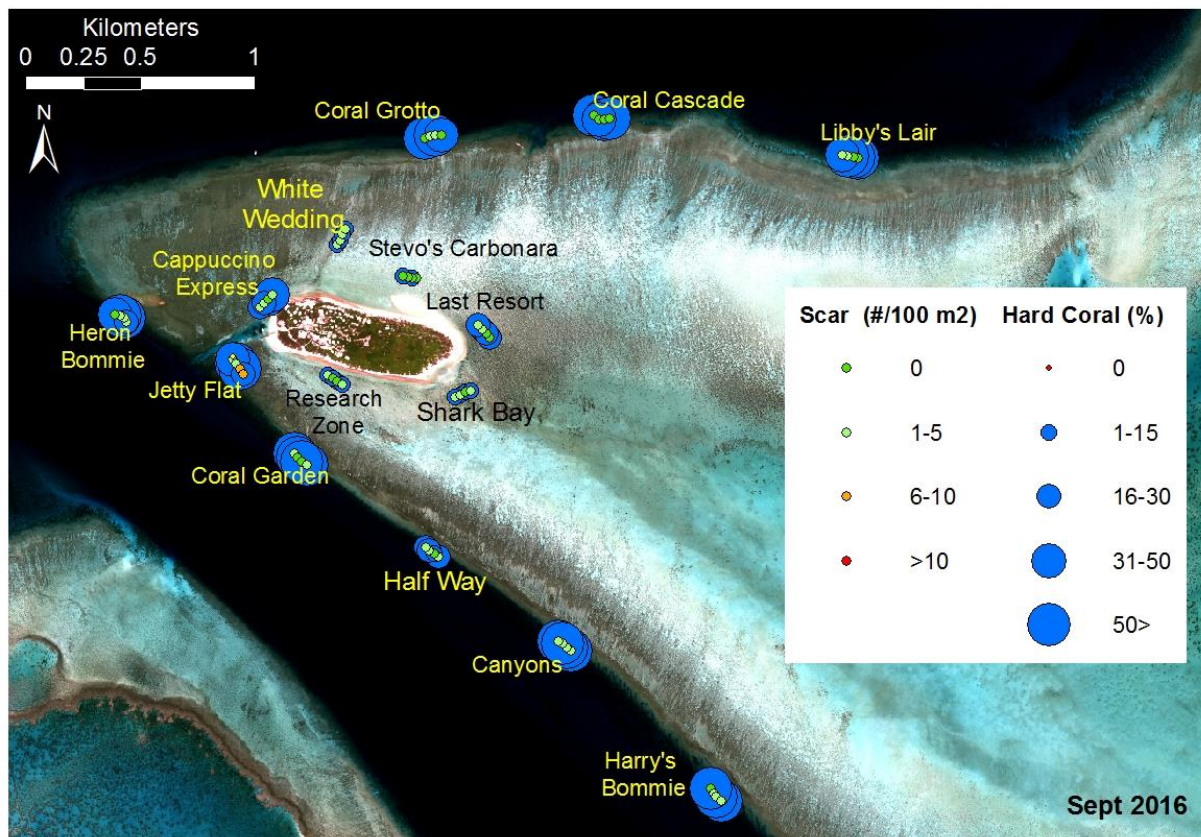


Figure 2. Map of Heron Island with Reef Check hard coral cover and unknown scar data. Each survey site is represented by four circles, each displaying summary data for one of the four 100m² areas that makes up a full 400m² transect.

Thirteen of the 15 sites showed instances of unknown scars. Of these, Jetty Flat and White Wedding were the only sites with more than 10 scars recorded per 400m² (19 and 13 respectively). The 2016 data indicates higher levels of coral scars on the southern side of Heron Island (average of 6.72 counts per 400m²) compared with the northern side (average of 5 counts per 400m²). This is consistent with previous findings; 2015 results (southern side with an average of 6.14 counts per 400m² in 2015, and 10.28 counts in 2014; and the northern side with an average of 2.5 counts per 400m² in 2015 and 4.28 counts in 2014). The southern side also has higher average coral cover (44.1% compared to 35%); a finding consistent with previous reports. Shallow inshore, easily accessible sites had a higher average of unknown coral scar occurrence (7 counts per 400m²) when compared to deeper, reef crest/slope sites accessible only by boat (4.8 counts per 400m²).

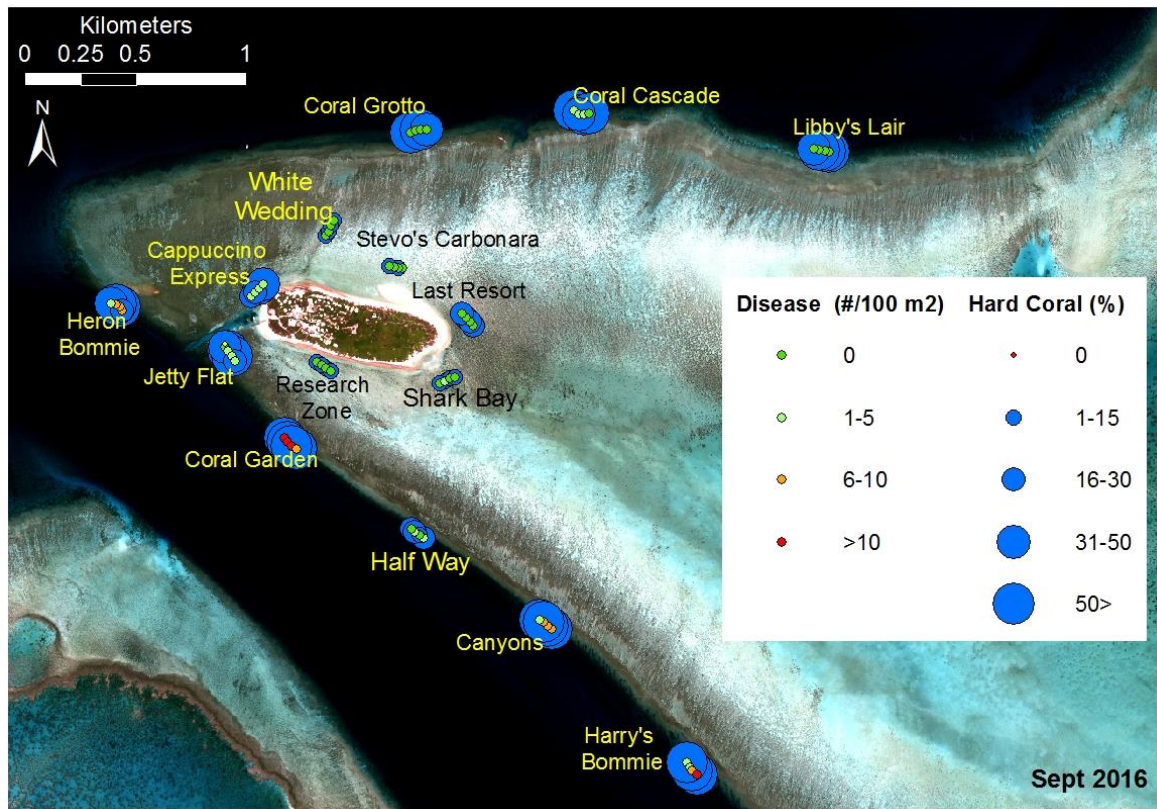


Figure 3. Map of Heron Island with Reef Check hard coral cover and coral disease data. Each survey site is represented by four circles, each displaying summary data for one of the four 100m² areas that makes up a full 400m² transect.

Nine of the 15 sites had instances of coral disease recorded on transect. The 2016 data indicates a higher concentration of coral disease at Coral Gardens (50 counts), Canyons (27 counts), Harrys Bommie (24) and Heron Bommie (24) than at other survey locations (average of 4.2 counts per 400m² when excluding the above mentioned sites and sites with no disease recorded). Sites on the southern side of the island had a higher average incidence of disease (15.7 counts per 400m²) when compared to the northern sites (4.4 counts per 400m²). As mentioned previously, southern sites also have a higher average coral cover (44.1%) than northern sites (35%).

Shallow inshore, easily accessible sites had a much lower average of coral disease occurrence (2.1 counts per 400m²) when compared to deeper, reef crest/slope sites accessible only by boat (16.3 counts per 400m²).

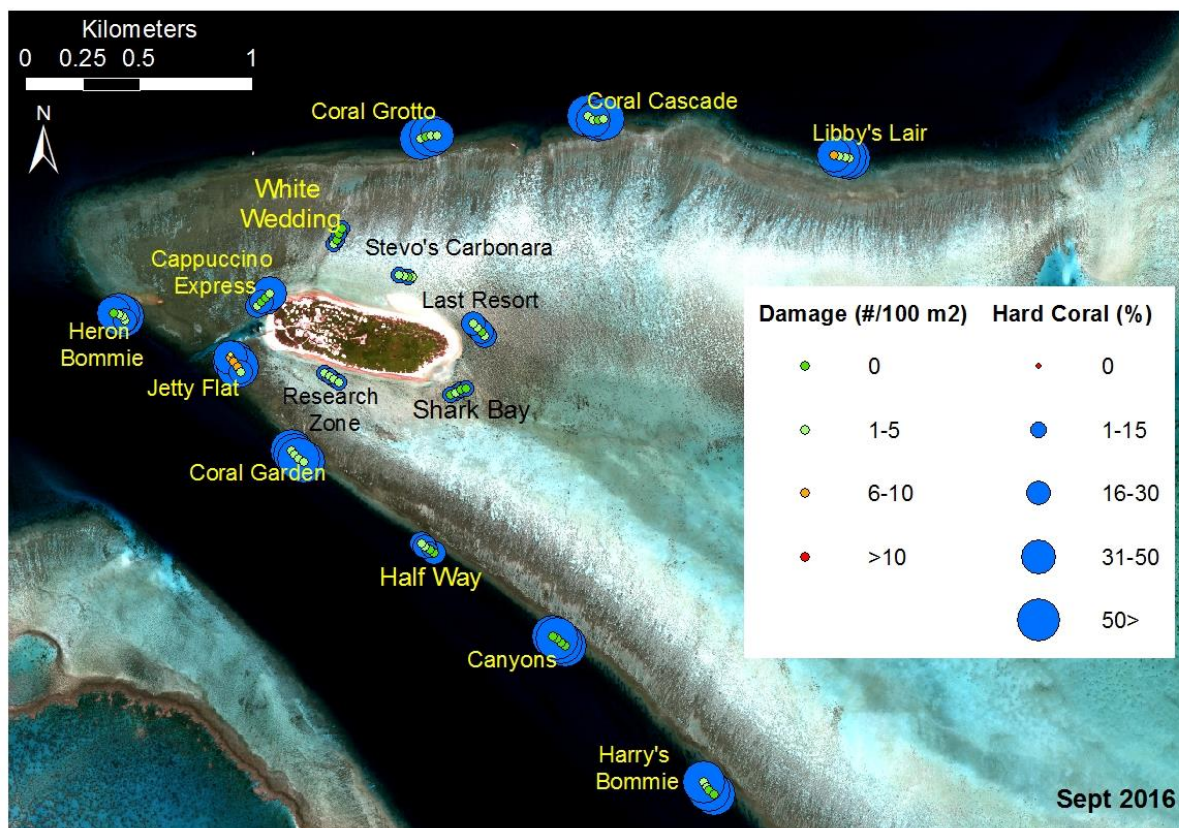


Figure 4. Map of Heron Island with Reef Check hard coral cover and coral damage data. Each survey site is represented by four circles, each displaying summary data for one of the four 100m² areas that makes up a full 400m² transect.

Fourteen of the 15 sites had instances of coral damage. Canyons was the only site with no examples of coral damage found on the transect. The 2016 data indicates a higher than average (average over all 15 sites is 6.7 counts per 400m²) concentration of coral damage at Jetty Flat, Libby's Lair, Coral Cascade and Coral Gardens (29, 15, 8 and 7 counts per 400m² respectively).

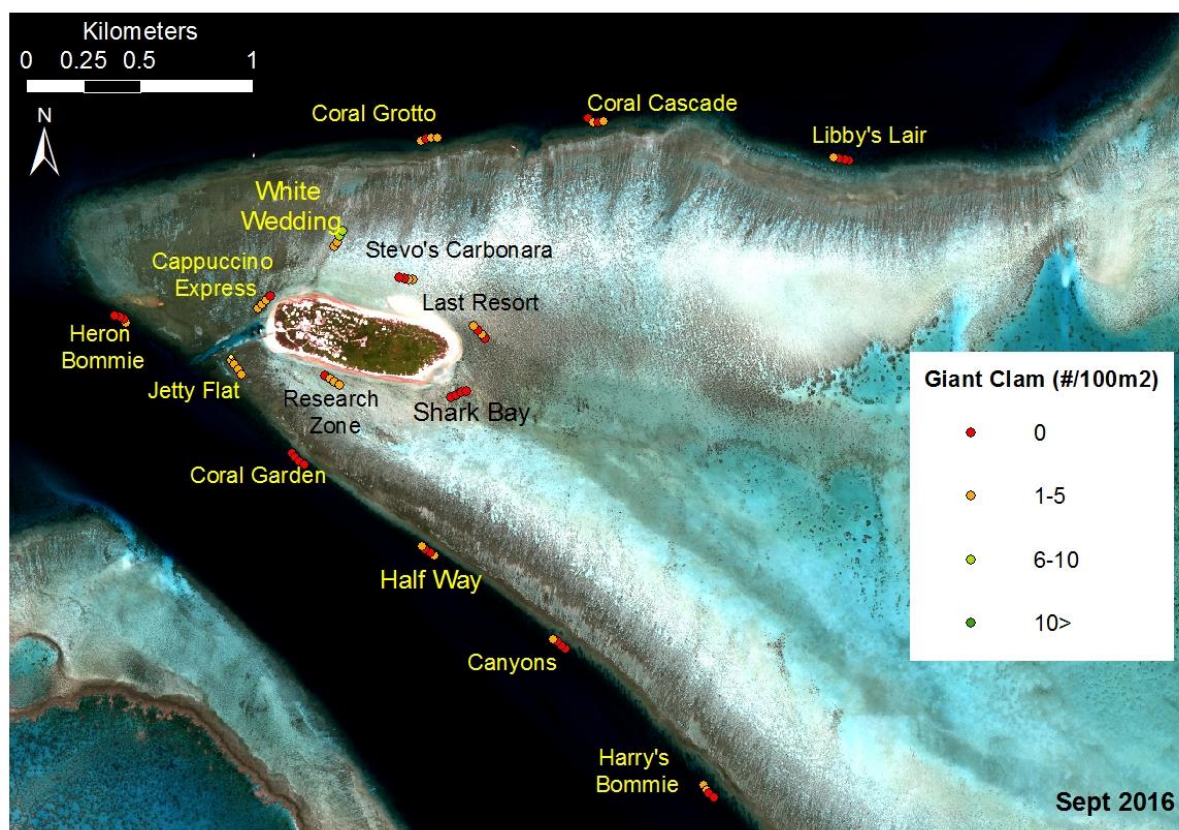


Figure 5. Map of Heron Island with Reef Check Giant Clam abundance. Each survey site is represented by four circles, each displaying summary data for one of the four 100m² areas that makes up a full 400m² transect.

The 2016 data indicates higher concentrations of giant clams on the northern side of the island (average of 5.9 clams per 400m² compared to 2.7 clams per 400m² found on the southern side). Northern near shore site White Wedding had the highest concentrations of giant clams with 20 found on the transect. Coral Garden was the only site with no giant clams recorded along the transect. Shallow inshore sites had a higher average of giant clams recorded (6.7 per 400m²) when compared to deeper, reef crest/slope sites (2.4 per 400m²).

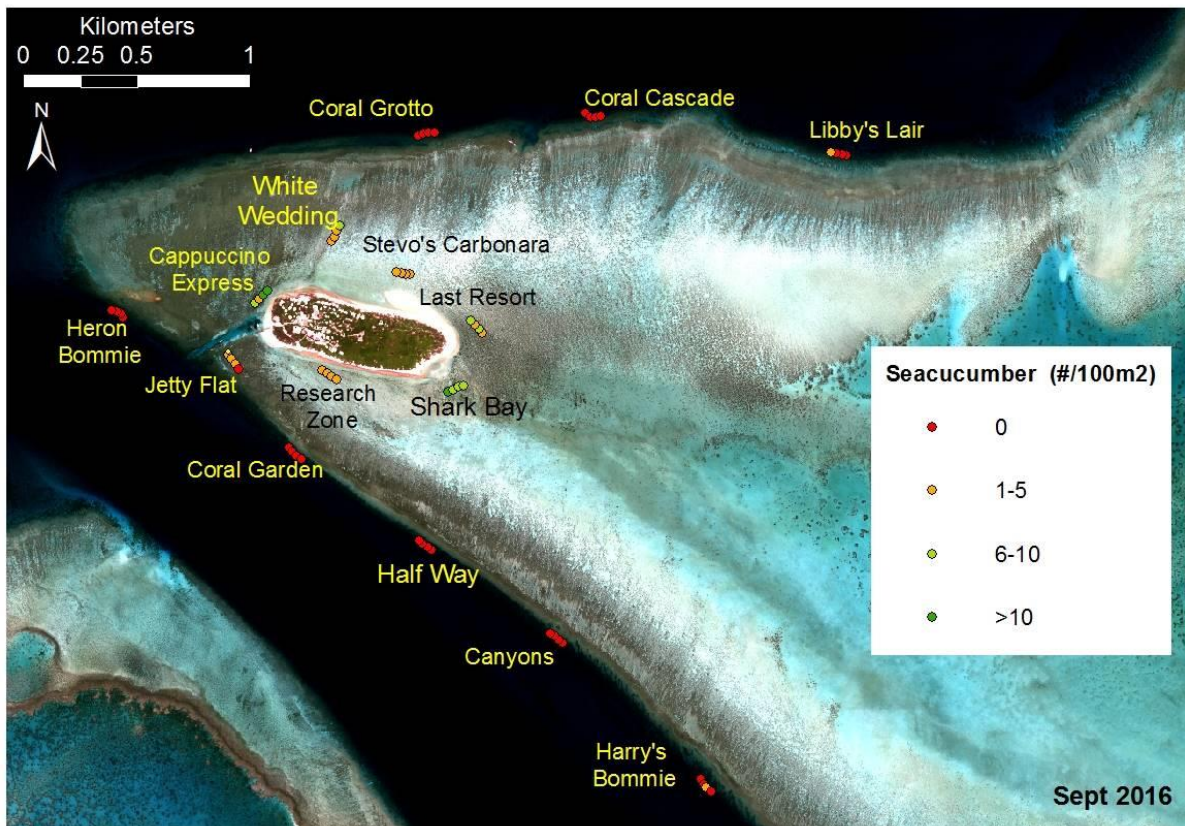


Figure 6. Map of Heron Island with Reef Check sea cucumbers abundance. Each survey site is represented by four circles, each displaying summary data for one of the four 100m² areas that makes up a full 400m² transect.

Target sea cucumbers were recorded at 9 of the 15 sites for 2016. The 2016 data indicates higher concentrations of sea cucumbers on near shore, sandy reef areas, when compared with survey sites along the reef crest- a finding consistent with all previous reports. Higher than average concentrations (more than 8.6 per 400m²) of target sea cucumbers were found at Cappuccino Express (38 per 400m²), Shark Bay (36 per 400m²), Last Resort (23 per 400m²) and White Wedding (14 per 400m²). Sites found to the north of the island had a higher average count per transect with 10.5 target sea cucumbers recorded per 400m² compared with an average of 6.4 per 400m² recorded for southern sites; a finding consistent with 2015 results.

5.0 INDIVIDUAL SITE REPORTS

5.1 Canyons

Canyons is situated at 6m along the reef crest, on the southern side of Heron Island. The site was added to the Reef Check reef health survey list in 2013, to gain a better spread of the southern reefs. 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.

Hard coral represented 79% of the total substrate cover at the Canyons survey site, one of the highest hard coral cover's recorded of all the sites surveyed at Heron Island. Of this, branching growth forms attributed the majority (64%). Rock with turf algae was the next greatest contributor to substrate, contributing 11.9%.

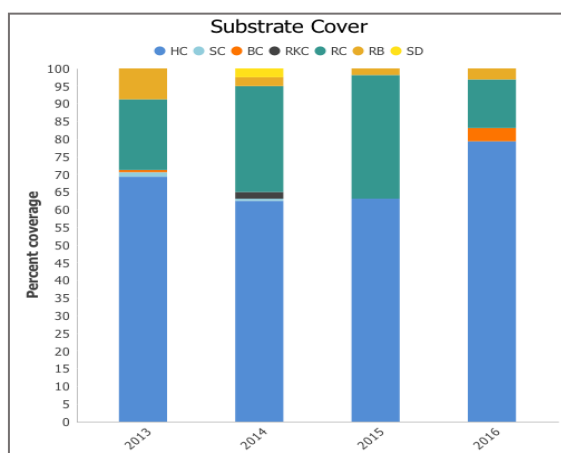


Figure 7. Benthic type and percent cover: Canyons, 2013- 2016.

One giant clam was recorded on the invertebrate survey. No other invertebrates were recorded on the survey.

Bleaching affected an approximately 4% of the coral population on the transect, with an average of 47% of each coral colony affected (an increase from 1% population and 45% colony level bleaching in 2015).

Twenty-seven incidents of disease and four scars of unknown origin were recorded at Canyons in 2016, compared to six counts of disease, 5 of coral damage, and 7 of unknown scars, recorded in 2015.

A fish survey was not carried out in 2016.



Image 2: Canyons Site Photo



Image 3: Bleached Hard Coral at Canyons

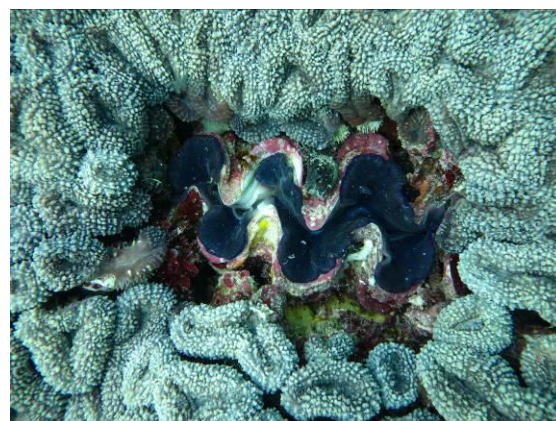


Image 4: Giant Clam at Canyons

5.2 Cappuccino Express

Cappuccino Express was added to the Reef Check reef health survey list in 2013, to gain more information on the near reefs. This reef area is easily accessible on snorkel and often visited by tourists as it is situated close to the resort. A strong current passes this area for much of the day. The site is characterised by small coral atolls and sandy patches and sits in 2m.

Hard Coral represented 24% of the total substrate at this site, all of which were branching. Rock with turf algae was the greatest contributor to substrate, attributing 42%. Sand accounted for 14%.

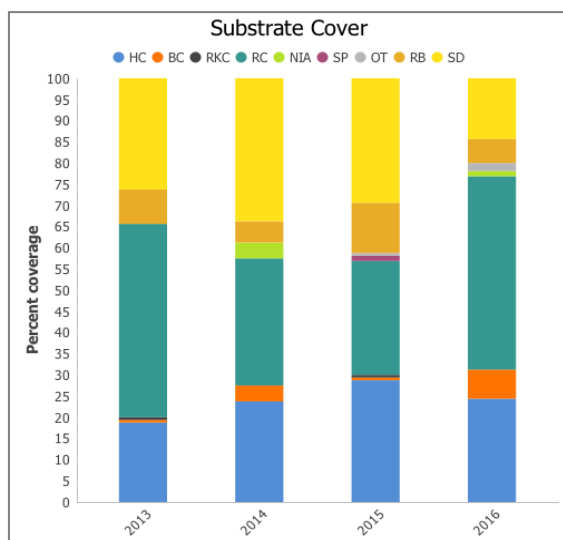


Figure 8. Benthic type and percent cover: Cappuccino Express, 2013- 2016.

Thirty-eight sea cucumbers, six giant clams and one *trochus* snail were recorded on the invertebrate survey.

Coral bleaching affected approximately 15% of the coral population, with an average of 19% of coral surfaces bleached; higher than 2015 population results (1% of coral population and 25% of coral surfaces) although similar to 2014 levels recorded (19% of coral population and 28% of coral surfaces).

Eight incidents of coral disease, six counts of unknown scars and two counts of coral damage were recorded at Cappuccino express in 2016.

A fish survey was not carried out in 2016.



Image 5: Cappuccino Express site photo



Image 6: Bleached Hard Coral, Cappuccino Express



Image 7: RCA surveyors on site

5.3 Coral Cascade

Coral Cascade is situated on the northern wall. The survey site is situated on the reef slope at 7m depth. Coral Cascade 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 cover represented 56.8% of the substrate at this site. This sloping reef site consists of a mixture of hard coral growth forms with branching (28%) and encrusting (23%) being the highest contributors. Rock (including rock with turf algae and rock with coralline algae) made up 33.7% of the substrate, and rubble accounted for 4%. Recently killed coral made up 2.5% of the substrate and soft coral attributed just 1.3%.

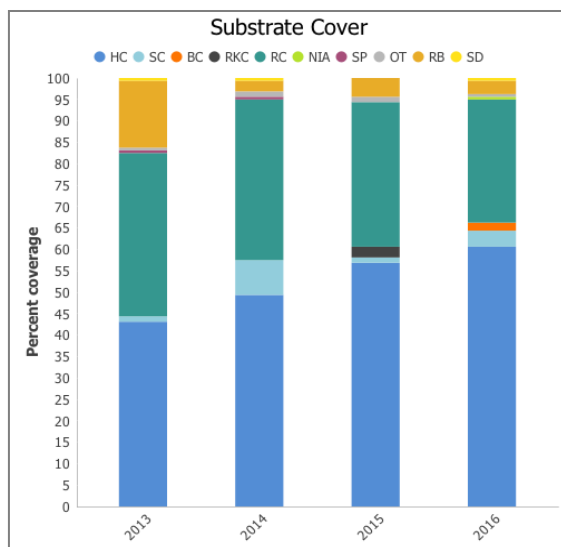


Figure 9. Benthic type and percent cover: Coral Cascade, 2013- 2016.

Six giant clams were the only invertebrates recorded on the invertebrate survey.

Bleaching was recorded on 4% of the coral population, with an average 28% of each affected coral surface bleached; higher than 2015 results (1% of coral population, and 16% colony level bleaching).

Other reef impacts recorded at this site include eight counts of coral damage and four incidents of disease.

A fish survey was not carried out in 2016.



Image 8: Coral Cascade site photo



Image 9. Bleached Hard Coral; Coral Cascade



Image 10: Flatworm at Coral Cascade

5.4 Coral Gardens

Coral Gardens is located on the southern side of Heron Island. It is characterised by high hard coral cover; particularly branching growth forms. It is a popular dive destination for the resort. The Reef Check site was first set up in 2011, and is situated at a depth of 5m, on the reef slope.

Hard coral accounted for 71% of the benthos at this site (the second highest for any site for 2016) and was made up almost exclusively of branching coral growth forms (67.5%). The rock category (including rock with turf algae and rock with calcareous algae) accounted for 23.1%. Soft coral made up 2.5% of the total substrate composition, and rubble attributed 2.5%. No macro algae has been recorded at this site since 2011 (6 counts).

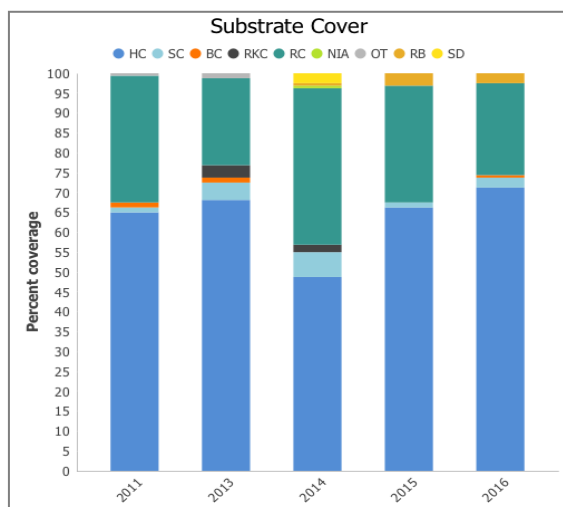


Figure 10. Substrate type and percent cover at Coral Gardens, 2011- 2016.

One *Trochus* snail was recorded on the transect in 2016. No indicator invertebrates were recorded on transect in 2014 or 2015.

Coral Gardens had the lowest bleaching levels recorded on any of the Heron reef RCA sites for 2016 (along with Stevos Carbonara), with less than 1% of the population showing signs

of bleaching, and 1% of the surface of these colonies; a decrease from previous recorded levels (16% colony bleaching in 2015, 20% recorded in 2014 and 29% in 2013).

Reef Impacts recorded at Coral Gardens include 50 incidences of coral disease (the highest recorded for 2016), 7 counts of coral damage, and 3 unknown scars;

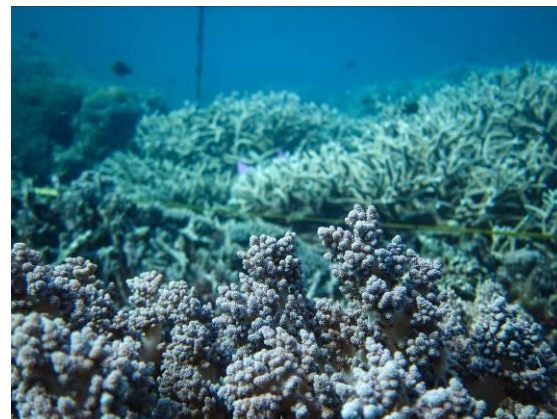


Image 11: Site photo from Coral Gardens



Image 12: Coral Disease at Coral Gardens



Image 13. Green Sea Turtle at Coral Gardens

5.5 Coral Grotto

The Coral Grotto is located on the northern side of Heron Island. It is characterised by high hard coral cover; particularly branching growth forms. This Reef Check site was first set up in 2011, and is situated at a depth of 6m, on the reef slope.

Hard coral accounted for 60% of substrate in 2014 (an increase from 43% in 2015 and 34% in 2014), consisting primarily of branching (25.6%) and plate growth forms (17.5%). Rock attributed 31.9% and soft coral made up 1.9%. Compared to previous surveys, the amount of rubble recorded was less (25% in 2011, 11% in 2013 9% in 2014, 7.5% in 2015 and .6% in 2016).

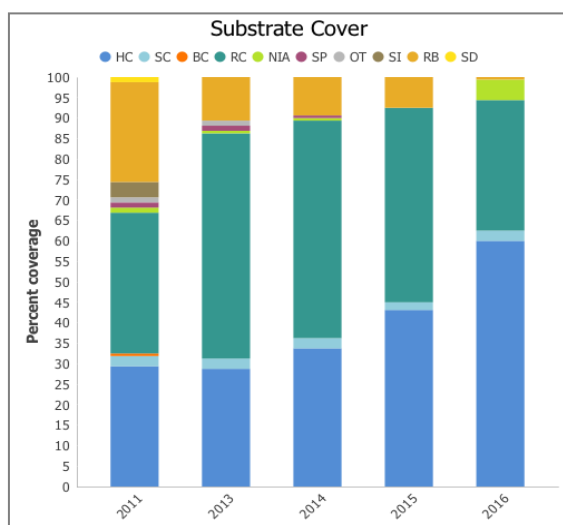


Figure 11: Benthic type and percent cover: Coral Grotto, 2011-2016.

Five giant clams were the only invertebrates recorded during the invertebrate survey.

Coral bleaching was estimated to affect 1% of the total coral population and 31% of each colony surface; an increase from 2015 levels (1% population and 20% colony bleaching in 2015).

Additional impacts recorded include six counts of coral damage and two unknown coral scars.

A fish survey was not conducted in 2016.



Image 14. Site Photo from Coral Grotto

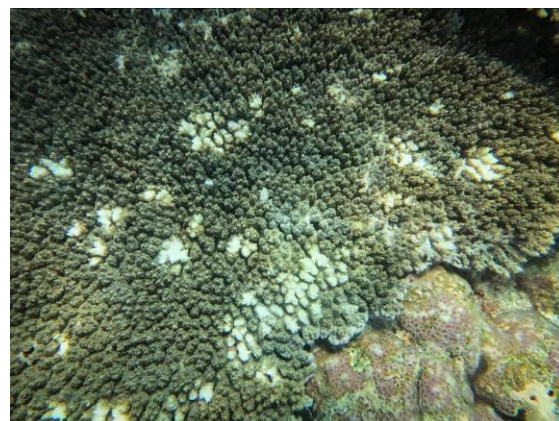


Image 15. Unknown Coral Scar



Image 16: Surveyor on transect

5.6 Half Way

Half Way was added to the Reef Check reef health survey list in 2014 to allow for a wider spread of survey locations around the island, and to gather more information on the southern side of the reef. The RCA site is situated on the reef crest at a depth of 6m, on the southern side of Heron Island.

Hard coral represented 16.8% of the total substrate cover at the Half Way survey site (a decrease from 30% recorded in 2015). The hard coral category was dominated by branching hard coral growth form (13%). Rock (rock with turf algae and rock with calcareous algae) made up 70% of the substrate. Sponge attributed 4% and soft coral made up 5% of the benthos. Six counts of macro algae were recorded at this site in 2016.

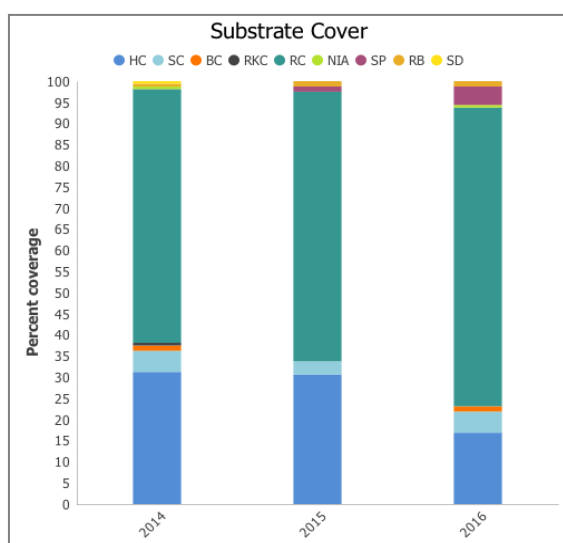


Figure 12: Benthic type and percent cover: Half Way, 2014 -2016.

Two giant clams and three *Trochus* snails were recorded on the invertebrate survey.

Bleaching affected less than 1% of the coral population and affected an average of 27.5% of the surface of colonies; similar to 2015 recorded levels (1% of the coral population and 25.3% of the surface of colonies).

Other reef impacts recorded included eight counts of unknown scars, three counts of coral damage and two counts of disease (down from 18 counts in 2015).

A fish survey was not conducted in 2016.



Image 17: Half Way site photo



Image 18: Trochus at Half Way



Image 19: Surveyor in action at Half Way

5.7 Harry's Bommie

Harry's Bommie is located on the southern side of Heron Island, on the reef wall. It is characterised by large coral bommies and high hard coral cover; particularly branching growth forms. The Reef Check site was first set up in 2011, and is situated at a depth of 9m, on the reef slope.

Hard coral cover at this site accounted for 83.8% of the benthos; the highest hard coral percent recorded for 2016. Of this, 62% was branching growth forms, and 13% was foliose. Rock (rock with turf algae and rock with calcareous algae) accounted for 12.5% of the total substrate. Soft coral and rubble accounted for less than 1% each.

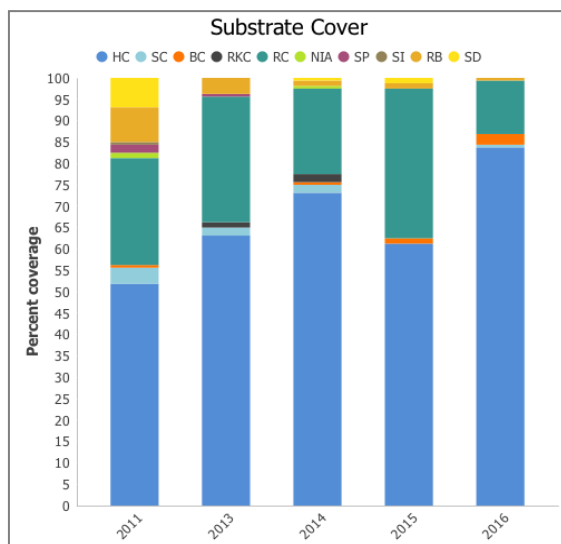


Figure 13. Benthic type and percent cover: Harry's Bommie, 2011- 2016.

Three giant clams and one seacucumber were the only invertebrates recorded during the invertebrate survey.

Coral bleaching affected approximately 7% of the total coral population, with an average of 13% each colony showing surface bleaching; an increase from 2015 population levels (1% of the total coral population) and a decrease from colony bleaching levels (26% colony surface bleaching in 2015).

Twenty four incidents of disease, five unknown scars and three counts of coral damage were recorded in 2016, compared to 21, 14 and 2 respectively, recorded in 2015.

A fish survey was not conducted in 2016.



Image 20. Site photo of Harry's Bommie



Image 21. Coral Disease at Harry's Bommie



Image 22. Soft coral at Harry's Bommie

5.8 Heron Bommie

Heron Bommie is located on the south west of Heron Island fringing reef. 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. The Reef Check site was first set up in 2011, on the reef slope at a depth of 6m.

Hard coral represented 46% of the substrate for 2016- a decrease from 2015 levels (65%). Of this, 36% consisted of branching growth forms. Rock (including rock with turf algae and rock with calcareous algae) accounted for 23%. Rubble attributed 20%, and soft coral made up 5.6%.

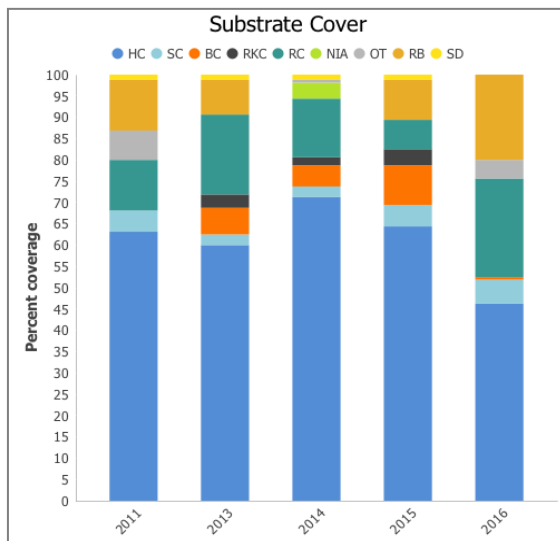


Figure 14. Benthic type and percent cover: Heron Bommie, 2011- 2016.

One giant clam was recorded at this site; the only indicator invertebrate recorded on the invertebrate survey.

Coral bleaching affected approximately 5% of the total coral population, with an average of 18% each colony showing surface bleaching; an increase from 2015 recorded levels (1% of the coral population bleached and 9% bleaching per coral surface).

Twenty three incidents of disease, eight unknown scars and six counts of coral damage were recorded in 2016. This is a decrease in the recorded incidents of disease from 2014 where 90 incidents were recorded.

In 2015, only two impact replicates were completed (instead of 4), with 14 incidents of coral disease recorded.

A fish survey was not conducted in 2016.



Image 23. Heron Bommie site photo



Image 24. Coral Disease, Heron Bommie



Image 25. Sweetlip at Heron Bommie

5.9 Jetty Flat

Jetty flat is located on the southern side of Heron Island, on the south east 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. The Reef Check site was first set up in 2011, and is situated at a depth of 2m.

Hard corals accounted for 44% of the benthos; 41% of this consisting of the generic hard coral category. Rock (including rock, rock with turf algae and rock with calcareous algae) attributed 44% to the substrate in 2016. Rubble accounted for 4%, and recently killed coral attributed 2%.

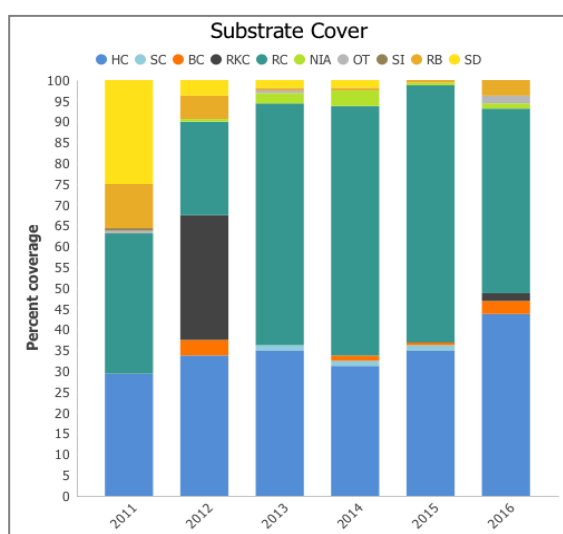


Figure 15. Benthic type and percent cover: Jetty Flat, 2011- 2016.

Eight giant clams and four sea cucumbers were the only invertebrates recorded on the invertebrate survey.

Coral bleaching affected approximately 5% of the total coral population, with an average of 13% each colony showing surface bleaching; an increase from 2015 recorded levels (4% of the coral population bleached and 7% bleaching per coral surface).

Reef impacts recorded during the 2016 survey at Jetty Flat included 29 counts of coral damage, 19 counts of unknown scars and 4 incidents of coral disease. (2015 results: coral damage: 23, unknown scars: 2, and coral disease: 5). One piece of general trash (a broken glass bottle) was recorded on the transect.

A fish survey was not completed in 2016.



Image 26. Jetty Flat site photo



Image 27. Target Sea Cucumber on transect



Image 28. Nutrient Indicator Algae; Jetty flat

5.10 Last Resort

Last Resort was added to the Reef Check reef health survey list in 2013 to allow for a wider spread of survey locations around the island, and to gather more information on near shore reef sites. This reef area is accessible on snorkel, located on the north-east corner of the island. It is frequented by tourists as it is a popular spot for shark and ray sightings.

Hard corals accounted for 21% of the benthos; almost exclusively made up of branching growth forms. Massive growth forms were the only additional growth form recorded. Rock (including rock with turf algae and rock with calcareous algae) attributed 17% to the substrate in 2016. Sand (30%), rubble (5%), and nutrient indicator algae (26% *Hydroclatharus sp*) attributed the remainder of the benthos. Last Resort had highest macro algal count for 2016 (18).

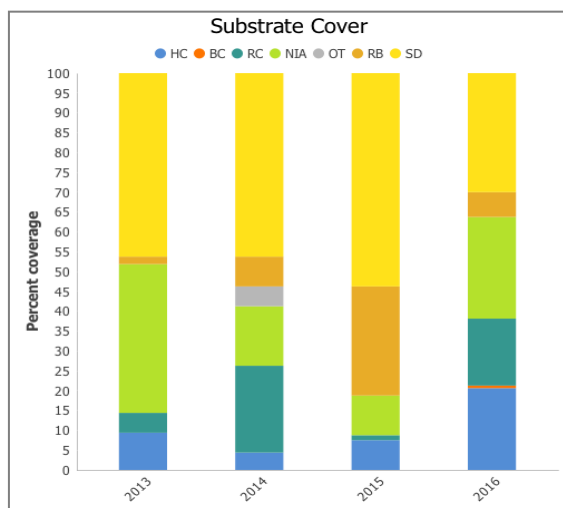


Figure 16. Benthic type and percent cover: Last Resort, 2013- 2016.

Four giant clams and twenty-three sea cucumbers were recorded on the invertebrate survey.

Coral bleaching affected %% of the coral population at Last Resort. Of these corals, an average of 48% of each coral surface was

affected. This is an increase from 2015 levels (1% population bleaching and 6% coral surface bleached).

Six incidents of coral damage was recorded (a decrease from 19 recorded in 2015), and three incidents of unknown scars were recorded during the 2016 impact survey.

A fish survey was not completed in 2016.



Image 29. Last Resort site photo



Image 30. Nutrient Indicator Algae



Image 31. Last Resort, surveyor on transect

5.11 Libby's Lair

Libby's Lair is located on the northern side of Heron Island, on the north east reef slope. It is characterised by high coral diversity and few deep gulleys. The Reef Check site was first set up in 2011 and is situated at a depth of 6m along the reef slope.

Hard coral accounted for 60% of the benthos at Libby's Lair. Rock (encompassing both rock with turf algae and rock with coralline algae) made up 20% of the substrate. Branching growth forms attributed 22% to the hard coral substrate, with plate (21%), encrusting (8%), massive (5%) and foliose (4%) attributing the remainder.

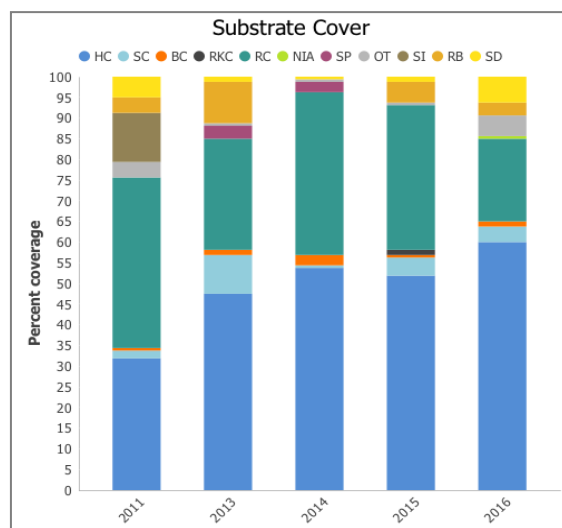


Figure 17: Benthic type and percent cover: Libby's Lair, 2011- 2016.

One giant clam and one sea cucumber were the only indicator invertebrates recorded at this site.

Coral bleaching affected an average of just 2% of the coral population; however the surface of each affected coral averaged 26%- an increase from 2015 results (1% population bleaching and 18.5% colony surface bleaching).

Additional impacts recorded included 15 incidents of coral damage, and 3 unknown scars.

A fish survey was not conducted in 2016.



Image 32. Libby's Lair site photo.

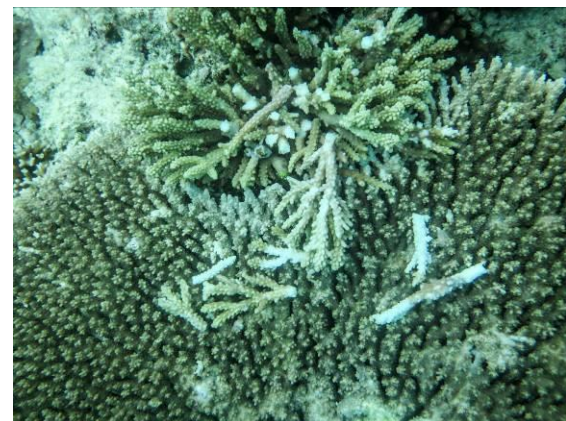


Image 33: Coral Damage at Libbys Lair



Image 34. Unknown scar, Libby's Lair

5.12 Research Zone

The Research Zone site is located on the southern side of Heron Island, within the scientific zone. It is utilised for 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, and shallow depth (max 2m). This Reef Check site was first set up in 2011.

The majority of the substrate at this site is sand (69%), with hard coral contributing just 7% to the benthos. Rock (including rock with turf algae and rock with coralline algae) was the second largest contributor, making up 14% of the substrate. Nutrient indicator algae attributed 4% to the substrate (NIA was not recorded at this site in 2015, a decrease from 11% of the cover recorded in 2014).

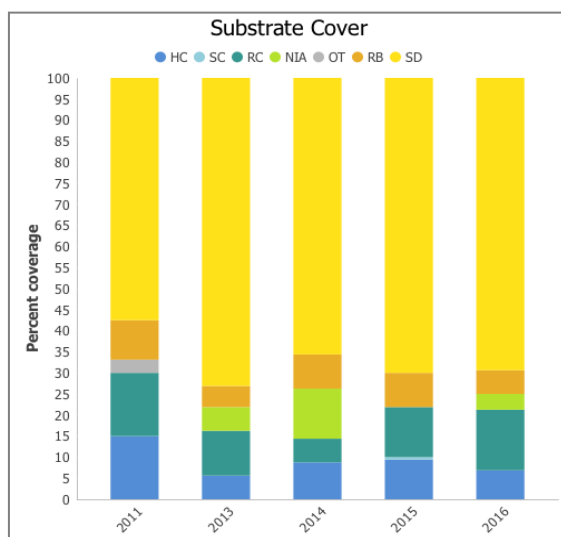


Figure 18. Benthic type and percent cover: Research Zone 2011- 2016.

Five giant clams, and four sea cucumbers were recorded on the invertebrate survey.

Coral bleaching affected almost 3% of the coral population, and an average of 16% of each affected corals surface- an increase from 2015 results (less than 1% population bleaching, and 3% colony surfaces affected).

Nine incidents of coral damage and two unknown scars were also recorded on the transect during the impact survey.

A fish survey was not conducted in 2016.



Image 35. Research Zone site photo



Image 36. Unknown Scar at Research Zone



Image 37: Target Sea Cucumber at Research Zone

5.13 Shark Bay

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 (max 2m). This reef area is a popular spot for shark and ray sightings. This Reef Check site was first set up in 2013.

Hard coral accounted for 6.9% of the benthos at this sandy reef flat location. Of this, branching growth forms attributed 5.6%, with the general hard coral category attributing the remaining 1.3%. Sand accounted for 63% of the benthic survey. The other category (almost exclusively *Halimeda*) contributed 14%. Rock (including rock with turf algae and rock with calcareous algae) attributed 12%. No nutrient indicator algae was recorded on transect for 2016 (compared to attributing 22% in 2015). This site had the second highest macro algal count for 2016 (8).

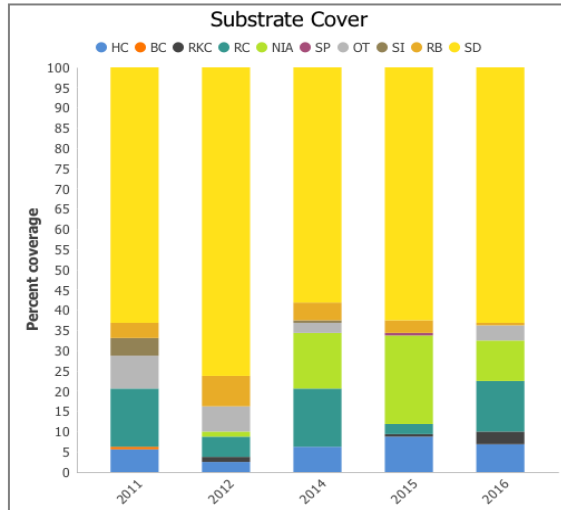


Figure 19. Benthic type and percent cover: Shark Bay, 2011- 2015.

Thirty-six sea cucumbers were found during the invertebrate survey- the second highest count for 2016 (Cappuccino Express had 38).

Coral bleaching affected 5% of the coral population, and an average of 6% of each affected colony.

This is a higher population bleaching level than that recorded in 2015 (1%) although the average colony bleaching level recorded was the same (6%). Six unknown scars, three incidents of disease, and one incident of coral damage were recorded on transect, compared to seventeen incidents of coral damage and three incidents of disease recorded in 2015.

A fish survey was not completed in 2016.



Image 38: Shark Bay Site Photo



Image 39: Unknown Scar, Shark Bay



Image 40: Macro algae (*Padina*) at Shark Bay

5.15 Stevos Carbonara

Stevos Carbonara was added to the Reef Check reef health survey list to allow for a wider spread of survey locations around the island, and to gather more information on the northern side of the reef. This area of reef flat is close to the resort and regularly frequented by tourists on snorkel and also reef walking. It is located on the North side of the island, between White Wedding, and Last Resort.

Hard coral accounted for just 1.2% of the benthic substrate. The generic hard coral category (.6%) and encrusting growth forms (.6%) being the only forms recorded. Sand made up 76% of the substrate cover. Nutrient Indicator Algae attributed 10.6% (the second highest NIA count of any site for 2016), and the 'other' category (consisting exclusively of Halimeda) made up 8%.

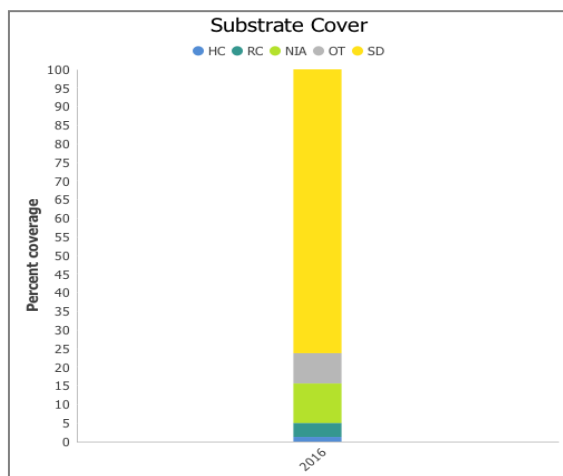


Figure 20. Benthic type and percent cover: Stevos Carbonara, 2016.

Eight sea cucumbers and four giant clams were recorded on the invertebrate survey.

Coral Bleaching affected less than 1% of the coral population, and 1% of the surface of coral colonies. Three counts of coral damage were also recorded.

A fish survey was conducted at this site. Three butterfly fish, six parrotfish and one snapper and were counted.



Image 41: Stevos Carbonara site photo

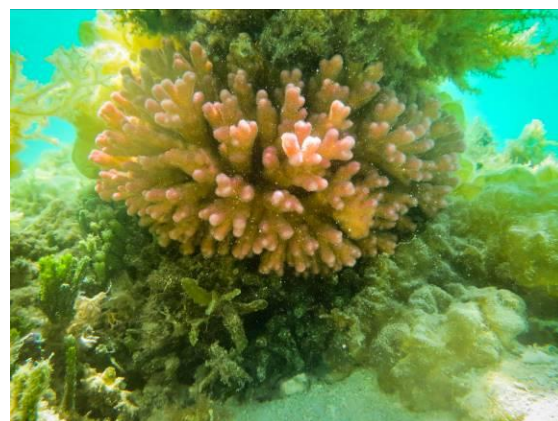


Image 42: Hard coral branching on transect



Image 43: Nutrient Indicator Algae at Stevos Carbonara.

5.15 White Wedding

White Wedding was added to the Reef Check reef health survey list to allow for a wider spread of survey locations around the island, and to gather more information on the northern side of the reef. This area of reef flat is close to the resort and regularly frequented by tourists on snorkel and also reef walking.

Hard coral accounted for 6.9% of the benthic substrate. Massive hard coral growth forms contributed 2.5% of the coral cover, with branching (1.9%) the generic hard coral category (1.9%) and encrusting (.6%) making up the remainder. Sand contributed 51% of the substrate, and rock (consisting of rock, rock with turf algae and rock with calcareous algae) attributing 27%. Soft coral attributed less than 1% to the benthos.

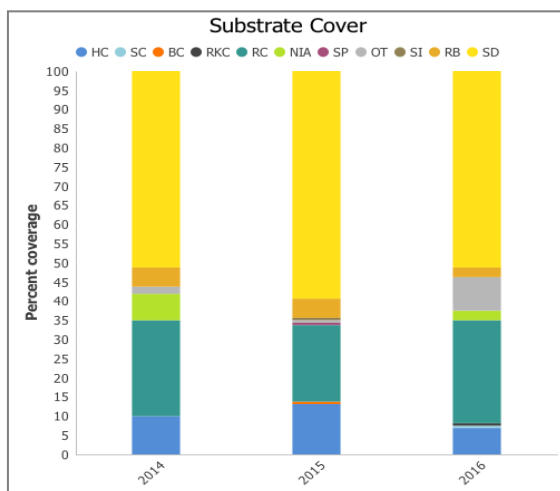


Figure 21. Benthic type and percent cover: White Wedding 2014-2016.

Twenty giant clams, fourteen sea cucumbers and one *Trochus* snail were recorded on the invertebrate survey. This was the highest number of giant clams recorded on any RCA Heron Island reef health survey for 2016. (White Wedding also had the highest giant clam counts for 2015 and 2014).

Coral Bleaching affected 10% of the coral population and an average of 15% of the

surface of affected coral colonies- an increase from 2015 recorded levels (6% of the coral population, and 4% of the surface of coral colonies). Thirteen counts of unknown scars and two counts of coral damage were also recorded.

A fish survey was not conducted in 2016.



Image 44: White Wedding site photo



Image 45: *Trochus* on transect



Image 46: Surveyor in action, White Wedding.

6.0 FURTHER INFORMATION

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

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