



Keppel and Magnetic Islands Monitoring Report for *Asparagopsis* Wild Harvest Project 2022

(6-12 months after harvest)

Permit number Queensland Government: 2110 – 25419 SDA
Permit number GBRMPA: G22/47296.1

Data and report by: FutureFeed, Reef Ecologic and CQU

Contacts:

Dr Robert Kinley – robk@futurefeed.com.au

Dr Adam Smith – adam.smith@reefecologic.org 0418726584

Co-authors: Adam Smith, Najeen Rula, Rachelle Brown, Kaysha Kenney

Date: 31 January 2024



TABLE OF CONTENTS

Executive summary.....	1
Background.....	1
Methods.....	3
Results.....	6
Middle Reef, Magnetic Island region.....	6
Keppel region	13
Discussion	22
Comparison of macroalgae over time	22
Recommendations	24
Appendices	25

Executive summary

The red macroalgae *Asparagopsis taxiformis* (Red Sea Plume) was observed at all locations during this monitoring period. Three monitoring techniques were utilised to assess reef health at three locations containing control and impact sites.

Magnetic Island had an average macroalgae cover between 25% and 51.1% and Keppel Island had an average macroalgae cover of between 6% and 29.6%. The macroalgae at Magnetic Island was harvested at depths of 1 m to 3 m and in the Keppel Islands between 8 m to 12 m. It appears that there are more macroalgae at Magnetic Island compared to Keppel Islands.

The average number of species observed using the iNaturalist method at Magnetic Island varied from 6 to 25 with an overall average of 18 species. The most observations were Red Sea Plume, Chinese Demoiselle and Goldstripe Butterflyfish. The average number of species observed using the iNaturalist method at Keppel Island varied from 12 to 42 with an overall average of 26 species. The species with the most observations were Longfin Rockcod, Chinese Demoiselle and Red Sea Plume. It appears that there are similar species but more species due to greater water depth, great visibility, location (i.e., further offshore) and/or less macroalgae in the Keppel region.

Our interpretation is that macroalgae cover in the treatment locations at both Magnetic and Keppel Island recovered to exceed before-harvest levels at 1 to 3 months. There also appears to be a temporal variation of approximately 15% to 25% percent cover over time at the control sites.

Background

This research program on the Wild collection of Red Sea plume (*Asparagopsis taxiformis*) is approved by GBRMPA research permit G22/47296.1 and Queensland Government SARA permit 2110-25419 SDA dated 18 March 2022.

The monitoring program must include the following monitoring events:

- (i) Prior to collection: same day as collection;
- (ii) On completion of collection: same day as collection;
- (iii) Once within one to three months post collection;
- (iv) Once within six to twelve months post collection;

Data on dates, volume and weight of Red Sea plume (*Asparagopsis taxiformis*) is in Appendix 1.

The Reef Ecologic team was contracted by the firm Future Feed to conduct regulatory monitoring under the GBRMPA and SARA permit conditions. Monitoring surveys were done at three times: before and post-collection, 3 months post collection and 6-12 months post collection using three methods: a 10-minute timed iNaturalist survey, the Rapid Monitoring (Eye on the Reef) timed swim and the Reef Health Impact Surveys (RHIS).

The Queensland Government permit condition 13(e):

The monitoring reports must:

- (i) include results and any recommended mitigation of impacts to, and restoration of, fisheries habitat;
- (ii) include details of the alert-to-action that is to be developed during the study with the information collected from the study;
- (iii) include the information described in Item 3 of Email: Final further information 2110-25419 SDA, prepared by Adam Smith, dated 9 February 2022, reference 2:09PM (Amended in red by SARA)
- (iv) state this permit number (2110-25419 SDA)

The GBRMPA reporting and notification conditions:

24. The Permit Holder must submit a research report annually from the date of issue of the permit and at any other time within 21 days of request. Report submission must be done through the Great Barrier Reef Marine Park Authority's Permits Online Portal, unless otherwise approved.

ITEM 3

Action

We propose a 4-step hierarchical monitoring protocol at each site during each major field trip

1. iNaturalist- we will take photographs and identify the key species of fauna
2. Eye of the Reef Sightings Network - we will use this app to report sightings of turtles, sharks, protected fish
3. Eye on the Reef Rapid Monitoring survey - we will undertake a 10-minute swim on SCUBA\snorkel and record the key species of fauna
4. Reef Health Impact Survey- this technique is focused on habitat and benthos. We will undertake between 1 and 3 RHIS surveys at each site

Furthermore, FutureFeed and Central Queensland University (Gladstone) under the Elevate programme will oversee the restoration, the PhD student under a project collection will access recovery and shift in faunal assemblages at different sites and will be a key part of the PhD student studies, and these sites will complement smaller manipulative removals (under the same permit) that the student will undertake, but be larger sites and removal carried out in a standardised way. The PhD student will

provide monitoring data for the development permit. If the student is absent at any time CQU research officers will support restoration reporting.

Methods

For the Middle Reef, Magnetic Island we defined six areas of interest with three impact and three control locations (Figure 1).



Figure 1. Map of Middle Reef, Magnetic Island indicating the impact (green) and control (red) sites and the GPS points for monitoring.

For the Keppel Region, each of the seven sites of interest has been indicated on maps, namely, the Southeast side of Keppel Island (Figure 2) and Humpy Island (Figure 3).

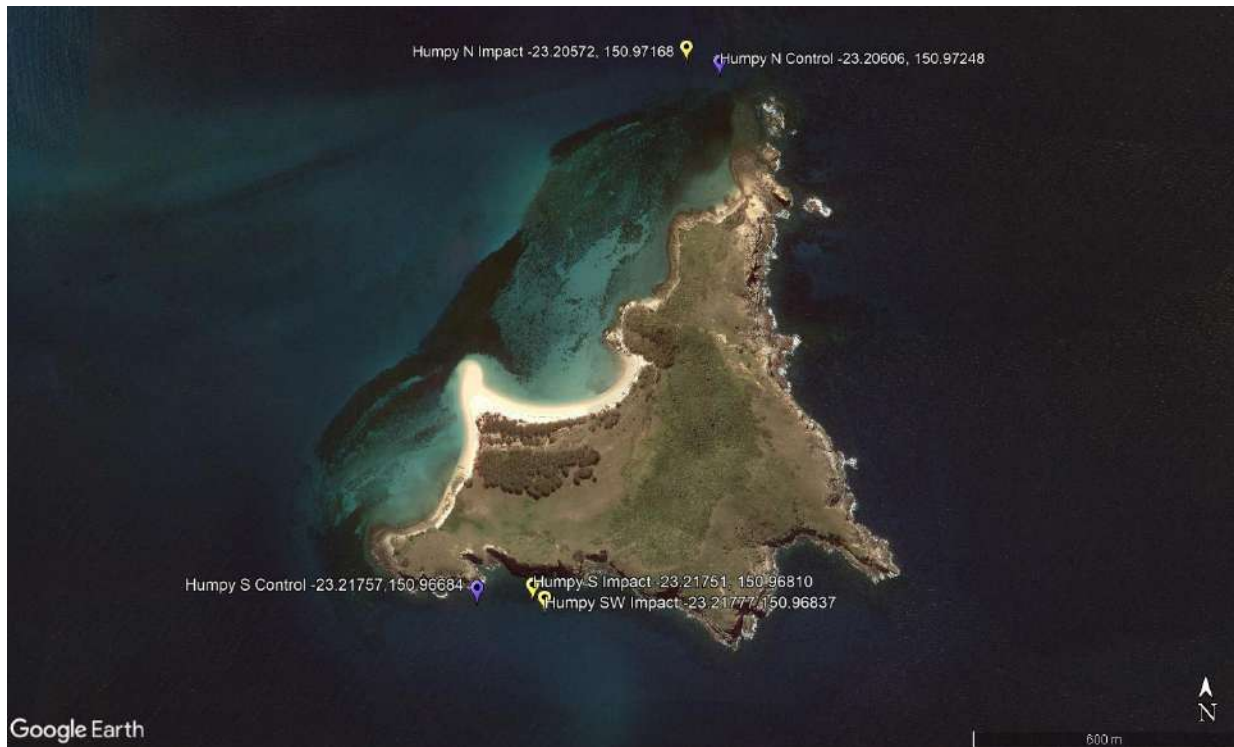


Figure 2. Map of Humpy (Bur-ye Bur-ye) island with sites where surveys were conducted 12 months post-harvest

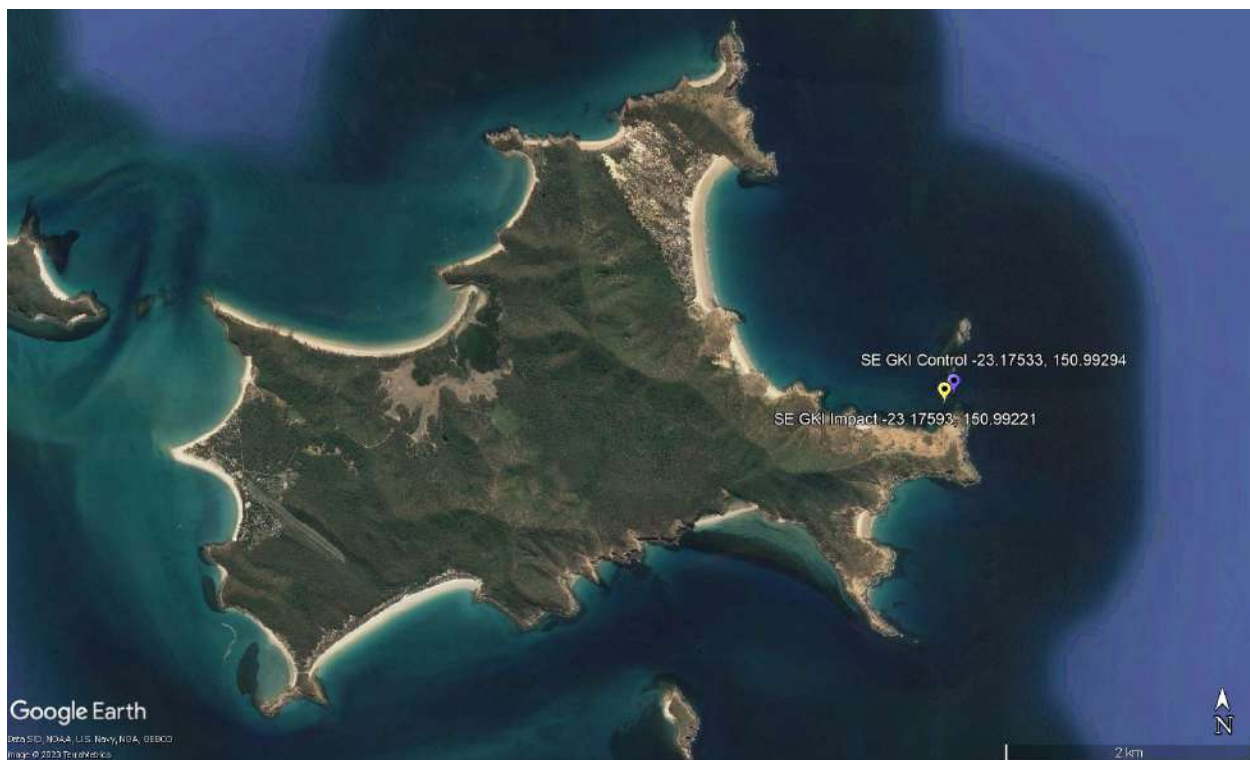


Figure 3. Map of Great Keppel (Woppa) island and the sites where the surveys were conducted 12 months post-harvest

The four monitoring events as required by the permit conditions were conducted over a 13-month period between August 2022 and September 2023 (Table 1).

Table 1. Dates of surveys at four times and two regions between 2022 and 2023.

	Magnetic Island	Keppel Islands
Before	12/09/2022	17-18/10/2022
Post-harvest	13-23/09/2022	17-18/10/2022
1-3 months	29/11/2023	30-31/01/2023
6-12 months	5/10/2023	14/10/2023

A team of four people from Reef Ecologic and Central Queensland University conducted a monitoring process involving three techniques at all sites:

1. iNaturalist time survey (10 minutes) to document the biodiversity of the sites.
2. Rapid Monitoring (Eye on the Reef) survey (10 minutes) to quantify categories of potential indicator species and species of commercial, recreation and conservation importance.
3. Reef Health Impact Survey (RHIS) to quantify the proportion of benthos and additional information on macroalgae morphology and coral morphology (Figure 4).

In addition, the GBRMPA Eye of the Reef Sightings Network was used to report opportunistic sightings of turtles, sharks and protected fish.

Method 1. Photographs of all biota during a 10 minute swim and observations added to iNaturalist for identification of number of species



Method 2. Rapid Eye on the Reef during a 10 minute swim and observations and counts of 11 categories of invertebrates and fish

Timed swim (10 minutes) See over page for survey methodology

ANIMALS	TALLY	TOTAL	ANIMALS	SIZE / SEX / TYPE	TALLY	TOTAL
Sea cucumber (all species)			Coral trout (all species)	<38cm		
Giant clam (all species)			Maori wrasse	>38cm		
Anemonefish (all species)				Male		
Butterflyfish (all species)				Female		
Grazing herbivores (see table over page)			Turtle (all species)	Green Turtle*		
Cods and groupers (over 20cm in length)				Hawksbill Turtle*		
			*See images over page	Other (please name)		
			Shark (all species)	Whitetip reef shark		
				Blacktip reef shark		
				Other (please name)		
			Crown-of-thorns starfish	< Size of hand		
				> Size of hand		

Method 3. Reef Health Impact Survey of six categories of benthic habitat, macroalgae type and coral type

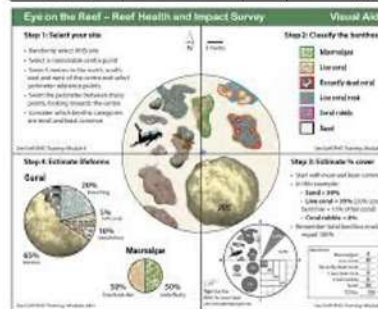


Figure 4. The three monitoring methods used to quantify species, key species at habitats.

These techniques were applied to Magnetic Island and Keppel Islands.

Results

This report is the third and final monitoring report for the *Asparagopsis* Wild Harvest Project 2022. This is in compliance with the condition of monitoring *once within six to twelve months post-collection*.

Middle Reef, Magnetic Island region

For this monitoring period (October 2023), the monitoring team conducted surveys at 6 sites in Middle Reef, between 1 m to 2 m in depth. The surveys were conducted within one day at both control and impact sites from where *Asparagopsis taxiformis* was removed in August 2022.

The average number of species observed using the iNaturalist method at Magnetic Island varied from 6 to 25 with an overall average of 18 species. The average for impact sites was 15 species and for control sites was 20 species (See Figure 5). The most observed species were Red Sea Plume, Chinese Demoiselle and Goldstripe Butterflyfish (Figure 6)

The number of species observed during Eye of the Reef varied from 0 to 1 and the abundance from 0 to 8 (Table 2) so these are not graphed in this report.

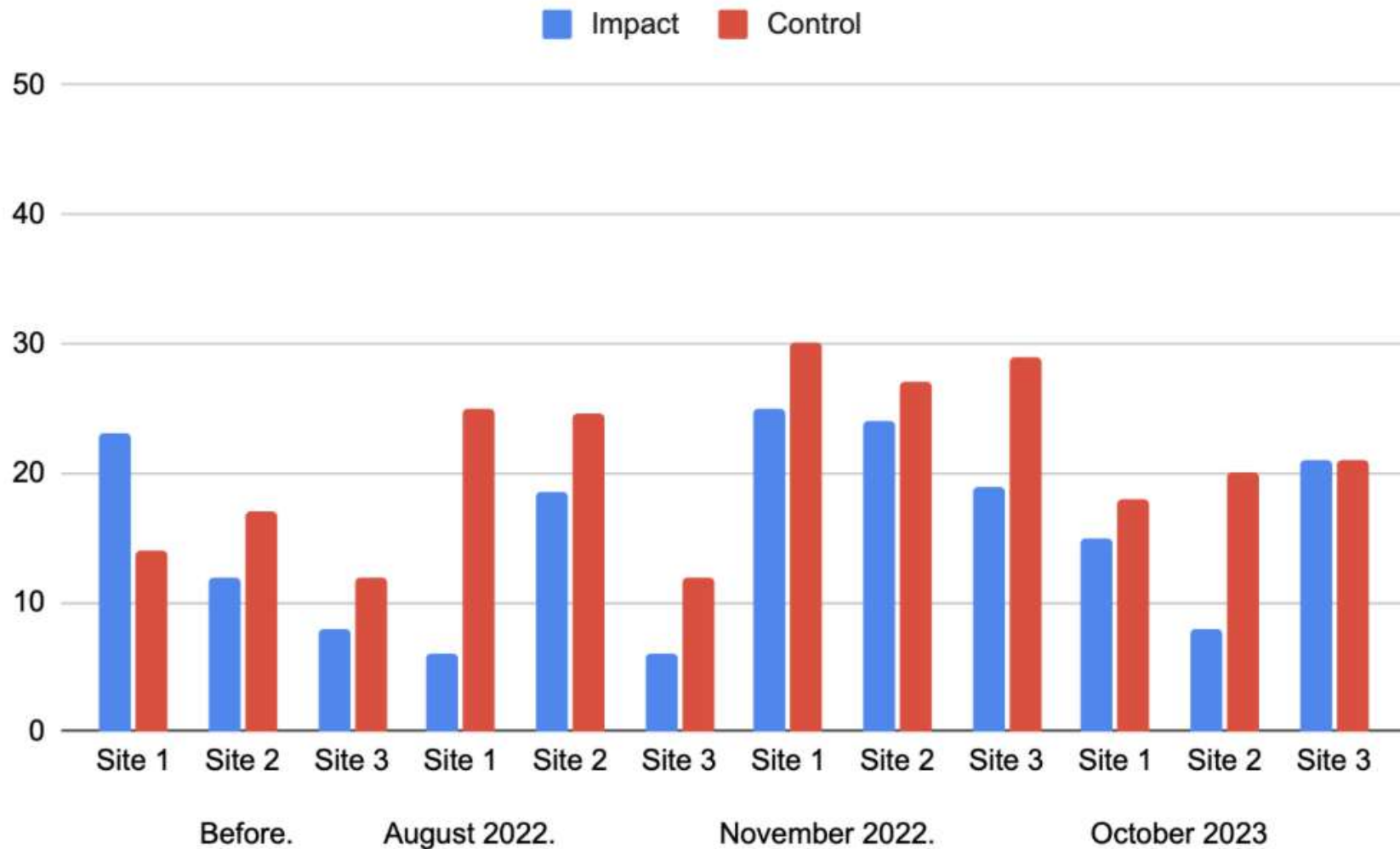


Figure 5. Average number of species identified at each site in the Middle Reef region by iNaturalist methodology during the initial removal during August 2022, the 3 months post removal in November 2022 and 12 months post removal during October 2023

Table 2. iNaturalist, Rapid monitoring, and Reef Health Impact Survey (RHIS) were conducted at collection sites (before and after algae collections) and at control sites ≥ 30 m from collection sites. Site refers to the North or Southwest side of the location island, Impact sites have monitoring conducted both before and after collection (BACI- Before After Control Impact). iNaturalist and Rapid monitoring record the total number of species observed, Rapid numbers refer to the total individuals observed, and RHIS consists of three surveys at each site.

Date	Time	Site	Lat	Long	Impact/ Control	BACI	iNaturalist Observer	iNaturalist species	Rapid Surveyor	Rapid Species	Rapid Numbers	RHIS Surveyor	RHIS number
5/10/2023	8:57	1A	-19.19714	146.81650	Impact	6-12 months after	Rachelle	15	Kaysha	1	2	Adam	3
5/10/2023	9:16	1B	-19.19798	146.81616	Control	6-12 months after	Rachelle	18	Kaysha	0	0	Adam	3
5/10/2023	10:05	2A	-19.19756	146.81456	Control	6-12 months after	Kaysha	8	Adam	0	0	Rachelle	3
5/10/2023	9:34	2B	-19.19699	146.81563	Impact	6-12 months after	Kaysha	20	Adam	1	1	Rachelle	3
5/10/2023	11:02	3A	-19.19724	146.81333	Impact	6-12 months after	Adam	21	Rachelle	1	8	Kaysha	3
5/10/2023	10:35	3B	-19.19683	146.81429	Control	6-12 months after	Adam	21	Rachelle	1	6	Kaysha	3

Observations

Search: Species Location

Custom Boundary 801 OBSERVATIONS 127 SPECIES 62 IDENTIFIERS 8 OBSERVERS





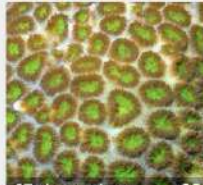















 <p>41 observations CC</p> <p>Red Sea Plume (<i>Asparagopsis taxiformis</i>)</p>	 <p>35 observations CC</p> <p>Chinese Demoiselle (<i>Neopomacentrus bankieri</i>)</p>	 <p>28 observations CC</p> <p>Goldstripe Butterflyfish (<i>Chaetodon aureofasciatus</i>)</p>	 <p>28 observations CC</p> <p>Spiny Puller (<i>Acanthochromis polyacanthus</i>)</p>	 <p>27 observations CC</p> <p>Genus <i>Dipsastraea</i></p>
 <p>22 observations CC</p> <p>Open Brain Corals (Genus <i>Labophyllia</i>)</p>	 <p>21 observations CC</p> <p>Peacock's Tail (<i>Padina pavonica</i>)</p>	 <p>21 observations CC</p> <p>Sargassum (Genus <i>Sargassum</i>)</p>	 <p>19 observations CC</p> <p>Lined Butterflyfish (<i>Chaetodon lineolatus</i>)</p>	 <p>16 observations CC</p> <p>Stripey Snapper (<i>Lutjanus carponotatus</i>)</p>
 <p>16 observations CC</p> <p>Bengal Sergeant (<i>Abudefduf bengalensis</i>)</p>	 <p>9 observations CC</p> <p>Scroll Corals (Genus <i>Turbinaria</i>)</p>	 <p>7 observations CC</p> <p>Finger Leather (Genus <i>Sclerophyllum</i>)</p>	 <p>5 observations CC</p> <p>Flowerpot Corals (Genus <i>Goniopora</i>)</p>	 <p>5 observations CC</p> <p><i>Acropora pulchra</i></p>
 <p>5 observations CC</p> <p>Bubblefin Wrasse (<i>Halichoeres nigrescens</i>)</p>	 <p>5 observations CC</p> <p>Genus <i>Laurencia</i></p>	 <p>5 observations CC</p> <p>Toadstool Leather Corals (Genus <i>Sarcophyton</i>)</p>	 <p>5 observations CC</p> <p>Genus <i>Cyphastrea</i></p>	 <p>5 observations CC</p> <p>Blushing Corals (Genus <i>Cladiella</i>)</p>

Figure 6. Representative photos of the most common species/genus identified at Middle Reef (Magnetic Islands)

Table 3. Reef Health and Impact Survey data from 5 October 2023 at Middle Reef, Magnetic Island

Surveyor	RM			RM			AS			AS			RM			RM		
Location	MR			MR			MR			MR			MR			MR		
Treatment or Control	T			C			T			C			T			C		
Before/After	6-12 months after			6-12 months after			6-12 months after			6-12 months after			6-12 months after			6-12 months after		
Survey #	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Lat	-19.19714			-19.19798			-19.19699			-19.19756			-19.19683			-19.19724		
Long	146.8165			146.81616			146.81563			146.19756			146.81429			146.81333		
Date	510/2023			510/2023			510/2023			510/2023			510/2023			510/2023		
Time	8:50			9:16			9:34			10:05			10:35			11:02		
Depth (m)	1.2			1.4			1.1			2			1			1.3		
Tide	low			low			low			low			low			low		
Water Temp (°C)	25			25			25			25			25			25		
Benthos Composition (%)																		
Macroalgae	60	50	30	30	30	15	25	65	15	5	15	10	20	50	50	50	30	20
Live Coral	40	20	60	20	30	70	65	20	50	30	25	40	70	40	20	20	40	10
Recently Dead Coral	0	0	0	0	0	0	0	0	0	0	0	0	5	5	30	30	30	70
Live Coral Rock	0	10	10	0	0	0	10	15	35	45	60	40	5	5	0	0	0	0
Coral Rubble	0	20	0	30	30	10	0	0	0	20	0	10	0	0	0	0	0	0
Sand	0	0	0	20	10	5	0	0	0	0	0	0	0	0	0	0	0	0
Macroalgae Type Distribution (%)																		
Slime	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Entangled/Mat Like	0	0	0	0	0	0	30	20	0	0	65	75	0	30	10	0	0	10
Filamentous	10	10	10	0	30	40	0	0	0	0	0	0	0	0	0	0	0	10
Leafy/Fleshy	0	0	20	0	0	0	0	10	60	60	10	20	100	70	90	90	100	70
Tree/Bush Like	90	90	70	100	70	60	70	70	40	40	25	5	0	0	0	10	0	10
Coral Type Distribution (%)																		
Soft	0	0	0	0	0	0	10	5	0	0	10	15	10	0	10	0	0	0
Branching	0	0	20	10	10	0	0	0	0	15	0	0	0	5	15	0	0	0
Bushy	10	0	0	10	20	5	10	15	10	25	20	10	0	0	15	0	0	10
Plate/Table	90	90	70	10	50	15	20	15	50	0	0	30	50	75	40	70	80	80
Vase/Foliose	0	0	0	0	0	0	10	15	0	25	30	10	30	5	0	0	0	0
Encrusting	0	0	10	0	0	0	40	15	40	20	10	25	0	10	10	10	0	0
Mushroom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Massive	0	10	0	70	20	80	10	35	0	15	30	10	10	5	10	20	20	10

Keppel region

Overall, the monitoring team conducted surveys at 7 sites, between 8 m to 13 m in depth in the Keppel Region (Table 4). The surveys were conducted within one day at both control and impact sites from where the seaweed *Asparagopsis taxiformis* was removed in October 2022. The data collection was conducted safely under the Reef Ecologic dive regulations and guidelines with 7 successful dives.

For this monitoring, the iNaturalist project data included 289 observations, with 104 new species, and from a people perspective, 3 observers and 25 identifiers (Figure 7). The three most observed species are Red Sea Plume (a seaweed), Longfin Rockcod (a fish), and Chinese Demoiselle (a fish). Interesting observations and citizen science community favourites include the Tasselled Wobbegong, Stingfishes, Ward's Damselfish, and Bowerbank's Cup Coral. Fish currently comprise 41.23% of the observed species, followed by molluscs and other animals. Reptiles comprise the smallest group (at 0.32%).

The Reef Health Impact Survey (RHIS) and Rapid data demonstrated a diverse range of habitats, with a wide range of algae and coral types recorded (Table 5). The "Tree/Bushy" type of macroalgae, represented by *Asparagopsis taxiformis*, was found to be the most significantly abundant algae type throughout all the sites monitored. The branching or *Acropora* corals were the most abundant coral type recorded throughout. These data were also supported by the iNaturalist observations at these sites.

Raw data showed that most of the sites (GKIN, HSW, and HS) showed a higher average number of species/iNaturalist observations one year after harvest compared to those recorded during harvest (Figure 8).

Table 4. iNaturalist, Rapid monitoring, and Reef Health Impact Survey (RHIS) were conducted at collection sites (before and after algae collections) and at control sites $\geq 30m$ from collection sites. Site refers to the North or Southwest side of the location island, Impact sites have monitoring conducted both before and after collection (BACI- Before After Control Impact). iNaturalist and Rapid monitoring record the total number of species observed, Rapid numbers refer to the total individuals observed, and RHIS consists of three surveys at each site.

Date	Time	Site	Lat	Long	Impact/ Control	BACI	iNaturalist Observer	iNaturalist species	Rapid Surveyor	Rapid Species	Rapid Numbers	RHIS Surveyor	RHIS number
14/10/2023	8:50	SE GKI	-23.17533	150.99294	Control	6-12 months after	Rachelle	38	Rachelle	3	6	Rory	3
14/10/2023	8:25	SE GKI	-23.17593	150.99221	Impact	6-12 months after	Rachelle	34	Rachelle	1	1	Rory	3
14/10/2023	9:50	HN	-23.20606	150.97248	Control	6-12 months after	Kaysha	14	Kaysha	1	1	Adam	3
14/10/2023	10:10	HN	-23.20572	150.97168	Impact	6-12 months after	Kaysha	12	Kaysha	0	0	Adam	3
14/10/2023	11:10	HS	-23.21751	150.96810	Impact	6-12 months after	Rachelle	29	Rachelle	2	4	Rory	3
14/10/2023	10:50	HS	-23.21757	150.96684	Control	6-12 months after	Rachelle	34	Rachelle	3	7	Rory	3
14/10/2023	11:30	HSW	-23.21777	150.96837	Impact 2	6-12 months after	Adam	27	Adam	2	4	Kaysha	3

Woppa Al-li (Keppel) Sea country

About Leave 12

A collaboration between Woppaburra Traditional Owners, Reef Ecologic, Futurefeed, CQUniversity, Wide Bay Pacific and Keppel Dive to share traditional and scientific knowledge and encourage learning about marine species

[Read More >](#) [Your Membership](#)

[Project Journal](#)

Overview **1,293** OBSERVATIONS **317** SPECIES **163** IDENTIFIERS **55** OBSERVERS [Stats](#)



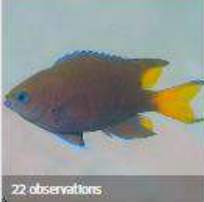


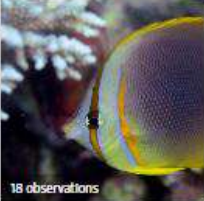







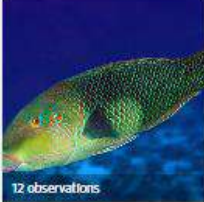

 <p>26 observations</p> <p>Longfin Rockcod <i>Epinephelus quoyanus</i></p>	 <p>26 observations</p> <p>Red Sea Plume <i>Asparagopsis taxiformis</i></p>	 <p>22 observations</p> <p>Chinese Demoiselle <i>Neopomacentrus bankieri</i></p>	 <p>21 observations</p> <p>Yellowback Puller <i>Chromis nitida</i></p>	 <p>20 observations</p> <p>Lemon Damsel <i>Pomacentrus moluccensis</i></p>
 <p>18 observations</p> <p>Goldstripe Butterflyfish <i>Chaetodon aureolasciatus</i></p>	 <p>18 observations</p> <p>Gunther's Wrasse <i>Pseudolabrus guentheri</i></p>	 <p>16 observations</p> <p>Greater Maze Corals Genus <i>Platygyra</i></p>	 <p>15 observations</p> <p>Bush Stone-Curlew <i>Burhinus grallarius</i></p>	 <p>14 observations</p> <p>Genus <i>Montipora</i></p>
 <p>14 observations</p> <p>Toadstool Leather Corals Genus <i>Sarcophyton</i></p>	 <p>13 observations</p> <p>Bengal Sergeant <i>Abudefduf bengalensis</i></p>	 <p>13 observations</p> <p><i>Paragoniastrea australensis</i></p>	 <p>12 observations</p> <p>Blackeye Thicklip <i>Hemigymnus melapterus</i></p>	 <p>11 observations</p> <p>Stripey Snapper <i>Lutjanus carponotatus</i></p>

Figure 7. Representative photos of the most common species/genus identified at Woppa Al-li (the Keppel Islands) during this project from 14/10/2022 to 19/11/2023 (Species tab on iNaturalist database). To view the full reel of species photos taken at Woppa Al-li on these dates, look in the 'Observations' tab on the iNaturalist database

Table 5. Reef Health and Impact Survey data from the 30th of January to the 31st of January at North Humpy Island (HN), Southeast Great Keppel Island (SE GKI) and Southwest Humpy Island (HSW)

Surveyor	RM			RM			AS			AS			RM			RM			KK		
Location	SE GKI			SE GKI			HN			HN			HSW			HS			HS		
Treatment or Control	C			T			C			T			C			T			T		
Before/After	6-12 months after			6-12 months after			6-12 months after			6-12 months after			6-12 months after			6-12 months after			6-12 months after		
Survey #	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Lat	-23.17533			-23.17593			-23.20606			-23.20572			-23.21757			-23.21751			-23.21777		
Long	150.99294			150.99221			150.97248			150.97168			150.96684			150.96810			150.96837		
Date	14/10/2023			14/10/2023			14/10/2023			14/10/2023			14/10/2023			14/10/2023			14/10/2023		
Time	8:50			8:25			9:50			10:10			10:50			11:10			11:30		
Depth (m)	13			13			11			14			11			11			11		
Tide	high			high			high			high			high			high			high		
Water Temp (°C)																					
Benthos Composition (%)																					
Macroalgae	10	30	5	65	45	30	30	75	60	60	60	60	2	0	0	5	10	10	0	0	10
Live Coral	15	30	60	10	5	10	5	5	5		1		90	90	95	90	85	40	35	30	70
Recently Dead Coral	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	50	
Live Coral Rock	0	0	30	10	10	10	10	0	0	0	0	0	8	5	5	5	5	0	0	0	0
Coral Rubble	5	25		10	20	15	10	10	5	2	19	10	0	0	0	0	0	40	20	10	10
Sand	70	15	5	83	20	35	45	10	30	38	20	10	0	5	0	0	0	10	40	10	10
Macroalgae Type Distribution (%)																					
Slime	5	10	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Entangled/Mat Like	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Filamentous	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
Leafy/Fleshy	5	5	5	15	20	30	20	50	40	50	50	50	0	0	0	0	5	5	0	0	10
Tree/Bush Like	90	85	80	80	80	70	80	50	60	50	50	50	100	100	100	100	95	95	100	100	80
Coral Type Distribution (%)																					
Soft	5	10	10	5	10	15	0	0	5	20		80	5	10	10	0	5	5	0	15	10
Branching	15	20	15	20	60	0	0	0	0	0	0	0	50	60	30	90	85	90	90	60	80
Bushy	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0
Plate/Table	0	30	35	0	0	0	10	0	5	0	0	0	5	0	10	0	0	0	0	10	0
Vase/Foliose	40	5	10	60	0	60	30	0	20	80	80	10	0	0	25	0	0	0	0	0	0
Encrusting	40	35	30	0	30	25	0	0	0	0	0	0	40	30	20	10	10	5	0	0	0
Mushroom	0	0	0	15	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0
Massive	0	0	0	0	0	0	60	100	70	0	10	10	0	0	0	0	0	0	10	15	10

The number of species from iNaturalist observations was higher for Humpy South and Southeast GKI in the recent monitoring (12 months post-harvest), which was similar to the previous monitoring (3 months post-harvest) although more pronounced (Figure 8). More species were observed in two control sites in Oct 2022, one control site during January 2023, and in all control sites in October 2023 compared to the impact sites. More species were generally observed in the current monitoring compared to October 2022 for all sites except Humpy North. Overall, more species were observed during January 2023 (between 24 and 42) compared with October 2022 (between 15 and 26) and October 2023 (between 12 to 38).

Using the Rapid Monitoring technique, the total number of individuals (Figure 9) and species counts (Figure 10) were determined at each site (Table 4). Fewer individuals were generally observed in the recent survey compared to that during the 3-months post-harvest survey. More individuals were observed in the control sites of Southeast GKI and Humpy South, as well as in the impact area in Humpy Southwest, during the current monitoring compared with those in the same sites during the initial removal. More individuals were observed in the control sites than in the impact sites in the recent monitoring. No individuals were observed in the impact site in Humpy North during the recent monitoring. No individuals were observed at the control site of Site 1 (SE GKI) at the time of harvest, but 6 were observed 3 months post-harvest and 12 months post-harvest (Figure 9).

The number of species observed at all sites using the Rapid Monitoring technique was between 0 and 3, with control sites on average having more species 12 months post-harvest and at the time of algal harvest. This is in contrast to the 3-month post-harvest survey, where the impact sites had more or as many species as control sites. No species were observed in the impact site of Humpy North during the 12-month post-harvest survey. No species were also observed at Site 1 (SE GKI) at the control site at the time of harvest (Figure 10).

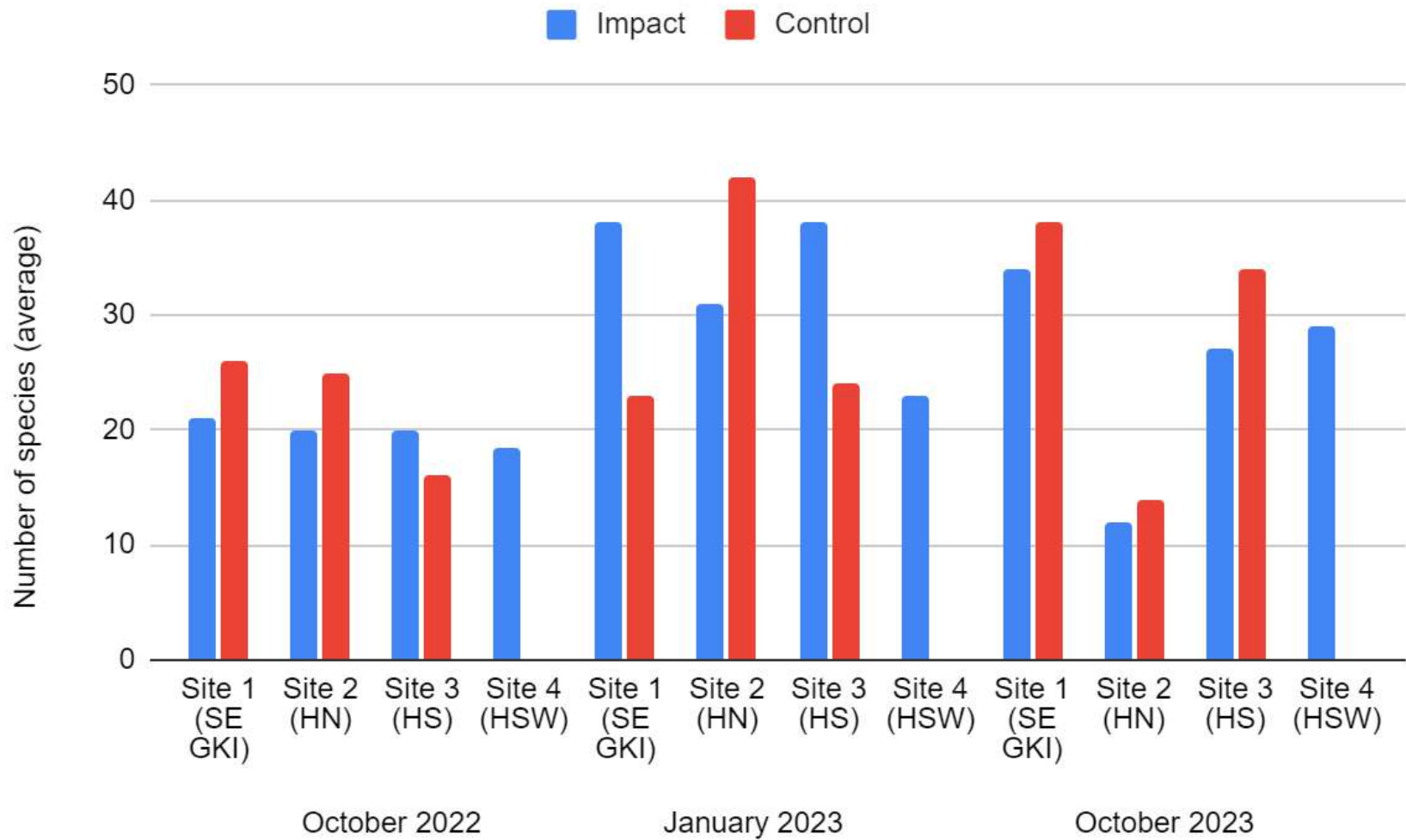


Figure 8. Average number of species identified at each site in the Keppel region by iNaturalist methodology during the initial removal during October 2022, the 3 months post removal in January 2023 and 12 months post removal during October 2023

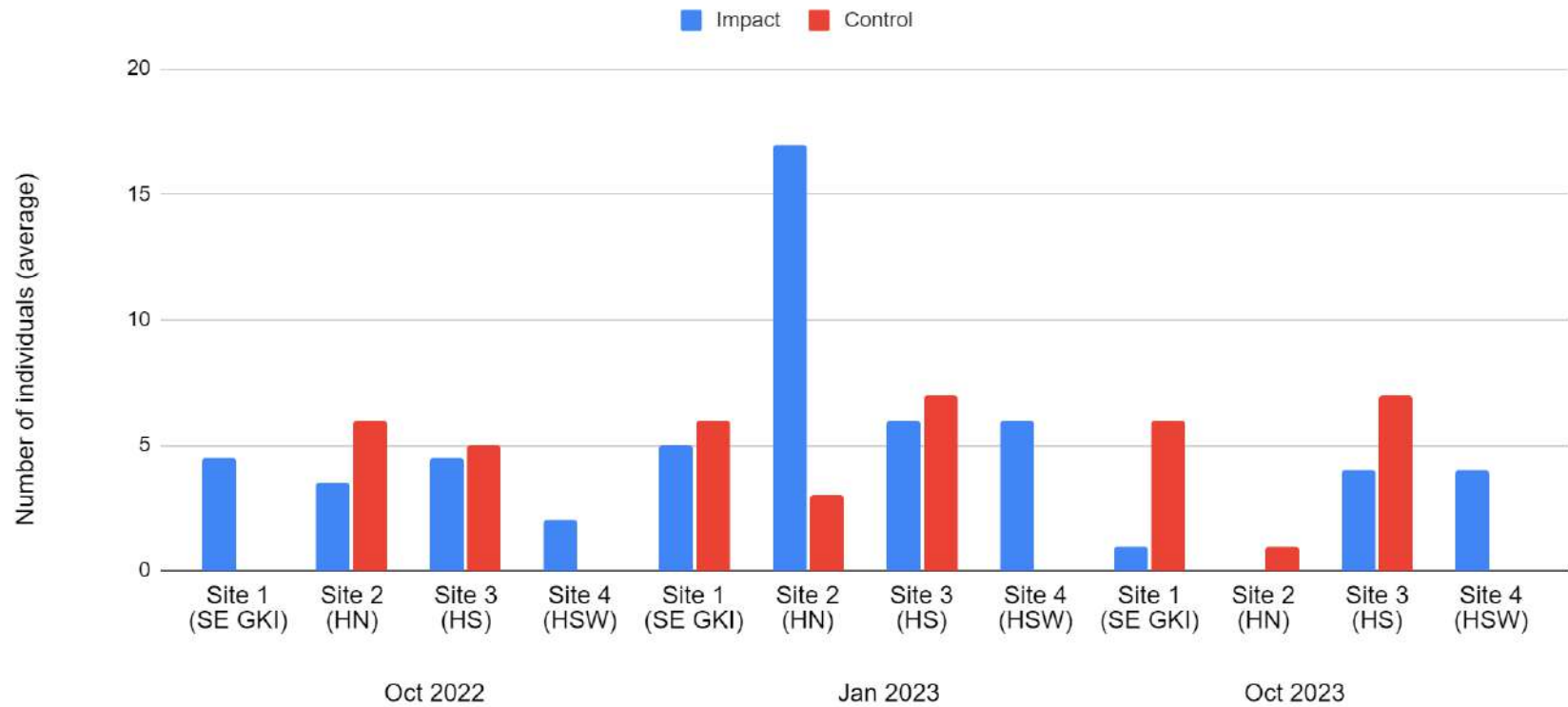


Figure 9. Average number of individuals identified at each site during the initial removal, the 3 months post-removal, and the 12 months post-removal surveys using Rapid Monitoring.

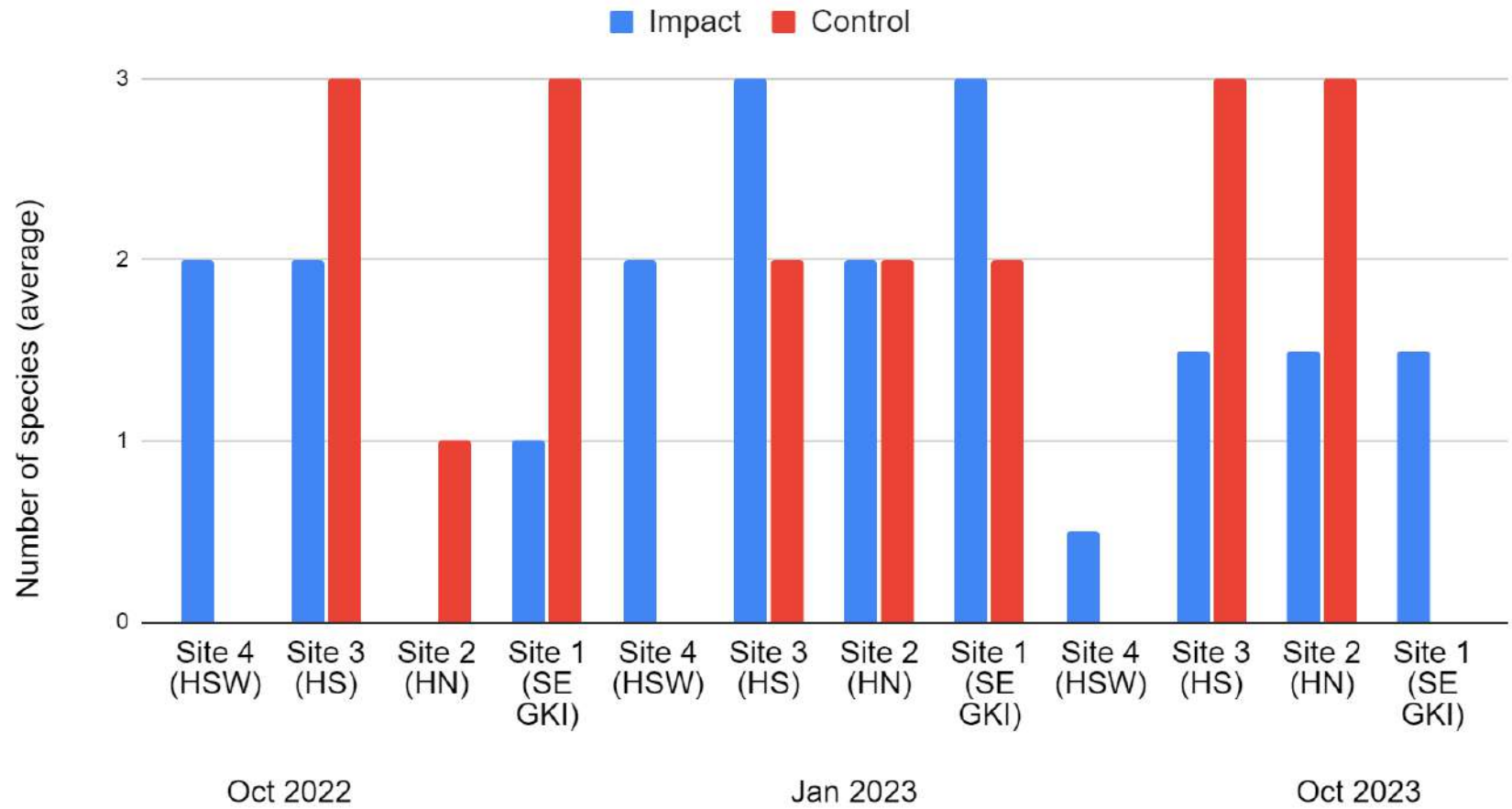


Figure 10. Average number of species identified at each site during the initial removal (A), the 3 months post-removal (B), and 12 months post-removal (C) surveys using Rapid Monitoring.

Discussion

Comparison of macroalgae over time

We compared the percentage cover of macroalgae at Magnetic Island and Keppel Islands using Reef Health Impact Survey methodology over four times between control and treatment locations to note any decreases or increases in macroalgae cover as a result of harvest over time (Figure 11).

The reason we created these graphs is the Queensland Government permit condition 13b:

Where *Asparagopsis taxiformis* has not recovered to pre- collection area of cover and percent density within 12 months after harvesting, the monitoring program described in a) must also include the following additional monitoring events:

- (i) 1 year post collection;
- (ii) 2 years post-collection;
- (iii) 3 years post-collection;
- (iv) 4 years post-collection; and
- (v) 5 years post-collection

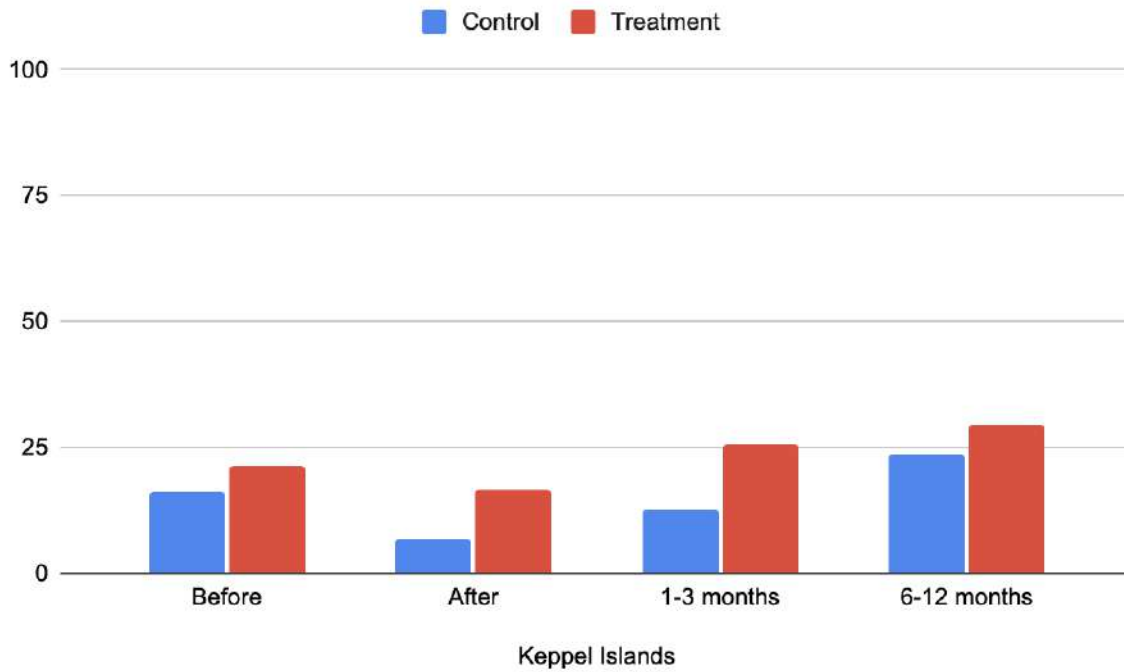
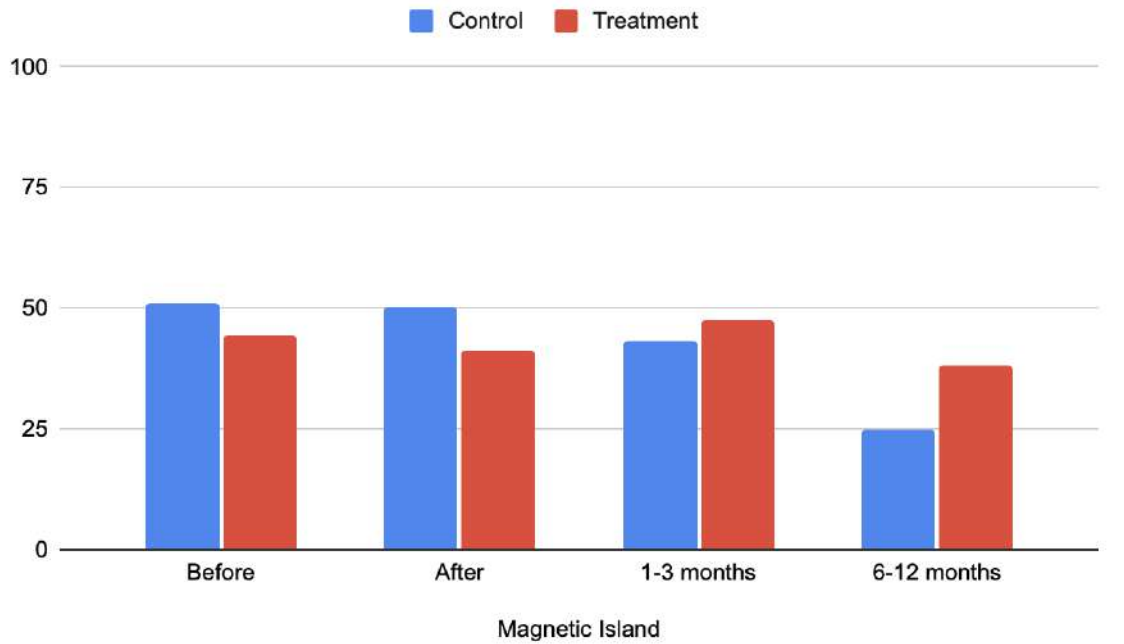


Figure 11. A comparison of macroalgae cover at Magnetic Island (top) and Keppel Islands (below) in all control locations (no harvest) compared to treatment locations (Asparagopsis harvest) over time

Our interpretation is that macroalgae cover in the treatment locations at both Magnetic and Keppel Island recovered to exceed before-harvest levels at 1-3 months. There also appears to be a temporal variation of approximately 15% to 25% percent cover over time at the control sites.

Further detailed analysis will occur on the potential changes in the number of species over time at Magnetic and Keppel Island to determine if there are any secondary impacts associated with the wild harvest of algae.

Recommendations

Based on a Before-After-Control-Impact study of small-scale wild harvest of the Red Sea Plume it appears that there are no long-term impacts on macroalgae and it recovers within 1 to 3 months. It is recommended that further analysis of potential impacts on species is undertaken. If there are no significant negative impacts, it is recommended that a small-scale wild harvest fishery is developed in a partnership between industry and traditional owners.

Appendices

Appendix 1. Collection data

Date	Location	Volume (l)	Wet weight (kg)
23 09 2022	Middle Reef 1	210	90
12 09 2022	Middle Reef	330	135.9
19 09 2022	Middle Reef 3	350	144.05
13 09 2022	Middle Reef	200	78.6
20 09 2022	Middle Reef	310	131.5
	Total	1400	
14 10 2022	Humpy Island, Keppels	100	
14 10 2022	Humpy Island, Keppels	50	
	SE Great Keppel Is	80	
	Humpy Island, Keppels	100	
	Total	330	