Southern GBR Habitat Mapping Fieldtrip,

Include: Hardline Reefs To Reefs

Offshore From Townsville

19th May – 6 June 2019

Projects supported:

GBRMP Mapping Project

Remote Sensing
RESEARCH CENTRE

School of Earth and Environmental Sciences

The University Of Queensland
AUSTRALIA

Australian Government
Great Barrier Reef Marine Park Authority

Australian Institute of Marine Science

EOMAP

EYE ON THE REEF

CORALWATCH

Great Barrier Reef Foundation

VULCAN

Version 5, 10 June 2019 Chris Roelfsema

Overview
Goals for trip

Calibration and validation data need to be collected for habitat mapping project in for the Hardline Reef area to reefs offshore from Townsville by visiting approximately 16 selected reefs where at each 8 shallow dives and 3-5 snorkel transects will be conducted.

Activity

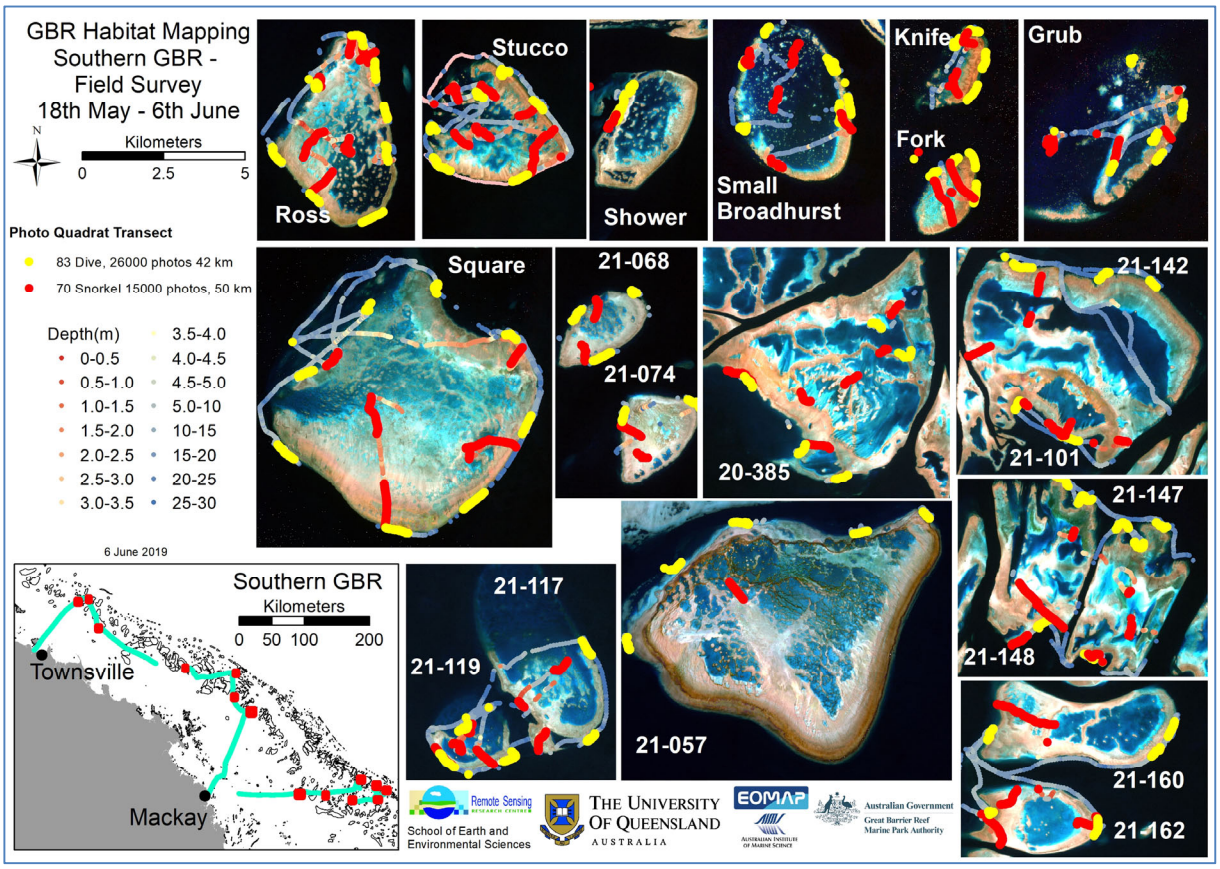
At each reef following activities will take place:

1. Dives along the reef slope at 5 m depth 30 min each equivalent to approximately 500 m, collecting:
    a. Georeferenced Benthic Photo transects
    b. Stereo GoPro transects for rugosity
    c. CoralWatch surveys
    d. Reef Health Impact Surveys
    e. COTS counts
    f. COTS tissue samples for genetic work
2. Snorkel over reef flat 30 min each equivalent to approximately 500 -1000 m, collecting:
    a. Georeferenced Benthic Photo transects
    b. Stereo GoPro transects for rugosity
    c. CoralWatch surveys
    d. Reef Health Impact Surveys
    e. COTS count
    f. OTS tissue samples for genetic work
3. Reef-wide Drone Survey
4. Bathymetry data for ongoing work

Summary of Activities Trip

	Total
Distance covered by Mv Kalinda	1255 km, 683 nm
Number of Reefs visited in Southern GBR	20
Number of survey days	16
Number of weather down time days	2
Number of Quadrat Photos	26,406 (dive), 15,038 (snorkel)
Number of Photo/rugosity Transects	83 (dive) 70 (snorkel)
Total Transects length	42.2 km (dive), 50.1 km (snorkel)
Number of Rugosity photos	185,160 (dive), 86,780 (snorkel)
Number of RHIS	136
Number of CoralWatch	153
Number of COTS counts	17 (14 at 21-119)
Number of COTS tissue samples	16 (14 at 21-119)
Number of CCA samples	386
Number of Hydrophone recordings	9
Number of Depth readings	131,301

Conditions Varying from no wind to 20-25 kn wind


GBR Habitat Mapping
Southern GBR -
Field Survey
18th May - 6th June
N
Kilometers
0 2.5 5
Photo Quadrat Transect
83 Dive, 26000 photos 42 km
70 Snorkel 15000 photos, 50 km
Depth(m)
0-0.5
0.5-1.0
1.0-1.5
1.5-2.0
2.0-2.5
2.5-3.0
3.0-3.5
3.5-4.0
4.0-4.5
4.5-5.0
5.0-10
10-15
15-20
20-25
25-30
6 June 2019
Southern GBR
Kilometers
0 50 100 200
Townsville
Mackay
Ross
Stucco
Shower
Small
Broadhurst
Knife
Fork
Grub
Square
21-068
21-074
20-385
21-142
21-101
21-147
21-148
21-117
21-119
21-057
21-160
21-162
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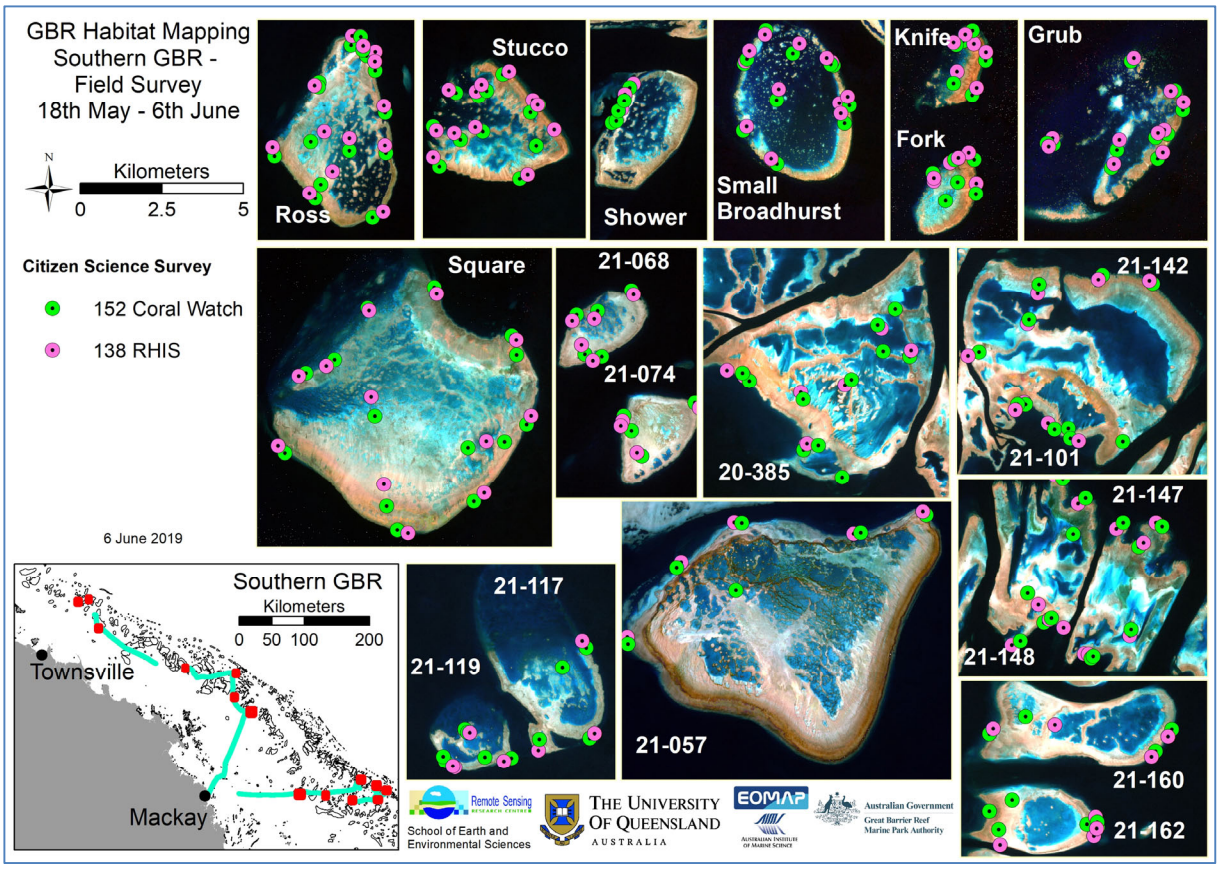
GBR Habitat Mapping
Southern GBR -
Field Survey
18th May - 6th June
N
Kilometers
0 2.5 5
Citizen Science Survey
152 Coral Watch
138 RHIS
6 June 2019
Southern GBR
Kilometers
0 50 100 200
Townsville
Mackay
Ross
Stucco
Shower
Small
Broadhurst
Knife
Fork
Grub
Square
21-068
21-074
20-385
21-142
21-101
21-147
21-148
21-117
21-119
21-057
21-160
21-162
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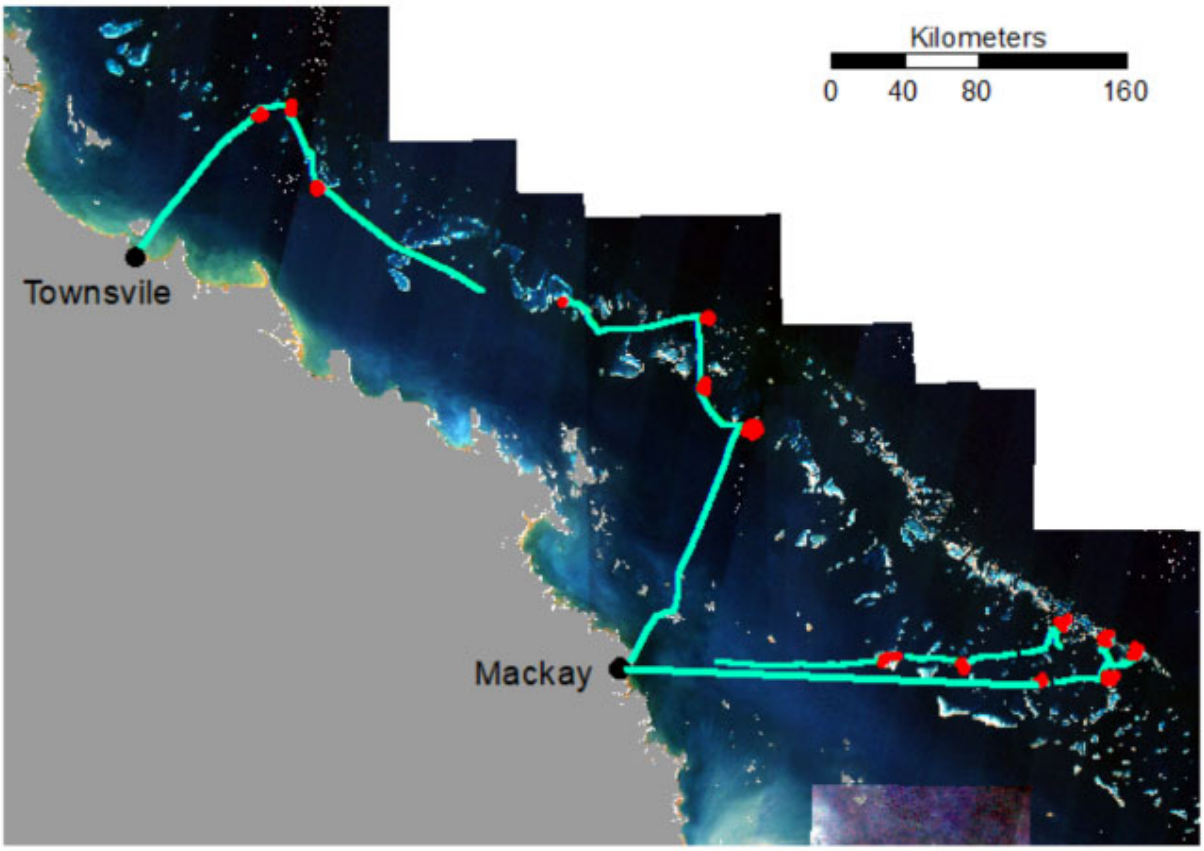
Study Site and Survey Location

Site requirements

- High and low wave exposure
- Intermediates are close to the above
- Minimal reef health impacts (undisturbed reefs)
- Variety of reef shapes
- Variety of reef aspects
- Variety of coral types
- Reefs with a perimeter larger than 8 km
- Some overlap with AIMS and GBRMPA

Trip 1 19-28th May Mackay-Hardline Reefs

Trip 2 28th May 6th June Mackay-Townsville



Boat

MV Kalinda main vessel

RIB Patrol, size engine 150hp and RIB Antares, size engine 150hp

Participants

Trip Part 1 19-28th May Mackay-Hardline Reefs-Mackay

	Code	Name	Start	End	T	Diving	Boat handler	Institute	Role
1	CR	**Chris Roelfsema**	19/5	6/6	1+2	Sci + inst	Rec	UQ Staff	PI
2	EK	**Eva Kovacs**	19/5	6/6	1+2	DM	Rec	UQ Staff	CW/RHIS+PT dive
3	EVK	**Emma Kennedy**	19/5	6/6	1+2	Inst	Coxs	UQ Staff	CW/RHIS+PT dive
4	KM	**Kathryn Markey**	19/5	6/6	1+2	DM	Coxs	UQ Staff	CW/RHIS+PT dive+ organiser
5	RB	**Rodney Borrego**	19/5	6/6	1	DM	Rec	UQ Staff	CW/RHIS+PT dive
6	AO	**Alexandra Ordonez Alvarez**	19/5	28/5	1	n.a.	non	Vol. UQ	CW+PT+ Dive + CCA
7	JP	**Josh Passenger**	19/5	28/5	1	DM	Rec	Vol. UQ	CW/RHIS+PT dive + Drone
8	IP	**Iva Popovic**	19/5	28/5	1	OWD	n.a.	UQ.Staff	CW+COTS

Trip Part 2 28th May 6th June Mackay-Townsville

	Code	Name	Start	End	T	Diving	Boat handler	Institute	Role
5	MR	**Meredith Row**	19/5	6/6	2	Res	Rec	UQ Staff	CW/RHIS+PT dive + Drone
6	DS	**Douglas Stetner**	28/5	6/6	2	Ins	Rec	Vol. UQ	CW/RHIS+PT dive
7	KJ	**Karen Johnson**	28/5	6/6	2	DM	Rec	Vol. UQ	CW/RHIS+PT dive

BDO = boating and diving officer on duty

2019 Trip 1 Mackay - Hardline Reefs Habitat Characterisation Team

Left to right: Eva Kovacs (EK), Kat Markey (KM), Emma Kennedy (EVK), Alexandra Ordonez (AO), Rodney Borrego (RB), Iva Popovic (IP), Josh Passenger (JP), Chris Roelfsema (CR).

2019 Trip 2 Mackay-Townsville Habitat Characterisation Team

Left to right: Emma Kennedy (EVK), Kat Markey (KM), Meredith Roe (MR), Karen Johnson (KJ), Eva Kovacs (EK), Douglas Stetner (DS), Chris Roelfsema (CR).

1 Sunday (19 May 2019)

People:
All travel to Mackay

Weather:
Partly clear sky, 20-25 kn wind, Water Temp 24 degree

Activities:
Travel and getting ready

Findings
- no specifics

Plan for tomorrow
Get gear ready and cross 5 am Mackay to reef 21-057

2 Monday (20 May 2019)

People:
All

Weather:
Partly Clear sky, 20-25 kn wind SE, Water Temp 24 degree

High 10:49 am

Activities:
5 am leave Mackay in direction reef 21-057, leave postponed from Sunday night due to weather conditions

Travel and getting ready, arrived Reef 21-057 around 4pm, set up equipment for tomorrow.

Findings
- no specifics

Plan for tomorrow
Survey reef 21-057 and cruise to next reef.

3 Tuesday (21 May 2019)

People:
All

Weather:
Overcast, breezy, 15 knots, gusting 20 knots. Water Temp 25ºC.

High 11:30 am, Low 05:18 pm

Wind chop on North West side of reef, Wind chop and swell on South West side.

Activities:
8:00 am Dive boat depart

8:30 am Snorkel boat depart

12:00 pm Snorkel boat return

1:00 pm Dive boat return

1:30 pm Kalinda depart to 20-074 site

5:30 pm Kalinda arrived at anchorage

Reef Name: **21-057**	Dive	Snorkel
People (initials)	CR, JP, KM, AO, IP	EK, EVK, RB
#Quadrat Photos	1464	181
#Photo Transects	5 (D1->D8->D7->D6->D2)	1 (S4)
Total Transects length (m)	2003	453
#Rugosity photos	13566	2192
#RHIS	5	0
#CoralWatch	5	1
#COTS counts	0	0
#COTS samples	0	0
#CCA samples	20 (snorkelling/diving)	0
#Hydrophone recordings	1	0
#Echosounding pings	6157	na

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

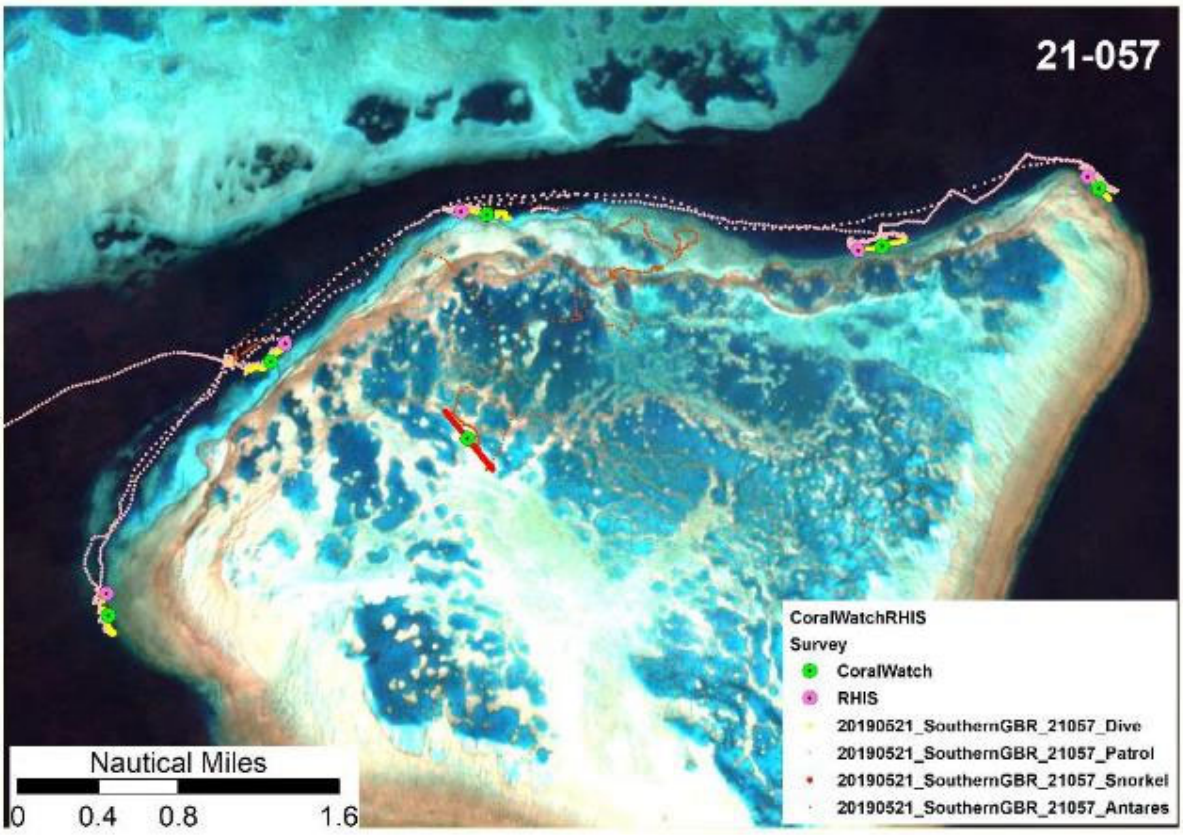
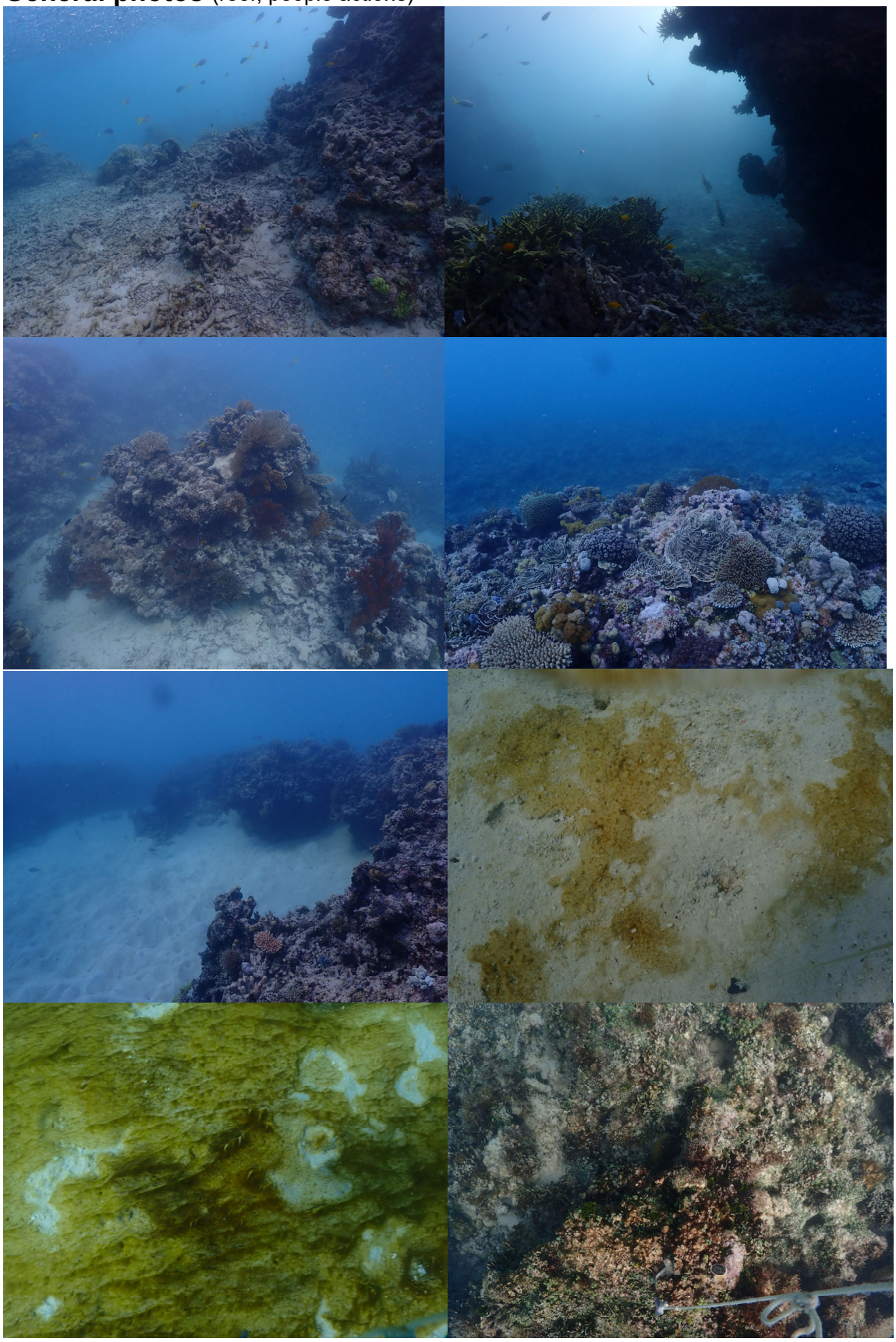


Figure 1: Survey sites

General photos (reef, people actions)



Findings (in regards to methods, team, reef health or other observations)
Reef 21-057 lagoon was difficult to enter except one hour either side of high.

Ridge system throughout lagoonal area creating a bathtub, which was impossible to enter on low tide.

Dive transect

- No access to South East site due to wind and swell
- Time limited to only 5 transects due to starting day and sea condition slow to drive between sites, and very big reef.
- D1, D8 and D7 mixture of sand and walls due to protected site of reef and facing neighbouring reef, narrow 1 km wide channel in between.
- Strong current hence growth of seafans and softcorals.

Snorkel transect

- Lagoon filled with coral bommies, halimeda covered reefs, deeper sandy pools
- Little water on top making it hard to access
- Echosounder not connecting
- Snorkel tracking GPS disappeared from dry-back/float, float not completely inflated and possible back not closed properly. As a result GPS coordinates of photos need to be calculated based on interpolation between drop off and pickup point
- RHIS not attempted as not enough substrate, Coral Watch just one survey (6 corals only)

GPS on float need to be secured or by connecting to float or by blowing up float so its tight enough.

4 Wednesday (22 May 2019)

People:
All

Weather:
Partly cloudy, 20-25 kn SE wind, sun, Water Temp 24 degree

High 12:11 pm, low tide 6:28 am

Activities:
7:00 am Snorkel and Dive boat depart

12:00 pm Snorkel and dive boat return

0:30 pm Kalinda depart to 20-101 site

5:30 pm Kalinda arrived at anchorage

Reef Name: **21-068 and 21-074**	Dive	Snorkel
People (initials)	CR, EK,JP,EVK	KM,AO,IP,RB
#Quadrat Photos	1739	741
#Photo Transects	5	4
Total Transects length (m)	2191	2087
#Rugosity photos	13040	3578
#RHIS	5	4
#CoralWatch	5	4
#COTS counts	0	0
#COTS samples	0	0
#CCA samples	33 (snorkelling/diving)	
Echosounding pings	2336	na

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

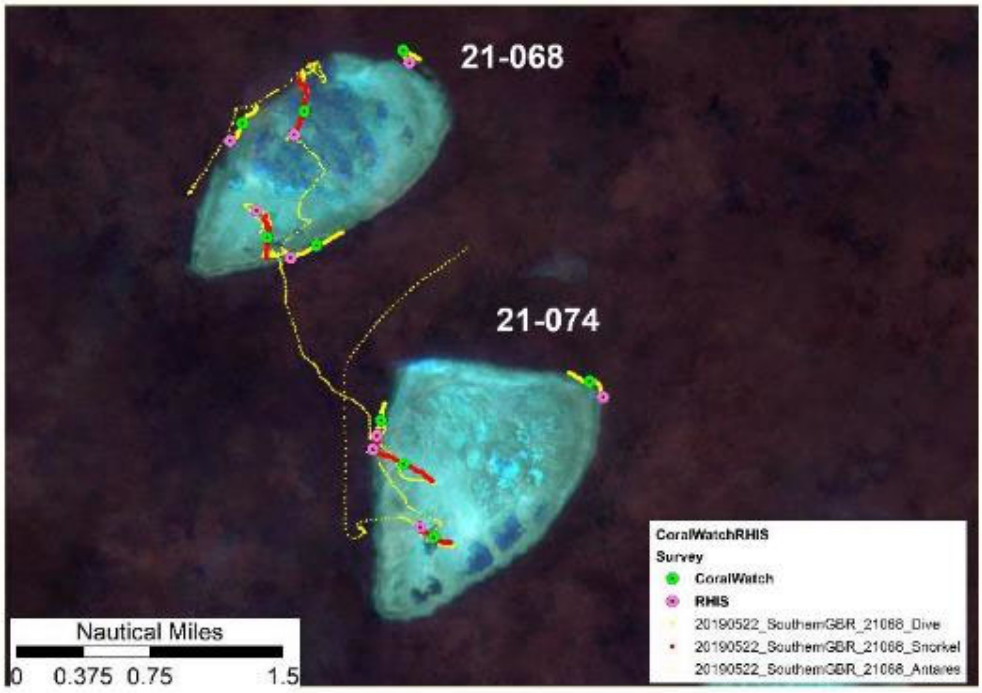


Figure 2: Survey sites

General photos (reef, people actions)

Findings (in regards to methods, team, reef health or other observations)

Dive transects

- All gear worked perfect
- D1 at 21-068 has alternating areas of dense coral (mixed forms and colours) on the slope with rubble
- D2 at 21-068 had large branching rubble area, partly wall but plateauing at location of transect
- D4 at 21-068 high number of mushroom coral, and mixture of other coral, sloping area, with closer to 3 m a small wall.
- D1 at 21-074 high coral cover dominant branching, but also other geomorphs plate and massive, lots of fish, sloping area
- D4 at 21-074 was a field of huge bommies with overhangs and walls, some enormous round mounds and some tall pinnacles.
- 20-074 deeper reef then 20-068, no clear developed reef crest.

Snorkel transects

- All gear worked perfect

Plan for tomorrow

- Survey 20-085

5 Thursday (23 May 2019)

People:
All

Weather:
Clear sky, 10-15 kn wind SE, Air temp 29 degrees, Water Temp 24 degree

High 12:56 pm, low 7:14 am

Activities:
7:00 am Snorkel and Dive boat depart

1:00 pm Snorkel and dive boat return

1:30 pm Kalinda depart to 20-101 site

4:30 pm Kalinda arrived at anchorage

Reef Name: **20-385**	Dive	Snorkel
People (initials)	EK, KM, RB, AO	CR, EVK, IP, JP
#Quadrat Photos	855	1524
#Photo Transects	5 (D7->D5->D9->D10->D4)	6 (S8->S9->S1->S2->S3->S4)
Total Transects length (m)	2116	3115
#Rugosity photos	1076	7898
#RHIS	4	4
#CoralWatch	5	6
#COTS counts	0	0
#COTS samples	0	0
#CCA samples	43 (snorkelling/diving)	
Echo sounding pings	2462	na

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

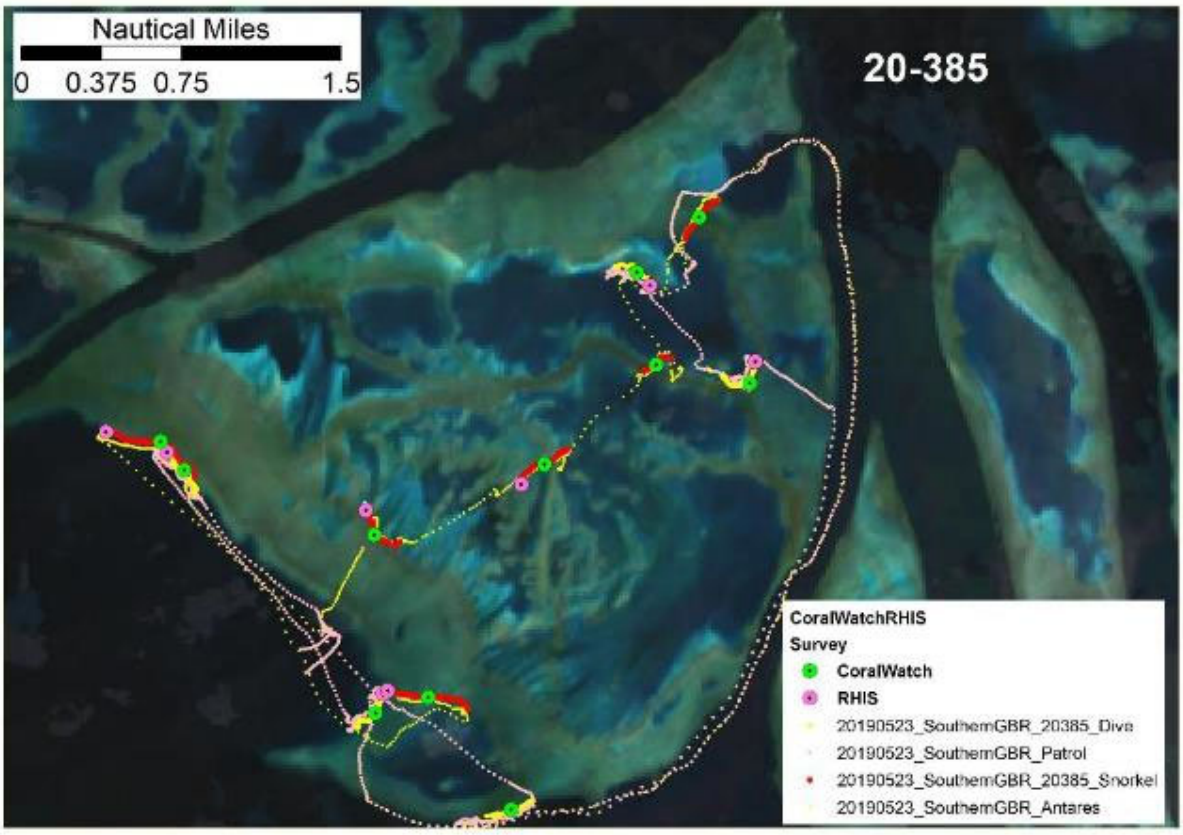


Figure 2: Survey sites

General photos (reef, people actions)








Findings (in regards to methods, team, reef health or other observations)

- Dive Transect
    - D7 leeward reef slope – scattered rough coral bommies, small fish, rubble and sand
    - D9 northern side of upper large lagoon – sandy base to depth of ~10m, bommie ridge covered in coral, lots of mushroom coral in 'bloom', active leopard shark.
    - D4 southern end of eastern channel – large patches of beautiful coral and fish alternating with large patches of rubble/CCA. Gradual slope dropping down to the (not visible) bottom of the channel. Large fish. Maori wrasse. Speedy leopard shark.
- Snorkel Transects
    - S8 edge of the reef following the reef rim, sheltered site reef rim, classic CCA on the plateau (high amount 80%) and healthy coral before the slope
    - S9 reef flat, starting with coral algae zone, then hard substrate white with bommies of coral and then more coral before getting in deeper water
    - S1 reef rim inside lagoon on edges start and end point of transect coral with on north side sandy slope and south side slope with branching coral with rubble, mid reef top hydroid brown and CCA
    - S2 like S1 but now on the highest point caulerpa and halimeda and CCA
    - S3 coral plateaus, with slightly sloping rubble areas (past thick branching coral) in deeper sand, large stands of Seriatopora and Acropora thickets in deeper lagoon, plenty of rubble around too
    - S4 current took us sideways instead of over reef flat – but more thickets of Acropora

6 Friday (24 May 2019)

People:
All

Weather:
Clear sky, 15-20 kn SE wind, Water Temp 24 degree

High 13:49 pm, low 08:06 am

Activities:
7:00 am Snorkel and Dive boat depart for Reef 21-101

1:00 pm Snorkel and dive boat return – dived to retrieve lost tank and tawny nursesharks

2:30 pm Kalinda depart to 21-147 site (through passage between reefs)

4:00 pm Kalinda arrived at anchorage

Reef Name: **21-101 and 21-142**	Dive	Snorkel
People (initials)	EVK, CR, JP, KM	IP, AO, EK, RB
#Quadrat Photos	1386	592
#Photo Transects	5	7
Total Transects length (m)	2302	3153
#Rugosity photos	14440	4840
#RHIS	4	5
#CoralWatch	5	7
#COTS counts	0	0
#COTS samples	0	0
#CCA samples	25 (snorkelling/diving)	
Echo sounding pings	1452	na

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

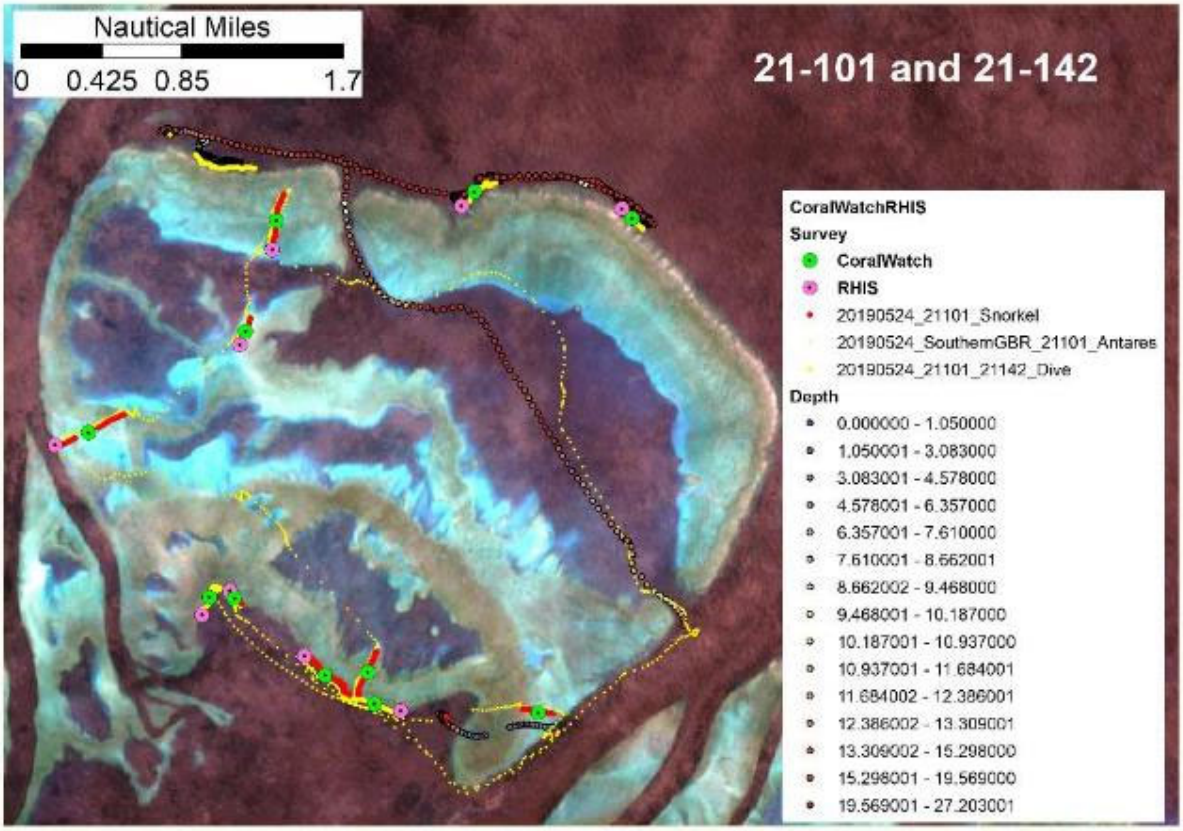
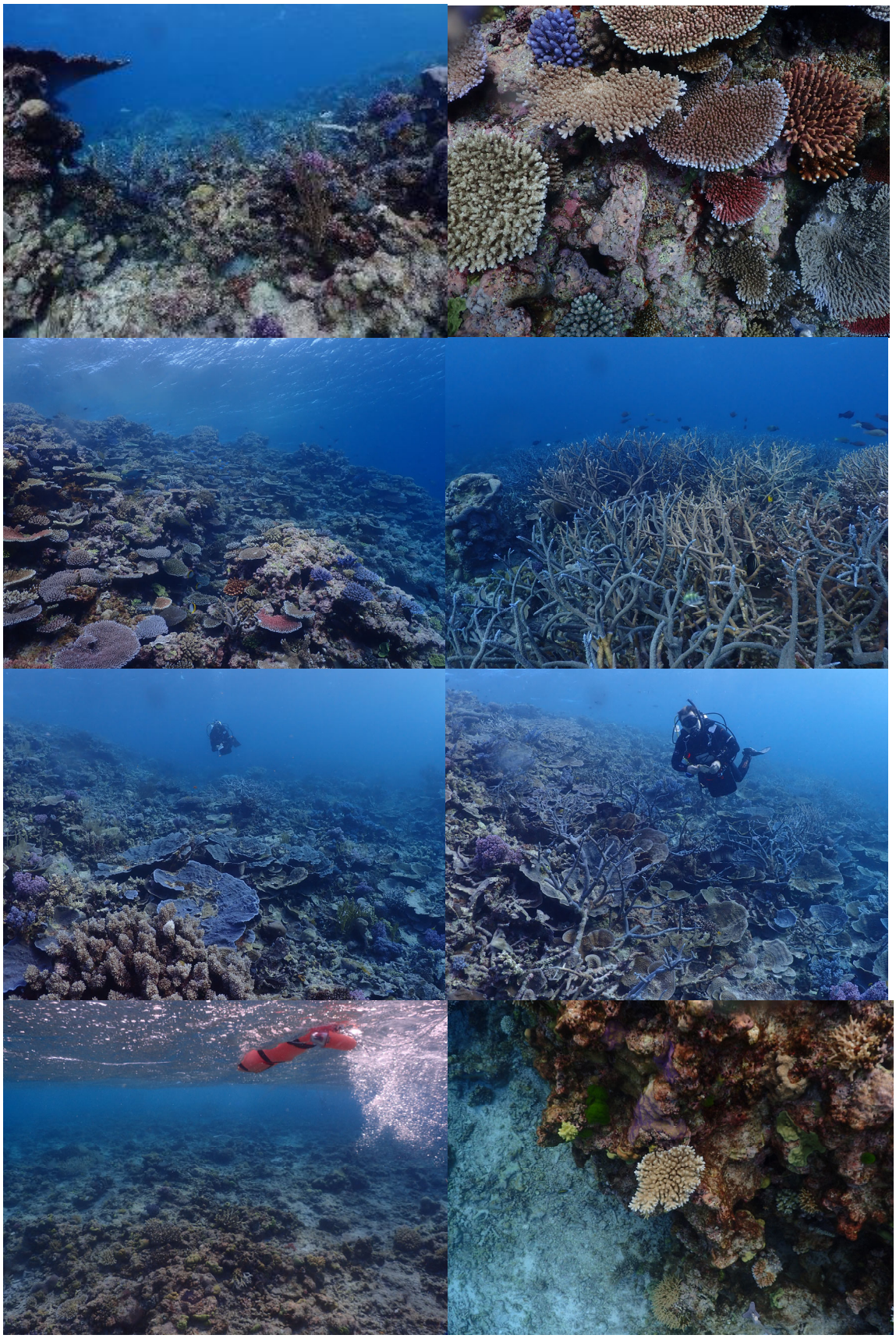
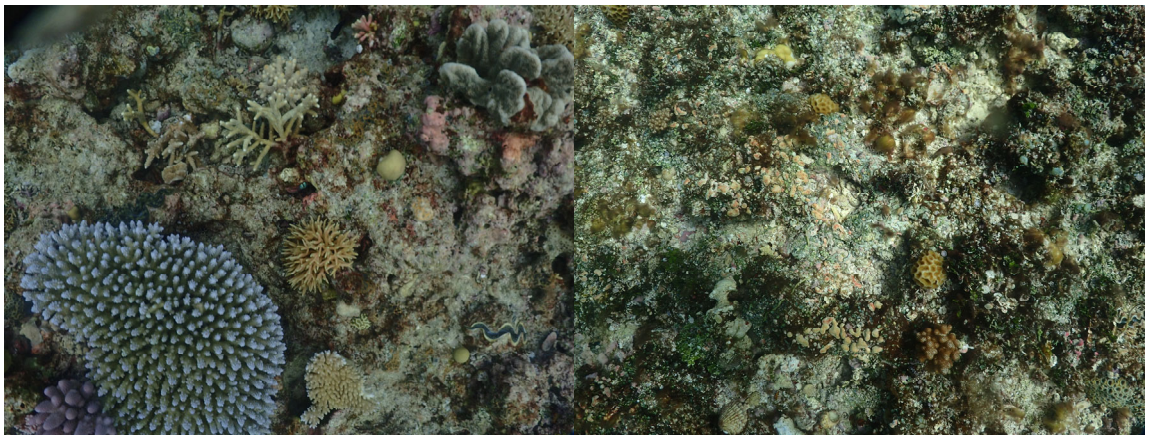


Figure 3: Survey sites

General photos (reef, people actions)





Findings (in regards to methods, team, reef health or other observations)

General

- Large deep lagoon up to 25 m with narrow openings. Strong currents at openings
- Large shallow lagoon area
- Deep lagoon not always closed, as can have channels leading into it, hence require consideration

Snorkel:

- S5 – parallel to the reef crest on the outer reef flat. Lots of coral and lots of current!
- S6 - parallel to the reef crest on the outer reef flat. Almost like spur and groove – alternating elevated areas of corals, and rubbly trenches. Huge Maori wrasse eyeing us off as tasty tid-bits!
- S1 – from northern reef crest to lagoon. Lots of coral close to the reef crest, decreasing in quantity and quality as we were approaching the lagoon. Lots of calerpa on the inner reef flat. Very white sand.
- S7 – deep rubbly area with a few coral patches.
- S4 – started on a sandy reef flat, crossed a couple of deep sandy bottom lagoons, to cross the outer reef flat to finish at a beautiful reef crest with stunning corals and deep hidey holes full of fish and coral.
- S3 – started on an elevated low (relative) ridge which consisted of lots of branching corals with a rubbly top in the exposed areas. Progressed towards the reef crest where again. Stunning large white, sea snake swimming towards us.
- S8 – very deep sandy/macro algae area to start, changing to a shallower rubble area with small corals.

Dive

- 21-101-D5(D6-for photo transect) High coral cover large dense thick branching coral with high canopy, foliose coral, high diversity and lots of fish life, sloping protected embayment
- 21-101-D4 rubbley gentle sloping reef with sparse corals – mainly bushy acroporids
- 21-101-D1 Plating coral, strong current towards northern part transect, spurs and groves, gentle slope, pelagic fish, presence of large Maori wrasse. Abort RHIS and CCA survey due to strong current

- 21-142-D1 fast current running westwards along steep outer reef slope - CCA dominated stepped plateau – crest at around 7-9 m and then a drop to about 20 m sandy bottom. Broken profile with spur-and-groove style channels breaking up occasionally into large bommies. Grooves were deep sand filled channels. Top mainly flat hardground CCA dominated with sparse bushy corals (Stylophora dominant) and soft corals.
- 21-142-D2 Plating and bushy coral lower cover with lots of CCA and high turf and slime coral, strong currents

Plan for tomorrow

21-147/148

7 Saturday (25 May 2019)

People:
All

Weather:
Clear sky, 10-15 kn SE wind, Water Temp 24 degree

High 14:57; LT 09:08

Activities:
7:00 am Dive boat depart for Reef 21-147/148

8:00 am Dive boat depart for Reef 21-147/148

1:00 pm Snorkel boat return

1:30 pm Dive boat return

2:00 pm Kalinda depart to next site 21-160

4:30 pm Kalinda arrived at anchorage

Reef Name: **21-147/21-148**	Dive	Snorkel
People (initials)	CR, EVK, JP, RB	KM, EK, IP, AO
#Quadrat Photos	2359	1246
#Photo Transects	7 (21-147: D4, D5, D2; 21-148: D3, D1, D9, D10)	7
Total Transects length (m)	3713	3558
#Rugosity photos	17944	7206
#RHIS	7	5
#CoralWatch	7	6
#COTS counts	0	0
#COTS samples	0	0
#CCA samples	25 (snorkelling/diving)	
Echosounding pings	2479	4022

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

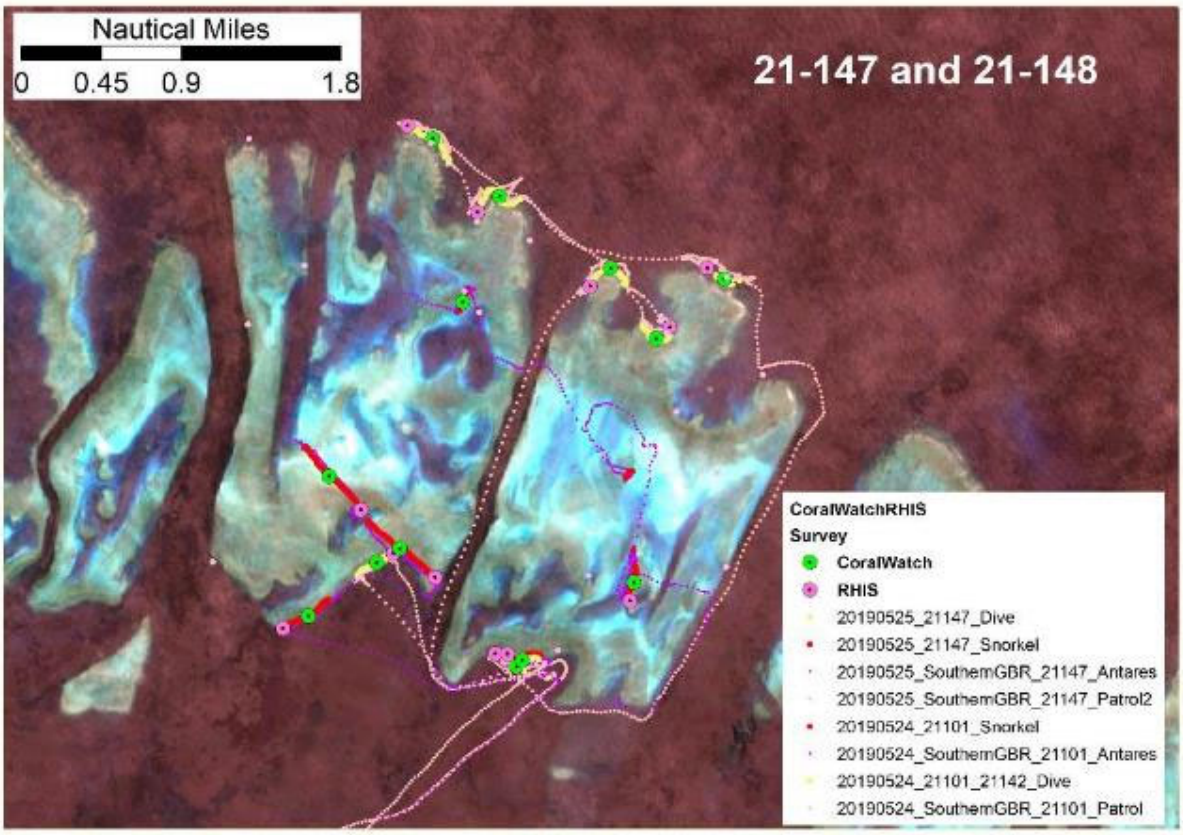
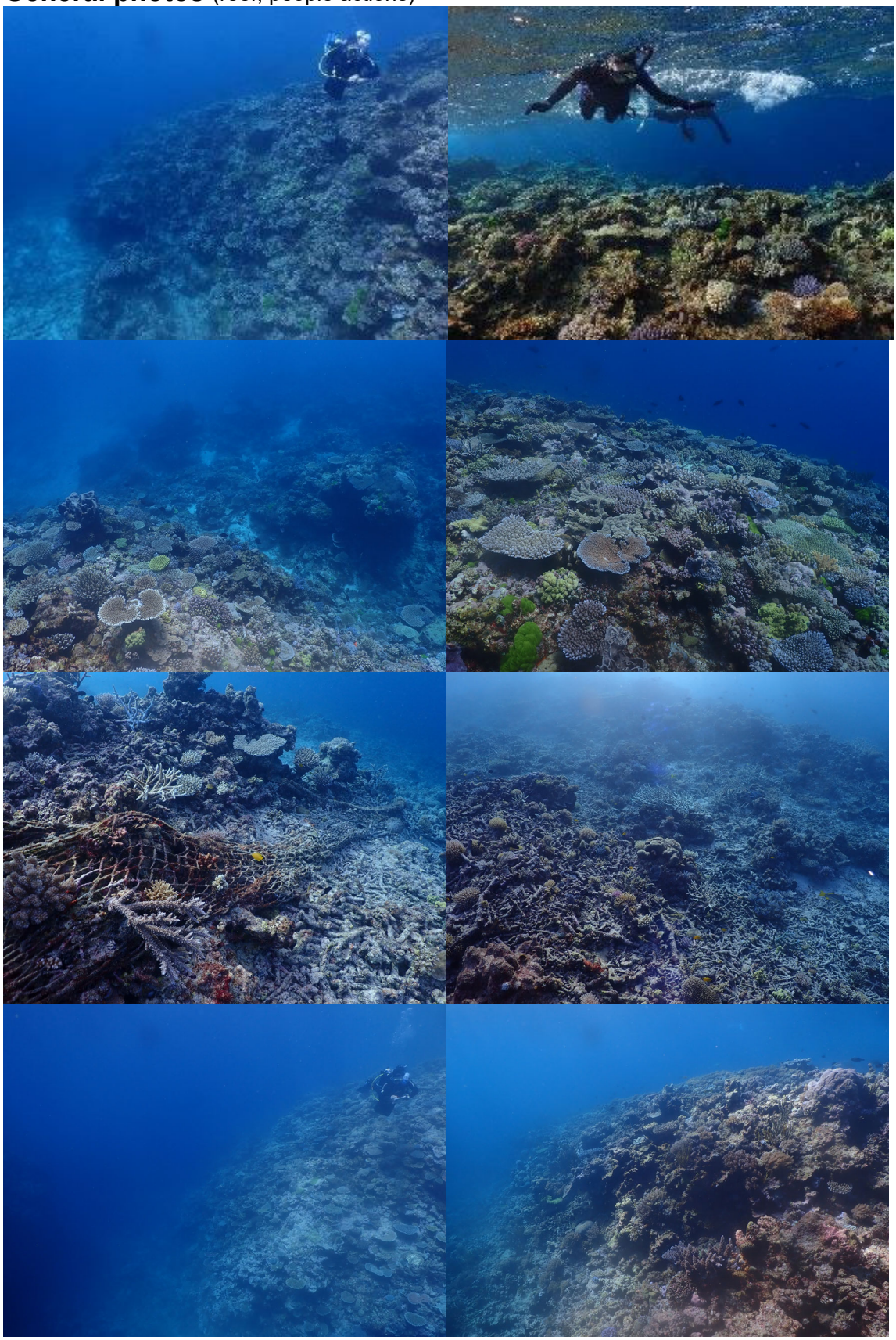
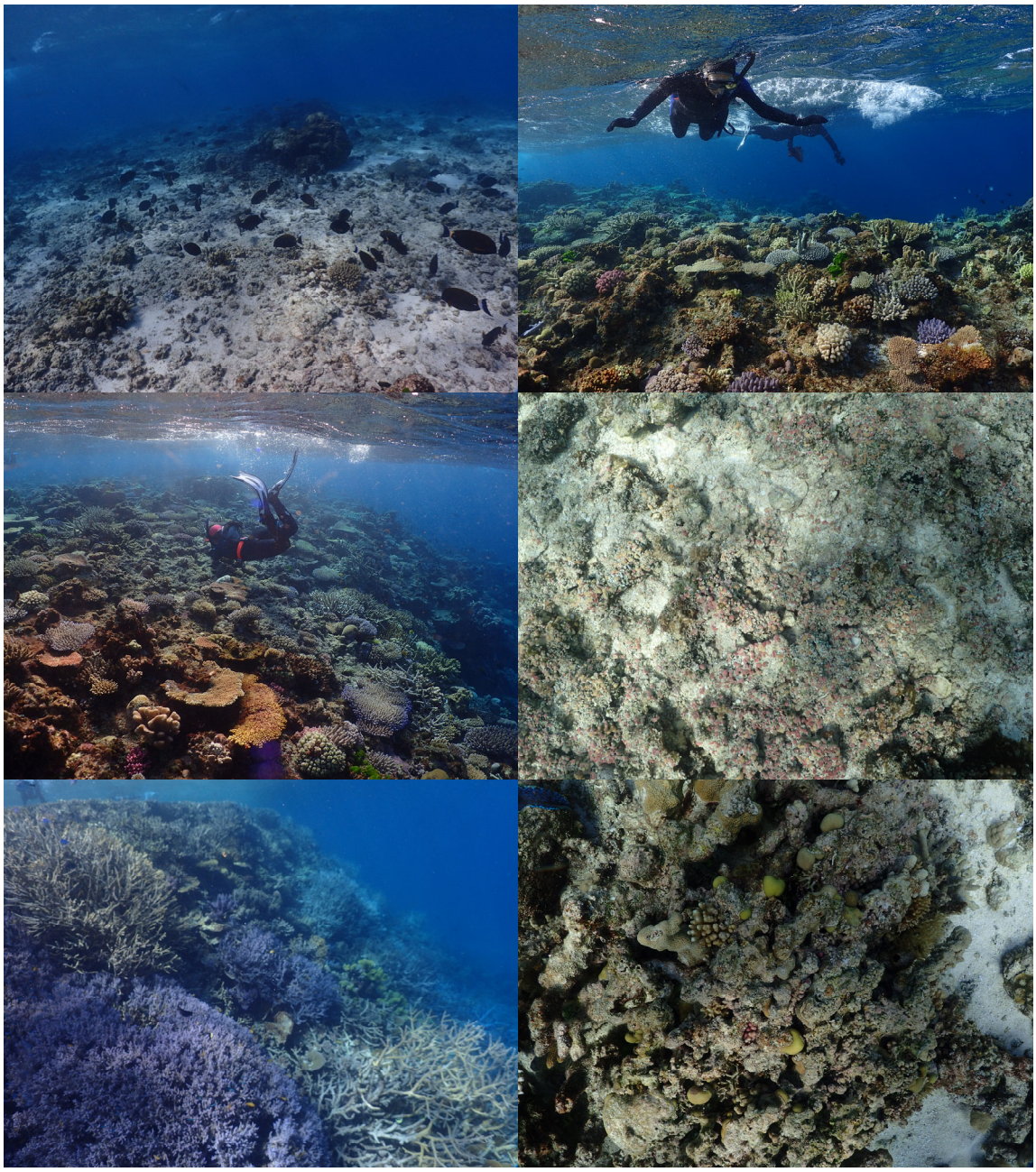


Figure 4: Survey sites

General photos (reef, people actions)





Findings (in regards to methods, team, reef health or other observations)
Dive

- 21-147 D4 Southern slope mainly rubble, with coral, dense coral growth above 5 m. Rubble consisted out of old branching.
- 21-148 D3 southern slope mainly consolidated rubble with sparse corals, large snappers on a gentle short slope onto mixed sand and rubble (around 8 m) – towards the end of the transect a HUGE house sized Porites coral at least 3 pixels big.
- 21-148 D1 Gentle slope, with spur groves, some coral and cca, mostly plate,bushy.
- 21-147 D5 exposed slope on northerly edge, began as wall with some tabulate Acropora but became a sloping terrace dominated by Porolithon CCA crust – crest flattened and stopped at around 6 m and then gently rolled down at a very flat

angle. Amazing number of very small green Porites all 5-7 cm in size covering whole reef

- 21-147 D2 Deep spur groove system coral cover and specifically on spurs dense plate coral
- 21-148 D9 shallow broken slope onto sandy area around 8 m deep looked like a reef in recovery – dominated by Isopora (some dead intact structures being resheathed) growing on dead Isopora framework thick consolidated rubble
- 21-148 D10 Mixture of coral with large rocky formations underwater strong current suggested by type of coral and lining present in sand.

Presence of narrow channels Deep from North to South with strong currents.

8 Sunday (26 May 2019)

People:
All

Weather:
Clear sky, and rain 10-15 kn S wind, Water Temp 24 degree

High 14:57, LT: 09:08

Activities:
7:00 am Snorkel and Dive boat depart for Reef 21-160, 21-162

12:00 pm Return Snorkel and Dive boat

12:30 pm Kalinda depart to next reef 21-117, 21-119

2:45 pm Antares and snorkel team go to conduct surveys at 21-117/119. Kalinda proceed to anchorage at 21-117

2:30 pm Kalinda arrived at anchorage 21-117

4:20 pm Snorkel team returns.

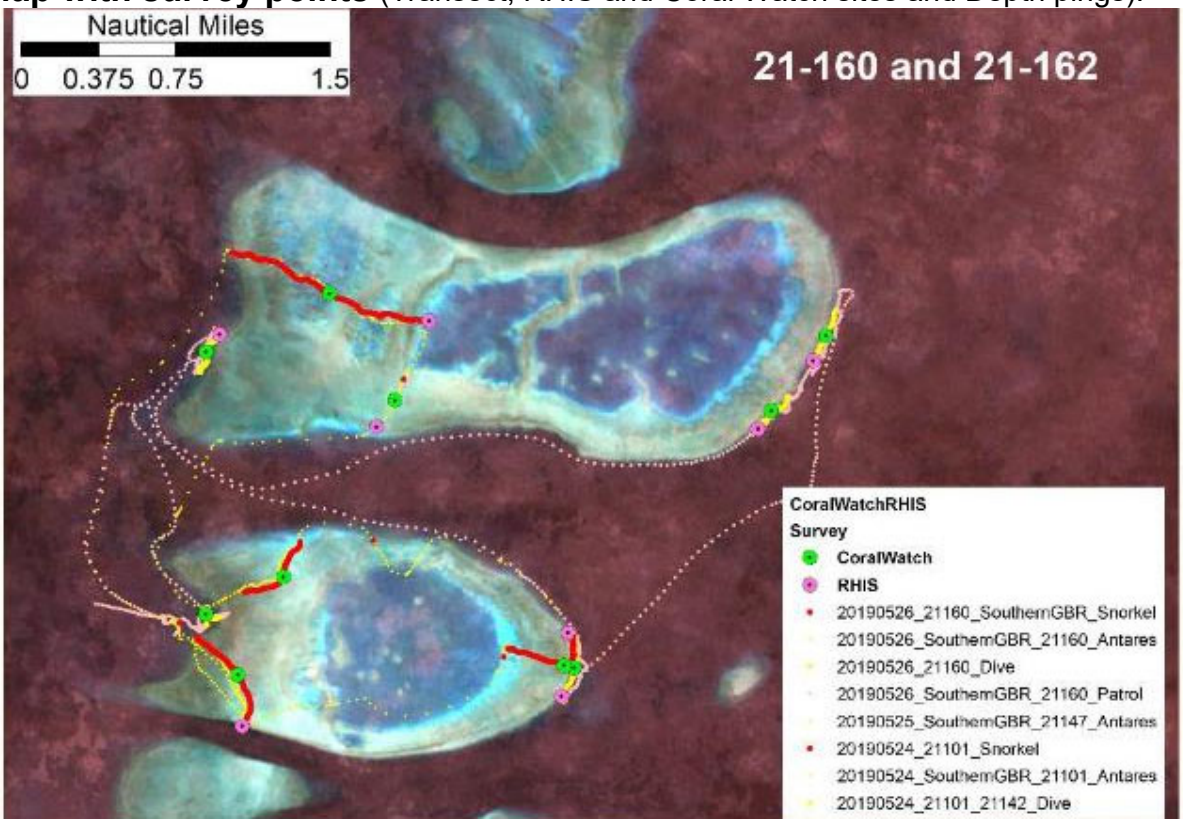
Reef Name: **21-160, 21-162**	Dive	Snorkel
People (initials)	EK, KM, AO, RB	EVK, JP, CR, IP
#Quadrat Photos	1016	2477
#Photo Transects	5	7
Total Transects length (m)	2259	4693
#Rugosity photos	9,308	12,236
#RHIS	4	4
#CoralWatch	5	5
#COTS counts	0	0
#COTS samples	0	0
#CCA samples	32 (snorkelling/diving)	
Echosounding pings		2152

.

Reef Name: **21-117, 21-119**	Dive	Snorkel
People (initials)	n/a	CR, KM
#Quadrat Photos		328
#Photo Transects		2

Total Transects length (m)		1345
#Rugosity photos		
#RHIS		1
#CoralWatch		2
#COTS counts		0
#COTS samples		0
#CCA samples		10
Echosounding pings		

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).



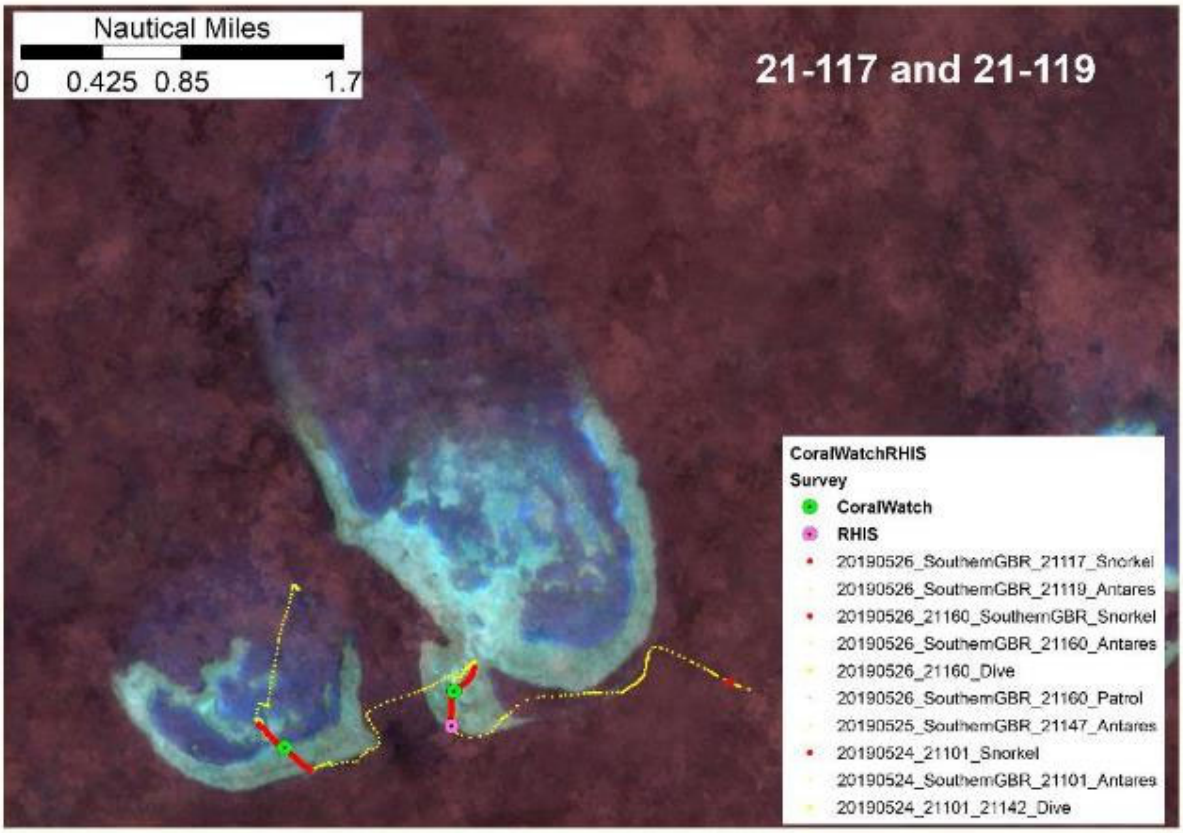


Figure 5: Survey sites

General photos (reef, people actions)

Findings (in regards to methods, team, reef health or other observations)
Dive Transects:

- 21-162 D1 – strong current towards the reef crest (not evident from surface) pushed divers towards crest. Lots of Acropora, gardens of branching coral
- 21-160 D5 – lee reef – large coral bommies, lots of diversity, swarms of huge fish and a chaperone Maori wrasse.
- 21-162 D4 – complex terrain with big coral formations with channels filled with rubble and sand. Lots of cyanobacteria growing on the rubble.
- 21-160 D2 – essentially a wall with outcrops and overhangs, beautiful diversity of coral.
- 21-160 D3 – Sloping reef with areas of rubble with complex terrain, good coral diversity.

Snorkel Transects:

- 21-162 S4 Going with current W→E, reef flat very shallow starting with dense coral, but varying between cyanobacterial cover/slime algae over pavement. Areas with dense coral in between, and then areas with forams and then going to edge with very healthy coral.
- 21-162 S2 W→E in lagoon sand with bommies, and then going to coral, and coral rubble and large coral heads, going to plate corals on the edge into deep water after crest
- 21-162 S2 (over reef rim), following crest large areas with plate coral in pastel colours
- 21-162 S1 N→ W, sandy area with hallimeda stands covered in slime algae going into reef area with coral and forams regions
- 21-160 S3, Lagoon via flat to slope from E→W, starting with reef bommie, then sand with thick branching coral, then with CCA rubble region like reef rim, going into sandy lagoonal areas with rubble surrounding thick branching coral, then going into shallow areas with with coral, finishing on the western site with large coral beds. In shallow areas also cyanobacterial cover/slime algae over pavement and areas with forams.
- 21-117 S2, S→N, coral, into cca rubble reef rim zone but not well defined.
- 21-119 S2, S→NW, rubble zone, reef rim area with dead coral and rock rubble, going into coral area with steep drop offs in to lagoon with in lagoons areas with branching coral in deep water.

9 Monday (27 May 2019)

People:
All

Weather:
Clear sky, 5-10 kn wind SE, Water Temp 24 degree

High 10:00 am

Activities:
7:00 am Snorkel and Dive boat depart for Reef 21-117/119

11:00 am Return Snorkel and Dive boat

JP stayed on board to further improve photo transect software user interface.

12:30 pm Kalinda depart to Mackay

Reef Name: **21-117/119**	Dive	Snorkel
People (initials)	CR, EVK, AO, EK	KM, IP, RB
#Quadrat Photos	2321	905
#Photo Transects	5	4
Total Transects length (m)	2793	2755
#Rugosity photos	12,028	None?
#RHIS	4	4
#CoralWatch	4	3
#COTS counts	0	12
#COTS samples		14
#CCA samples	20 (snorkelling/diving)	
Echosounding pings	1253	2491

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

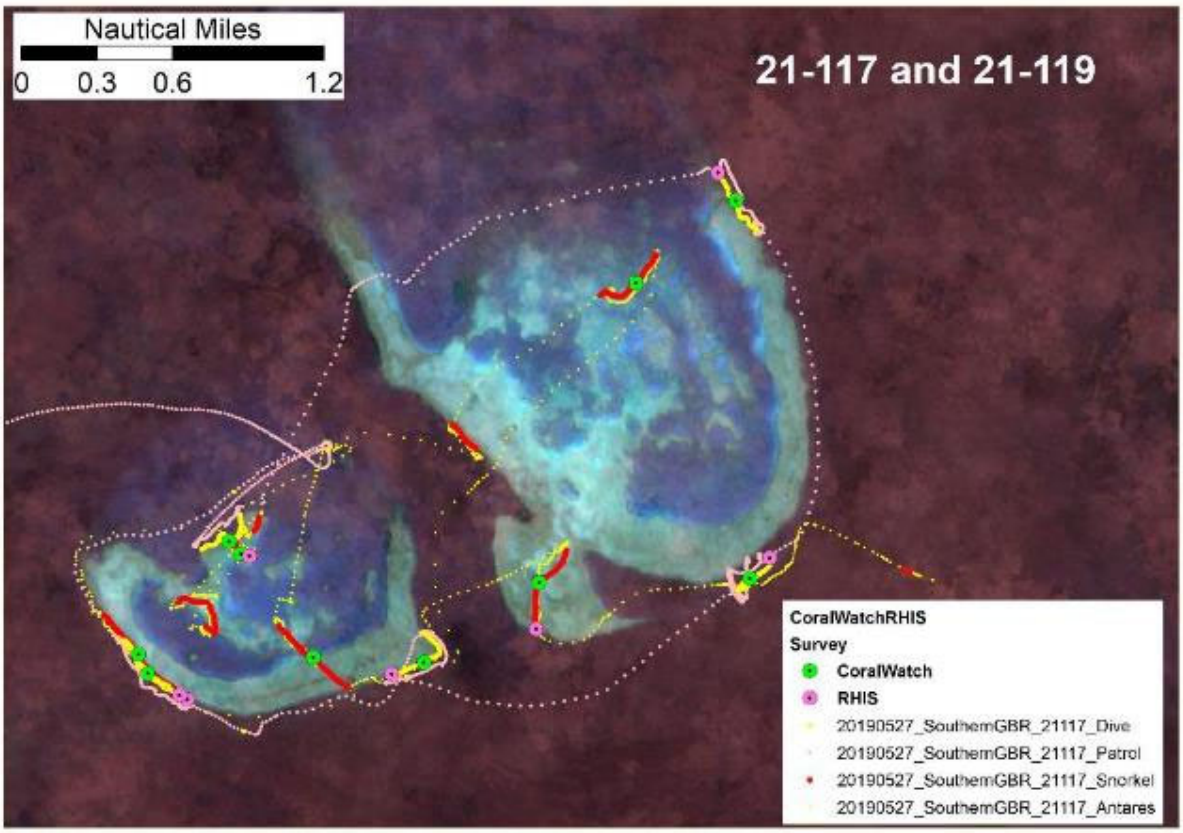


Figure 6: Survey sites

General photos (reef, people actions)

Findings (in regards to methods, team, reef health or other observations)

General

- Coral
  - Lots of disease observed
  - Branching coral in deep water of lagoon
  - Plate corals on north eastern site
- Other
  - Snakes and sharks observed
  - Various Napoleon fish
  - COTS 14 on transect

Snorkel transects

Dive Transects

- 21-119-D2, Current going East, dive W→E, branching, foliose, coral and nine sharks sighted, sloping reef up to 4 m, then wall up to 0 m.
- 21-119-D1
- 21-117-D1 Current going East, dive W→E starting but then change as dive was around a secondary barrier that reached shallowest 5 m, lots of rubble, plate and bushy coral with various deceases sighted.
- 21-117-D3
- 21-119-D3 Lagoonal dive, sloping reef up to 4 m, then wall up to 0 m,branching coral, big bolder corals, lots of fish life

Site names

- Note site name and time right on start slate for each photo transect so no confusion with processing.
- Dive logs, coral watch, RHIS slates should check site name with photo transect name.

10 Tuesday (28 May 2019) Change over Day

People:
JP, AO, IP, RB depart

DS, KJ and MR arrive

Weather:
Clear sky, 10-15 kn wind SE, Water Temp 24 degree

High 8:30 am

Summary Activities Trip 1:

Steamed approx. 320 nm with MV Kalinda, visited 10 reefs

Summary Trip 1	All Dives	All Snorkels
People (initials)	KM, EVK, EK, RB, AO, JP, CR	KM, EVK, EK, RB, AO, JP, CR, IP
#Quadrat Photos	11144	7672
#Photo Transects	32	31
Total Transects length	17377 m	21186 m
#Rugosity photos	90770 (Left+right)	169112(Left+right)
#RHIS	60(snorkelling+diving)	
#CoralWatch	72(snorkelling+diving)	
#COTS counts	0	14
#COTS samples	0	14
#CCA samples	199 (snorkelling+diving)	
Echosounding pings	24326 (snorkelling+diving)	

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

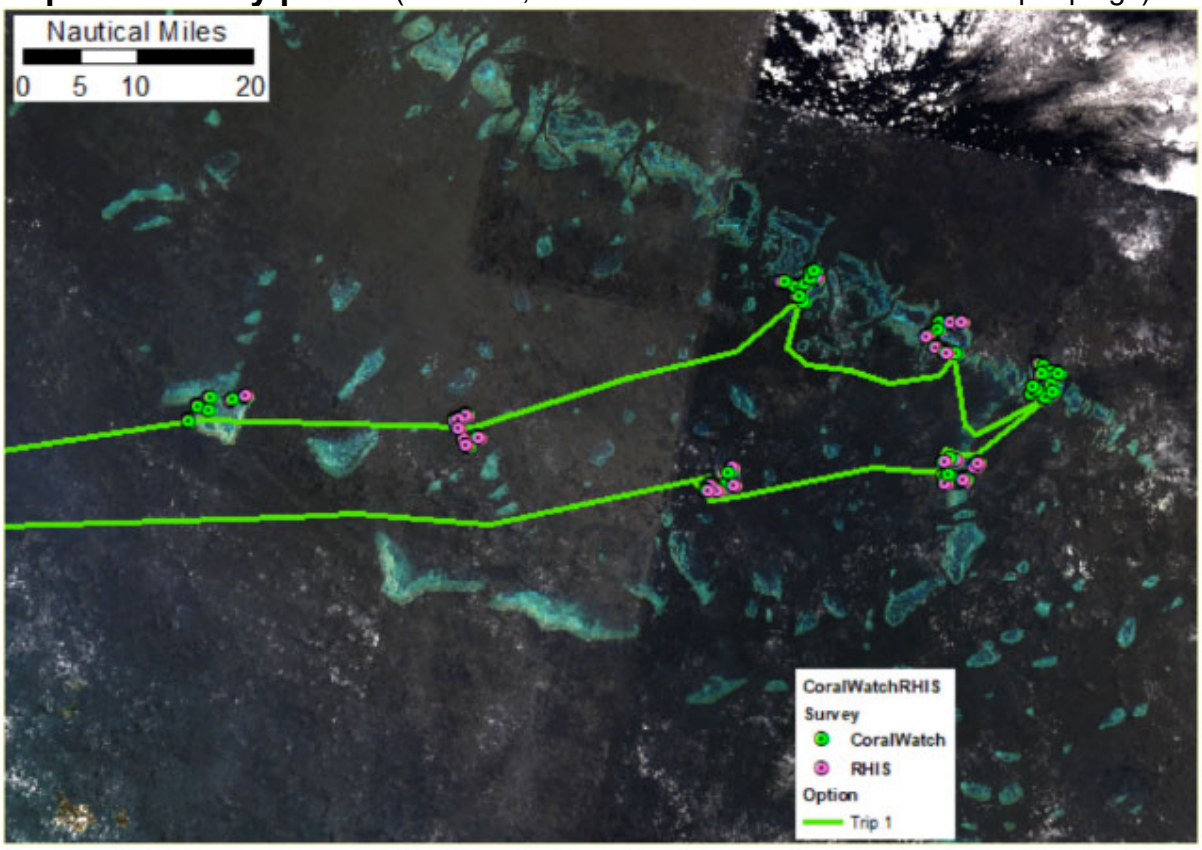


Figure 7: Survey sites

General photos (reef, people actions)

11 Wednesday (29 May 2019)

People:
All

Weather:
Clear sky, 5-10 kn wind SE, Water Temp 24 degree

High 6:33 pm, Low 12:05 pm

Activities:
7:00 am Snorkel and Dive boat depart for Square Reef

2:00 pm Return Snorkel and Dive boat

2:30 pm drone flight

3:00 pm travel to Ross Reef

5:30 pm anchorage at Ross Reef

Reef Name: **Square**	Dive	Snorkel
People (initials)	CR, KM, KJ, DS	EVK, EK, MR
#Quadrat Photos	2793	1318
#Photo Transects	8	6
Total Transects length (m)	4693	5825
#Rugosity photos	17746	6414
#RHIS	8	4
#CoralWatch	8	6
#COTS counts	0	0
#COTS samples	0	0
#CCA samples	18	28
Echosounding pings	14884	4800

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

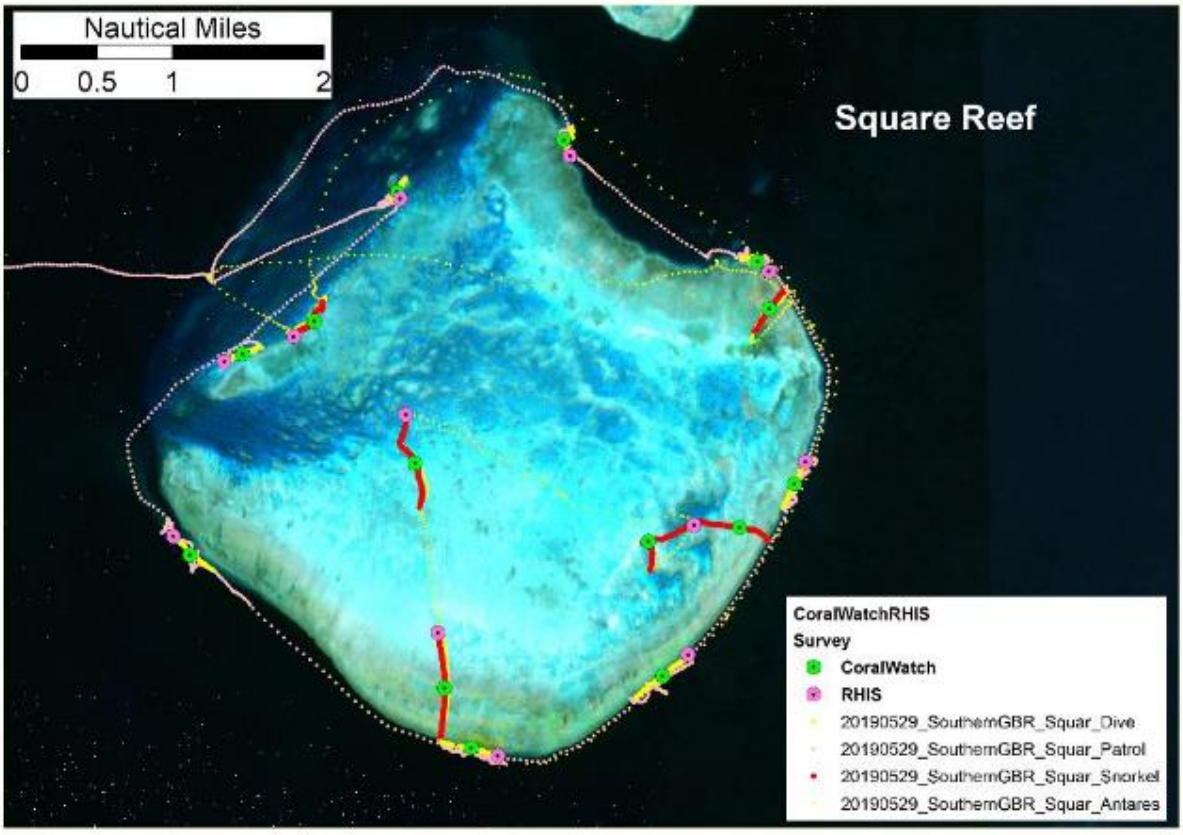
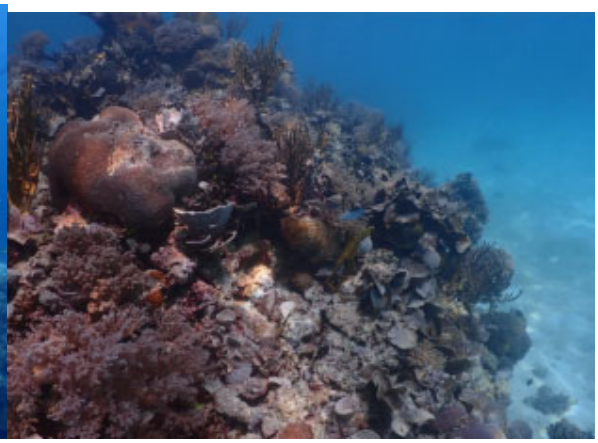


Figure 8: Survey sites

General photos (reef, people actions)





Findings (in regards to methods, team, reef health or other observations)

Great day very successful, good weather well-oiled team also with the new members, no wind, short distances between sites.

Dives:

- D1- Rubble zone, no life coral, bumphead parrot fish, low CCA
- D2
- D3- more coral plating and bushy and encrusting, sloping with high structural complexity at course scale, strong currents

- D4
- D5-plating and bushy coral, steep wall, strong currents, many sharks, and schooling fish, turtles,
- D6
- D7- sandy lagoonal type area, soft sponges, gorgonion coral, white sand, branching and bushy, encrusting and massive corals
- D8-

Snorkel:

- S5 – strong current, dense algal patch at start of transect
- S6 – from reef crest to flat, strong current, crest very narrow from a steep slope (wall?), straight to outer reef flat and transitioning to sand/algal/sponge inner reef flat, ending in a lagoon.
- S3 – ??
- S2 – large bommies studding a deep lagoon (4-5m) dominated by sponges and soft corals.
- S7 – very shallow, outer reef flat consisting of rocky areas and small corals ending in a very narrow reef crest.
- S4 – leeward side of reef. Followed the “crest” which was bommies dominated by sponges, soft corals and single massives.

12 Thursday (30 May 2019)

People:
All

Weather:
Clear sky, 5-10 kn wind S, Water Temp 24 degree

High 6:15 am

Activities:
7:00 am Snorkel and Dive boat depart for Ross Reef

1:00 pm drop of MR for drone flight

2:00 pm Return Snorkel and Dive boat

2:15 pm travel to Stucco Reef

5:30 pm anchorage at Stucco Reef

Reef Name: **Ross Reef**	Dive	Snorkel
People (initials)	CR, EVK, EK, MR	DS, KM, KJ
#Quadrat Photos	2848	1292
#Photo Transects	8	7
Total Transects length (m)	4245	5373
#Rugosity photos	22756	4594
#RHIS	8	6
#CoralWatch	8	7
#COTS counts	0	0
#COTS samples	0	0
#CCA samples	36	16
Echosounding pings	13175	11140

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

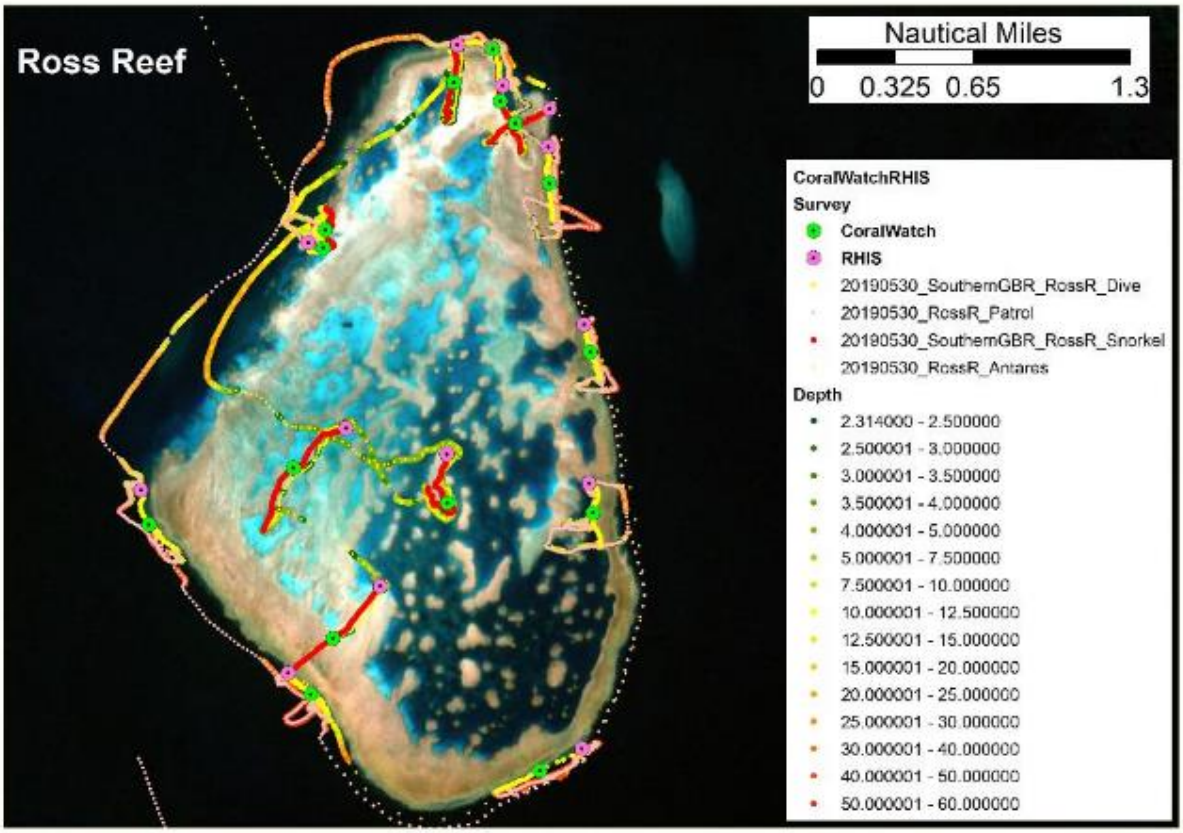
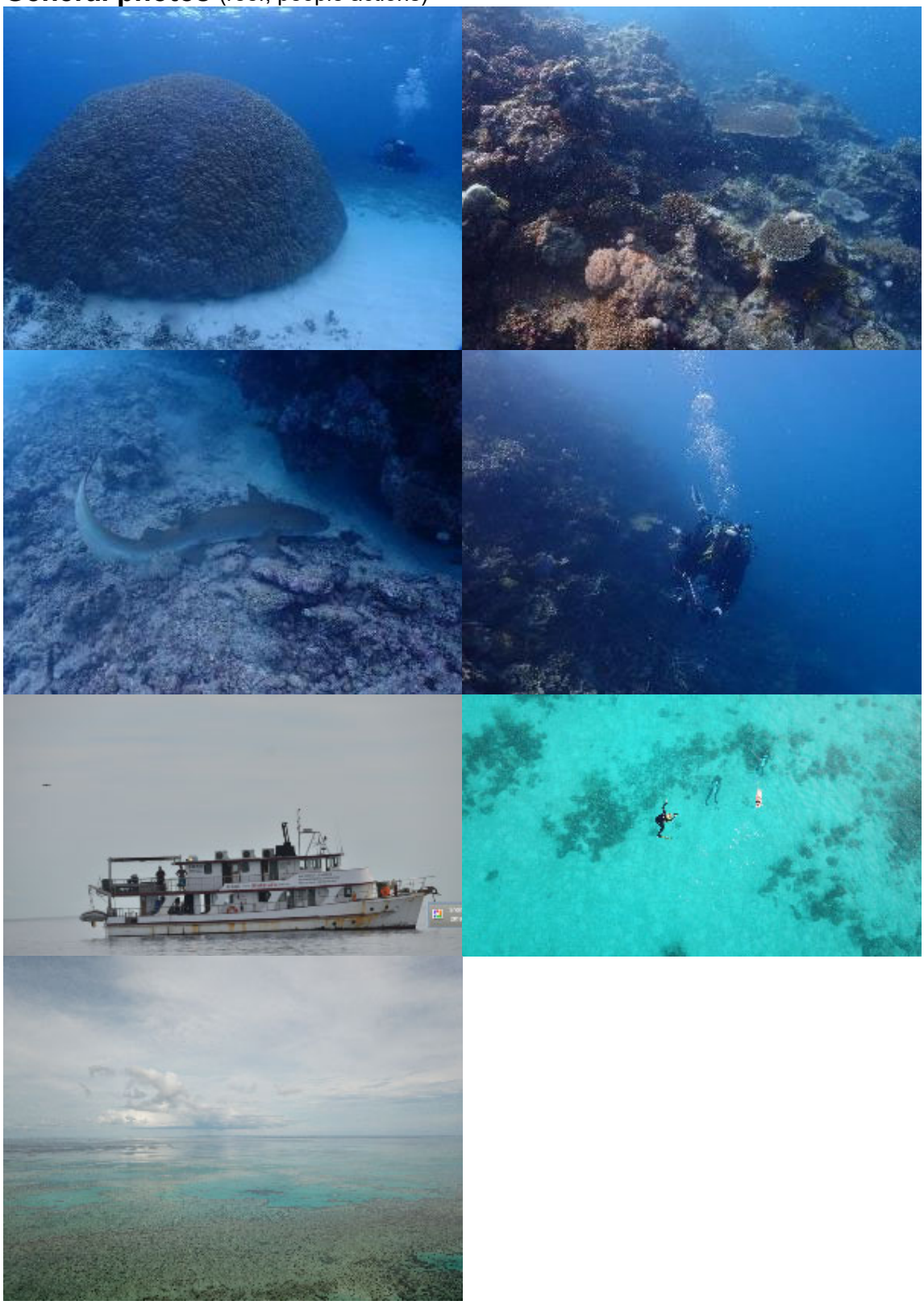


Figure 9: Survey sites

General photos (reef, people actions)



Findings (in regards to methods, team, reef health or other observations)

Dive:

- D1 – Rubble dominated initially, and then wall with low cover coral turning into channel with large massive porities bommies, several of them.
- D2 – Rubble dominated bottom along a vertical wall approximately 8m deep, some overhangs and photos may be dark in early morning light on side. Wall breaks up occasionally. Encrusting corals predominant. Four small white tips displaying aggressive behaviour.
- D3 – Wall from 15 m to surface with low plate, soft and encrusting corals predominantly, and on bottom of wall signs of rubble and large boulders turn on its side.
- D4 – Dive on inside wall of lagoon – popped across the reef rim into a steep slope onto a sandy bottom that sloped down to 25 m. Soft corals, plate and branching, with Tubastea on undersides. Large numbers of large colonial ascidian colonies dominating wall – look up photos at office – with very large healthy looking coral colonies on the sand (Porites, Pavona).
- D5 – strong currents reasonable coral cover, plate, bushy, encrusting and soft corals, lots of fish,
- D6 – Wall to a long way down! Coral outcrops making it difficult to photograph the wall without entanglement, wall with deep gullies cutting back into the rim and caves and swim throughs galore. Huge amount of fish biomass would be a colourful fun dive. Large anchor and rope found on reef.
- D7 – Wall to 40-70 m deep based on sonar readings, deep gullies and high large scale geography, turning into 5 m plateau with large coral bommies and other coral types in between, strong currents in last part over plateau.
- D8 – back reef bommie hop. Shallow to depth of max 6 m. Bright white sand punctuated by bommies covered in smaller corals, bottom covered in soft corals and large branching acropora.

Snorkel:

- S1 – NE current, Reef flat transect starting on the edge of a deep lagoon with steep edge and high coral cover, most of transect over relatively flat reef flat with foliose sponge and pocilloporidae. Ended at steep slope on northern outer edge.
- S2 – Transect crossing channel – steep slope into channel, with huge porites (apartment size) bommies within channel.
- S3 – transect along edge of channel. Beautiful slope with very large specimens of many coral species. Overhanging reef edge, branching and foliose corals at base of slope and sand with huge porites bommies within channel at about 10-15m depth.
- S4 – Started on south west edge with deep dark clear water and highly rugose edge then turned across the reef flat, fairly homogenous reef flat with turf algae and sponge, some coral.
- S5 – intermittent deeper sand areas (5-10m maybe) between reef flat areas. Spider webs on the reef everywhere – . On patches of sand the algae was very bright and fluffy about 5cm high.
- S6 – Transect around a large mid-lagoon ‘bommie/ patch reef’ shaped like a seahorse. Covered in lots of bright pink and purple pocillopora, soft coral, grey foliose sponge and gorgonians, with some branching Acropora stands in the sand along side.
- S7 – Short snorkel on complex NE edge, around large bommies and sand, some Acropora and branching porites stands on sand between bommies.

13 Friday (31 May 2019)

People:
All

Weather:
Cloudy with rain, 10-15 kn wind SE, Water Temp 24 degree

Turning 20-30 kn S and heavy rain and seas around 3-4 pm

High 7:10 am

Activities:
7:00 am Snorkel and Dive boat depart for Stucco Reef

12:00 pm Return Snorkel boat

12:30 pm Return Dive boat

1:00 pm travel to Shower Reef

7:30 pm anchorage at Seagull Reef, 2.5 nm off Shower Reef

Reef Name: **Stucco**	Dive	Snorkel
People (initials)	EK, EVK, DS, KJ	MR, CR, KM
#Quadrat Photos	1867	1823
#Photo Transects	6	6
Total Transects length (m)	3174	5190
#Rugosity photos	15282	7220
#RHIS	6	6
#CoralWatch	6	6
#COTS counts	0	0
#COTS samples	0	0
#CCA samples	34	10
Echosounding pings	12261	8190

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

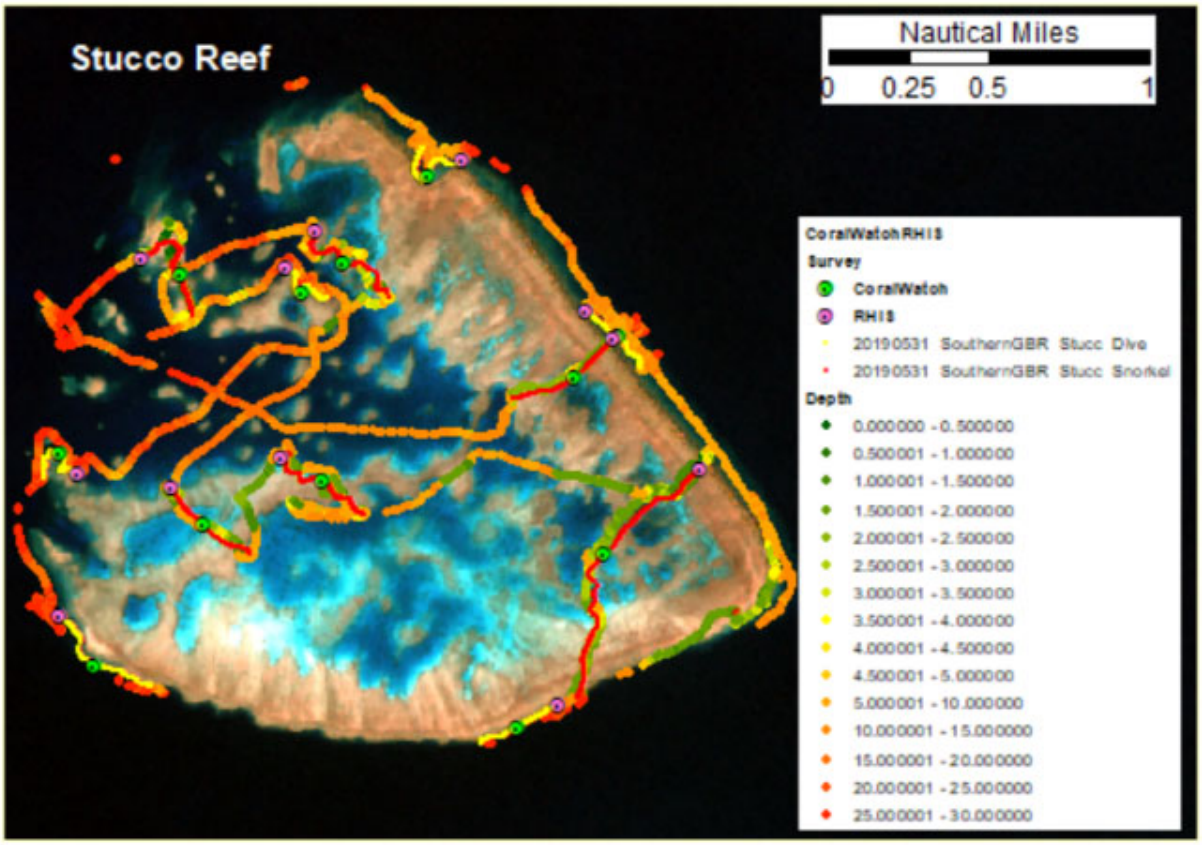
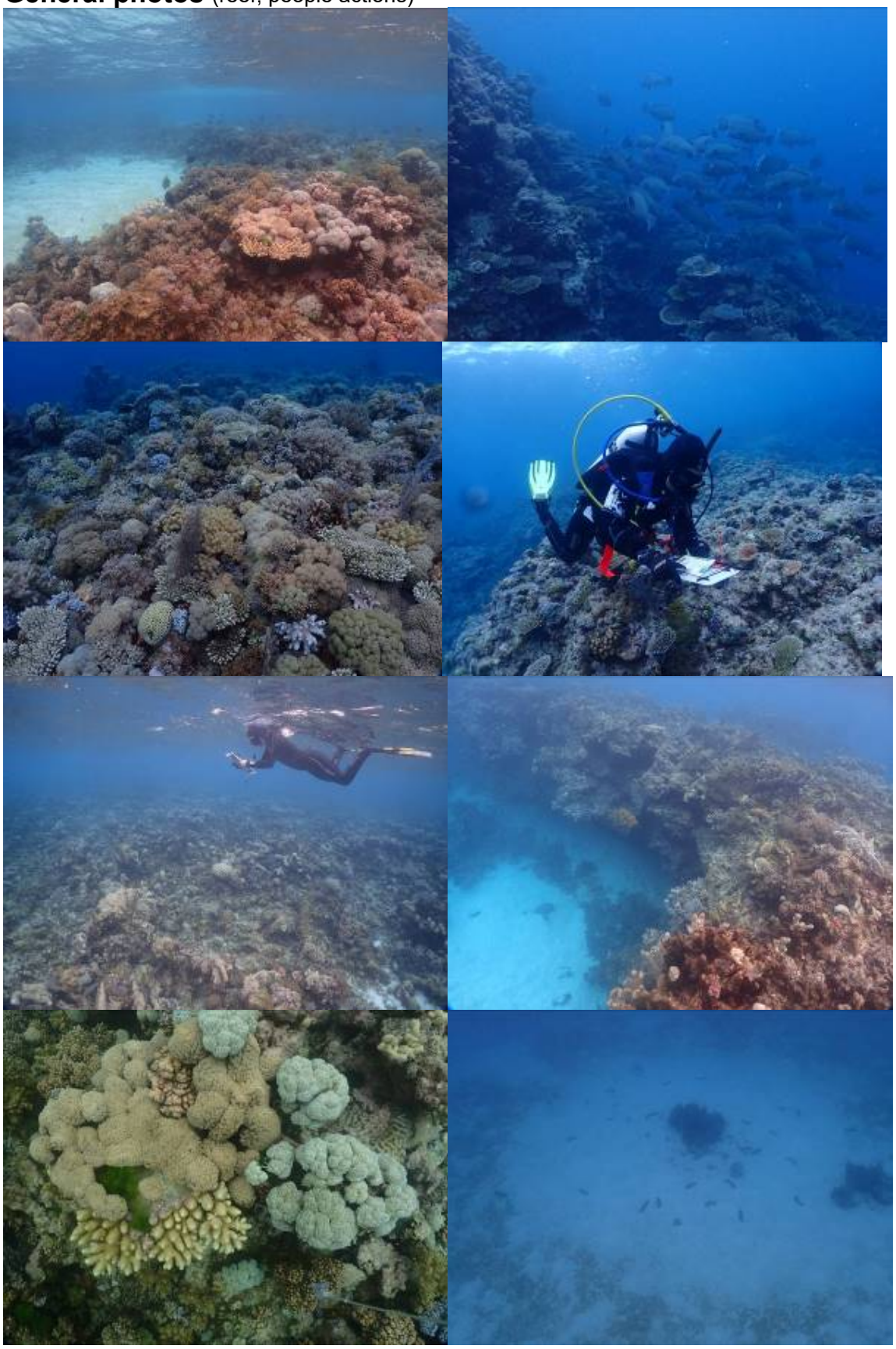


Figure 10: Survey sites

General photos (reef, people actions)



Findings (in regards to methods, team, reef health or other observations)
Dive:

- D1 – Flat very gently sloping plateau beginning at 6-8 m on the northern side of the reef, covered in bommies of variable height closer to crest producing complex terrain. Mainly CCA hardground dominated by soft corals (in places almost 100%) and some small bushy Acropora. In one part corals disappeared and replaced with 100 m of rubble with slimy green algae.
- D2 – Area of “merged” bommies of variable height from the crest to deep water. Lots of smaller corals, high diversty.
- D3 – Start of transect on vertical wall dropping down to 80 m – dominated by platy corals but current very strong unable to proceed west and so went with the current east where wall turned into a steep slope down to about 40m. Plentiful fish and corals, and a large school of (60) Bolbometapon parrotfish on the wall.
- D4 – very strong current which was constantly changing direction. Wall. Max depth about 10m. Lots of slimy algae.
- D5 – Started on western outer wall and followed the 5 m contour through into lagoon – reef top was around 5 m and the wall remained steep vertical dropping onto sand 8-10 m below deep, breaking up more and more frequently as we moved into the lagoon to forming mazes and overhangs
- D6 – Lagoon. Branching acropora across the sandy bottom. Rubble, with rocky outcrops covered in smaller corals.

Snorkel:

- S1 – Transect going over rocky areas with massive, encrusting and columnar coral and soft coral, with sand pockets in between.
- S2 – Transect over North West Reef crest area, gentle slope at reef crest.
- S3 – Long transect over East site of reef from south to North, covering several lagoonal areas, consistent precense of coral, very nice diverse lagoons with overhangs, variety of coral, dense branching corals in bottom of lagoons, lots of fish
- S5/S6 – Crossing ridge, covered in soft coral, and hard coral on the edges before it gets deeper.
- S4 – crossing over set of bommies/patch reefs

14 Saturday (1 June 2019)

People:
All

Weather:
Overcast, 25 knot winds S, cold with some wave chop, Water Temp 25 degree

High 7:47 am, LT 13:49

Activities:

10:30 am left safe anchorage, after time spent fixing tenders, weather down time

12:00 arrived Showers Reef

1:00 pm divers and snorkelers depart for Showers Reef

2:00 pm snorkel team return as reef to shallow to cross, and weather conditions not suitable for South and East site.

2:00 – 3:00 PM more boat fixing

4:20 pm divers return

Reef Name: **Showers**	Dive	Snorkel
People (initials)	CR, KM, MR, KJ	EK, EVK, DS
#Quadrat Photos	1519	298
#Photo Transects	4	1
Total Transects length (m)	2034	577
#Rugosity photos	8978	3200
#RHIS	3	1
#CoralWatch	4	1
#COTS counts	0	0
#COTS samples	0	0
#CCA samples	10	2
Echosounding pings		936

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

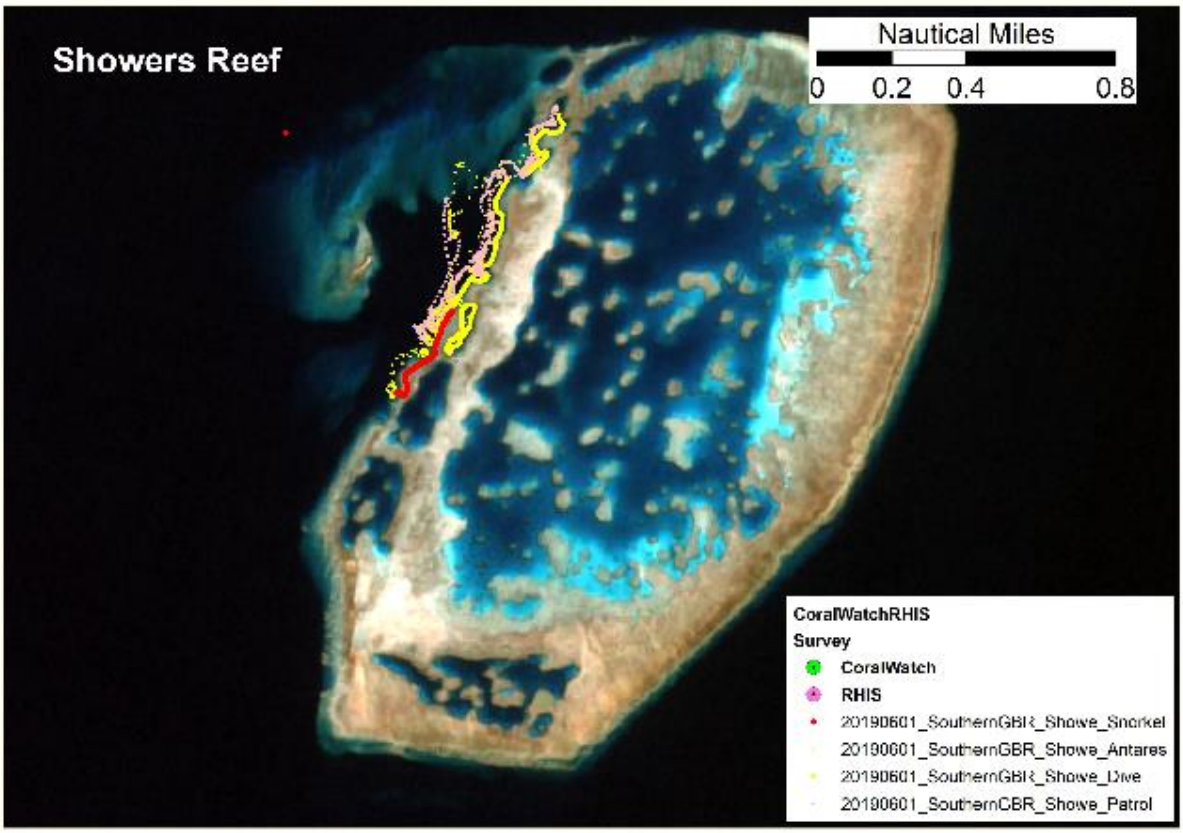


Figure 11: Survey sites

General photos (reef, people actions)

Findings (in regards to methods, team, reef health or other observations)

S3 – Reef flat was a flat hardground dominated by CCA and turf algae, very few corals, came to an abrupt drop at the crest – steep vertical wall down to 8 m covered in rubble which broke up in places to make gullies and caverns.

D3 – Large complex wall, not too steep and not very much coral everything dead lots of rubble, eerie like a ghost reef after damage from Cyclone Debbie. Lots of macroalgae. Felt like a graveyard.

D6 – Transect along bottom of steep slope with rubble all along. More coral towards end of the dive and some overhangs.

D7 – Wall to start with, with lots of live coral, mainly massive corals, eventually broke up into bommies, lots of fish life, barramundi cod and maori wrasse. Some branching coral in sheltered areas.

D8 – In the enclosed lagoon did a loop, rubble wall on the western flank and complex big bommies and thick acropora branching on the eastern protected side

Camera stopped working due to setting of tracking gps mode was turned off underwater.

15 Sunday (2 June 2019)

People:
All

Weather:
Clear sky, 10-15 kn wind SE, Water Temp 24 degree

High 8:30 am

Activities:

07:00 am Depart to Little Broadhurst Reef

05:30 pm Anchor at Little Broadhurst Reef

No surveys, as we were travelling all day

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

General photos (reef, people actions)

Findings (in regards to methods, team, reef health or other observations)

16 Monday (3 June 2019)

People:
All

Weather:
Cloudy, 15-25 kn wind S, Water Temp 24 degree

High 8:55 am

Activities:
7:00 am Snorkel and Dive boat depart for Little Broadhurst Reef

11:00 am Return Snorkel boat

01:00 pm Return Dive boat

01:30 pm travel to Davies Reef

03:30 pm Anchorage at Davies Reef

Reef Name: **Little Broadhurst**	Dive	Snorkel
People (initials)	EK, EVK, KM, MR	CR, KJ,DS
#Quadrat Photos	1979	916
#Photo Transects	7	5
Total Transects length (m)	3309	3471
#Rugosity photos		
#RHIS	7	5
#CoralWatch	7	5
#COTS counts	3	0
#COTS samples	1	0
#CCA samples	11	6
Echosounding pings	10830	3899

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

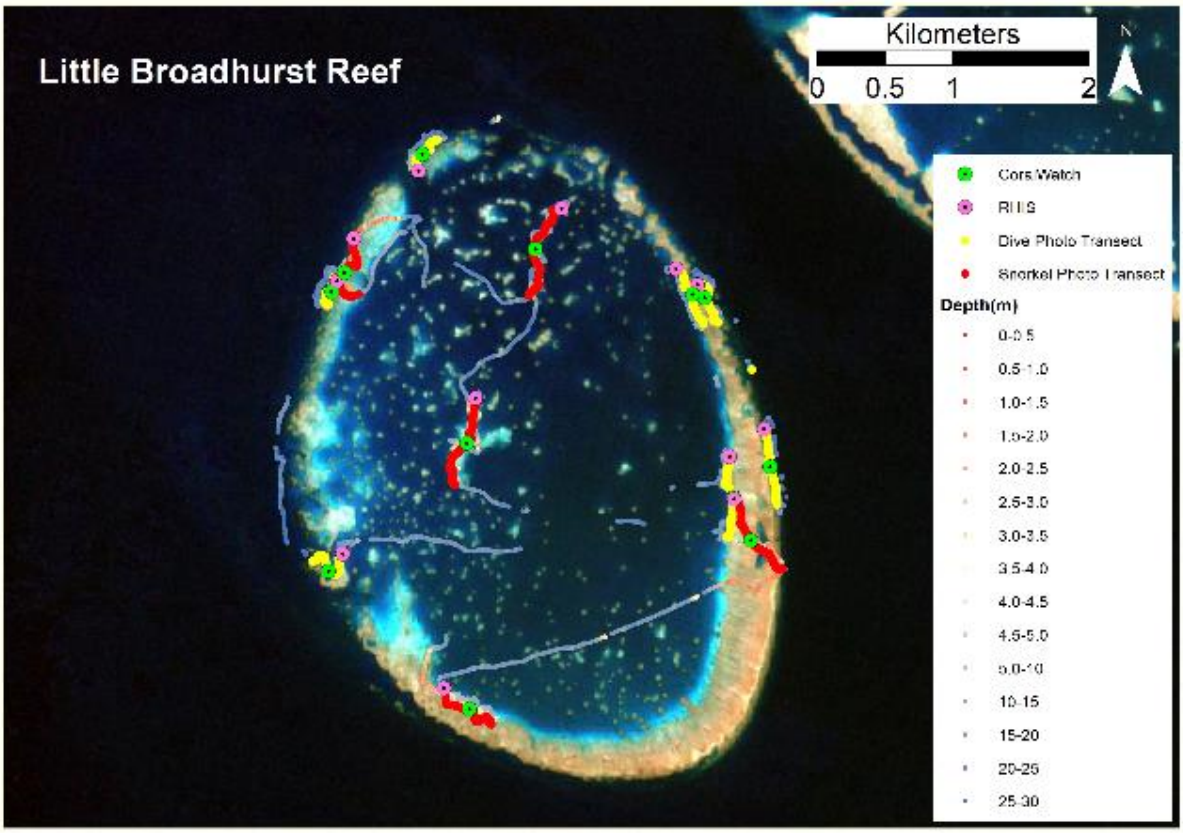
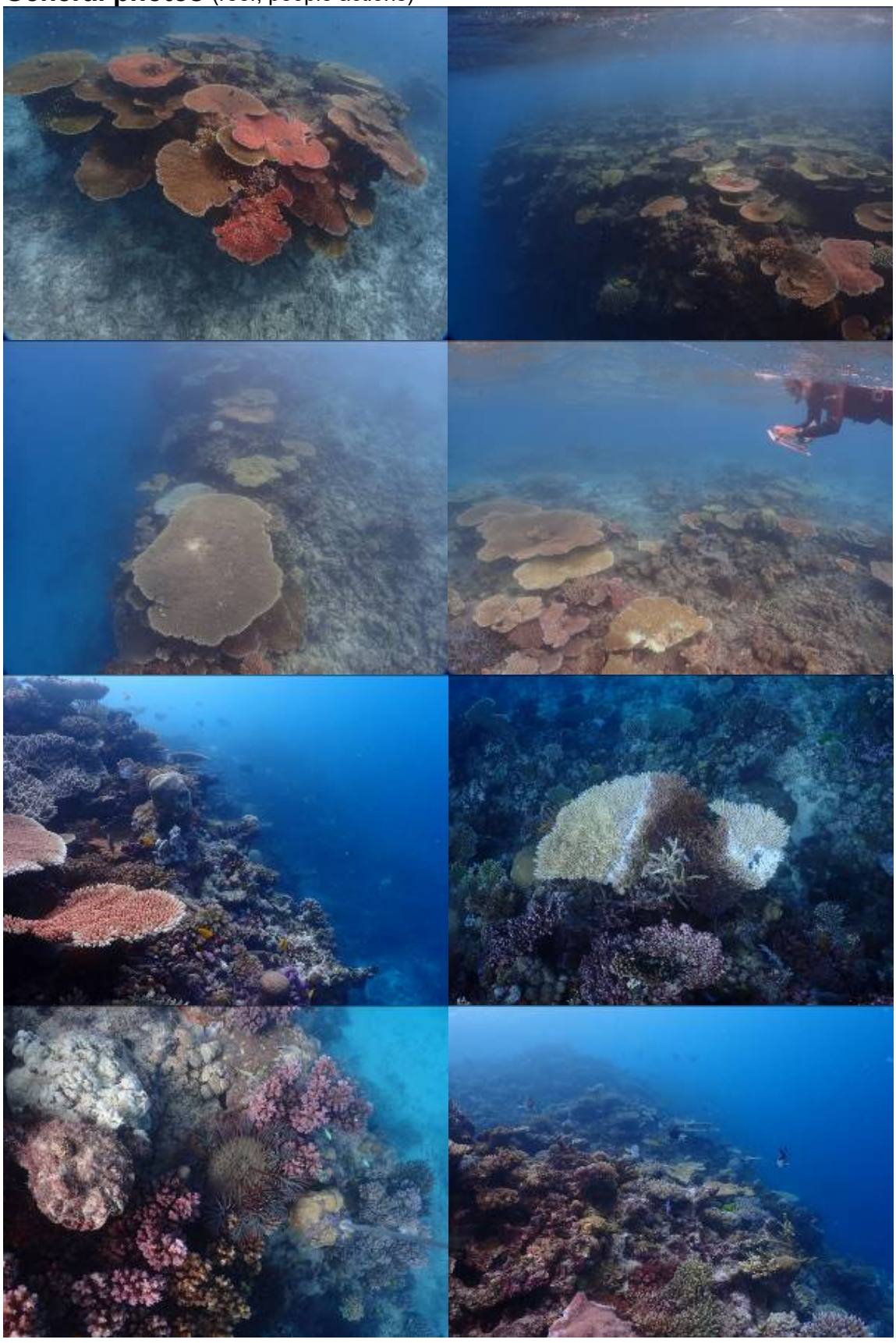


Figure 12: Survey sites

General photos (reef, people actions)



Findings (in regards to methods, team, reef health or other observations)

Software photo linking, has critical failure where photos are renamed after the shapefile is generated, as a result the coordinates assigned to the photos are right but will be confused as to which photo it is. It can be resolved luckily after discussion with JP. No data lost.

Snorkel Findings

- Strong surface currents against wave directions
- High water over reef, reef top seem deeper then other reefs that have been surveyed.
- High plate coral cover on most snorkels especially on edge from deep to shallow water.
- In lagoon patchreefs/bommies tipical micro reefs, shallow edge deep inside, steep drop offs.
- High branching coral cover in deeper water visible around lagoon.
- S3 snorkel small lagoon within reef crest region 10m+ deep with branching in deep water and plate coral on slopes

Dive Findings

- D1 – vertical wall with plate corals on top but not much on the side, some large Diploastrea and a few dead tabulate Acroporas, rubble at the bottom of the slope. Reef wall looked as if suffered damage maybe disease or bleaching.
- D2 – swell too large to make it round to planned D2 site so stopped halfway down western side of reef, wall broke up into a maze that led into lagoon – better and more diverse coral cover than D1
- D3 – dive in the lagoon side on the wall on the eastern side, shallow slope dominated by CCA dropped into a shallow sandy slope around 4-5 m which then sloped gently off into the lagoon. A few large corals – thick branching Acroporas and large massive Porites growing on the sand, and coral looked healthy.
- D6 – also in the lagoon but on north
- COTS found on D5 and D6

Plan for tomorrow

Knife and Fork Reef

17 Tuesday (4 June 2019)

People:
All

Weather:
Clear sky, 20-25 kn wind S, cold wind and swell Water Temp 24 degree

High 9:27 am

Activities:
5:00 am leave Davies Reef travel to Knife and Fork Reef

7:30 am Anchorage at Fork Reef

8:00 am Dive boat depart for Knife and Fork

10:00 am Snorkel boat depart for Knife and Fork

01:00 pm Return Snorkel boat

02:00 pm Return Dive boat

02:30 pm travel to Grub Reef

03:30 pm Anchorage at Grub Reef

Reef Name: **Fork and Knife**	Dive	Snorkel
People (initials)	EK, CR, EVK, DS	MR, KM, KJ
#Quadrat Photos	2678	1099
#Photo Transects	8	4
Total Transects length (m)	4149	4366
#Rugosity photos	12209	2512
#RHIS	8	4
#CoralWatch	8	4
#COTS counts	0	0
#COTS samples	0	0
#CCA samples	MNP zone – no collecting	MNP zone – no collecting
Echosounding pings	12209	2753

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

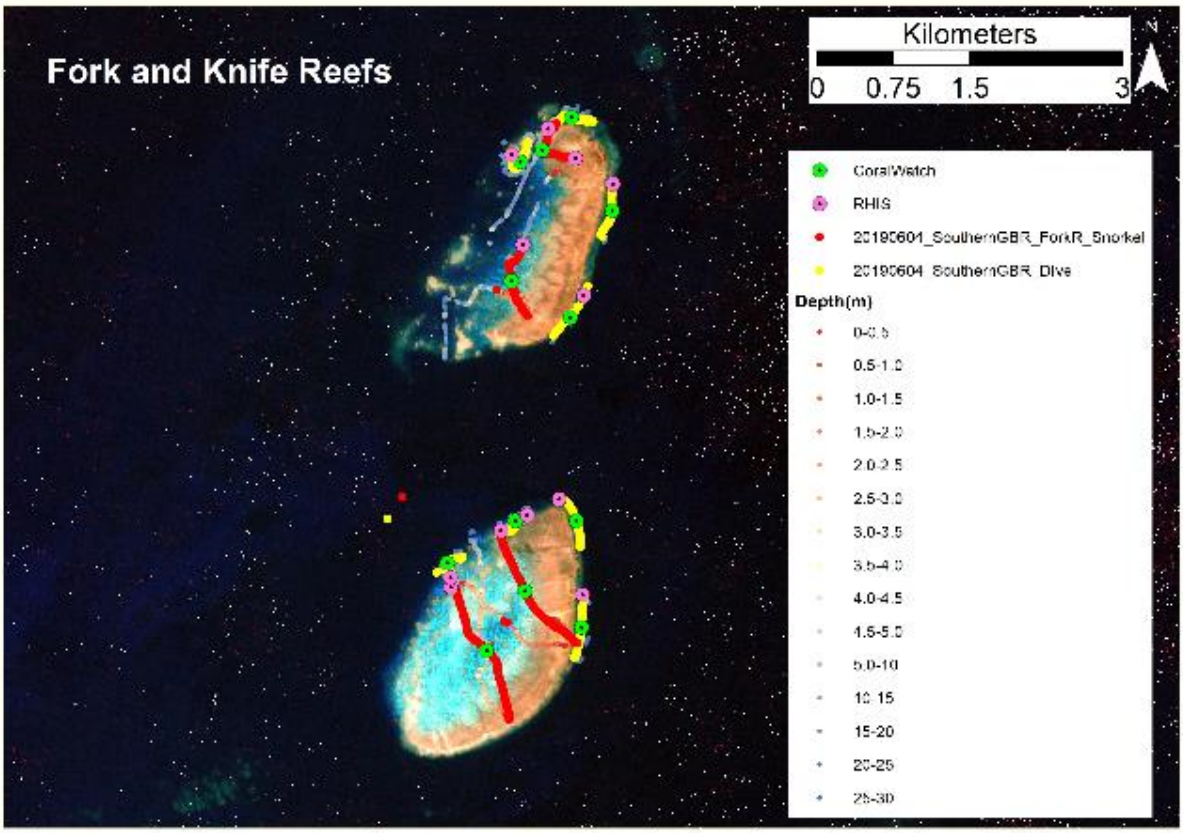
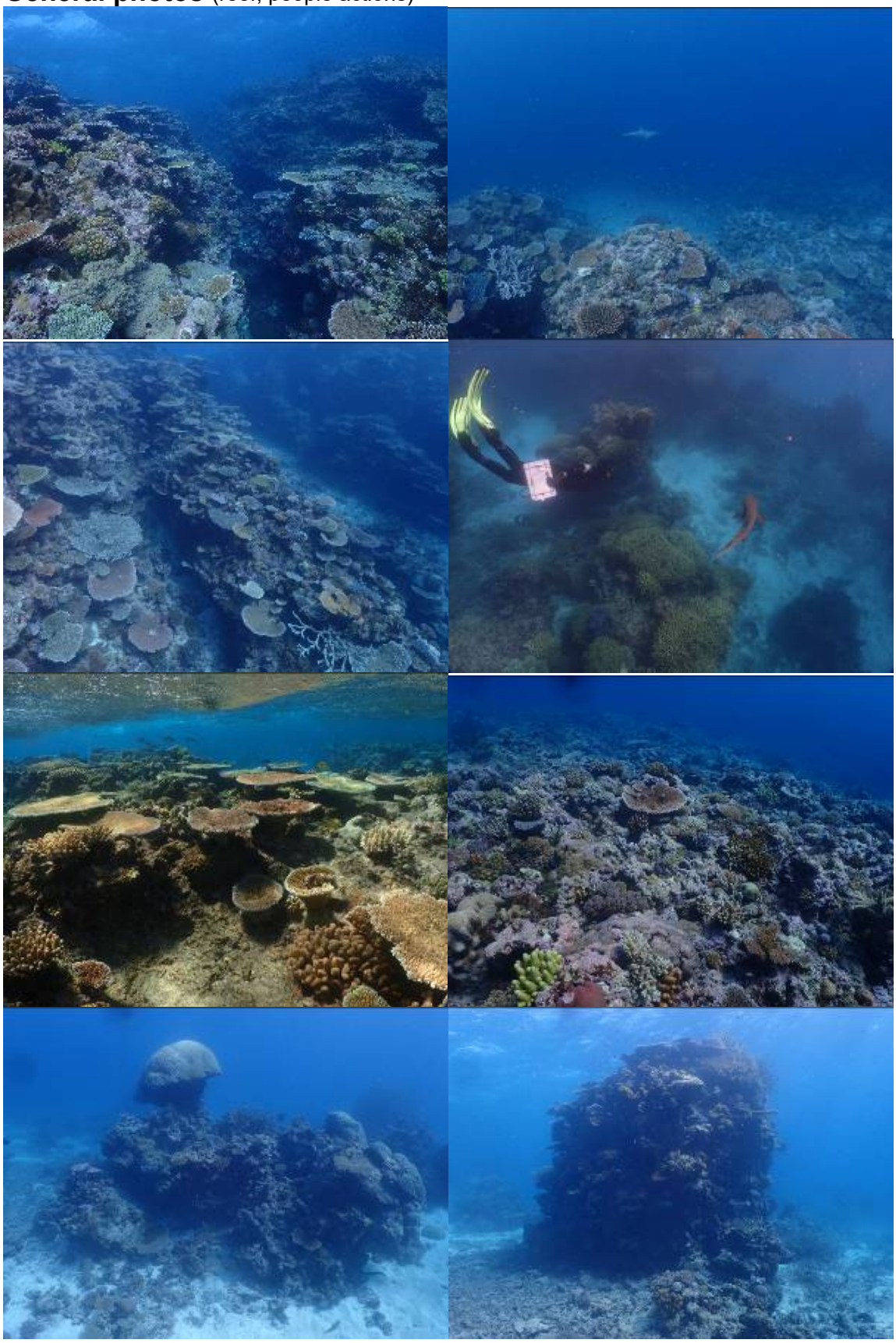


Figure 13: Survey sites

General photos (reef, people actions)



Findings (in regards to methods, team, reef health or other observations)
Dive:

- Fork D2 – Sheltered Slope transects with bommie structures, and rubble in between, going to Exposed Slope with more currents and coral cover increase
- Fork D3 – Complicated architecture, beautiful tiered plate corals interspersed with all other colours and forms of corals. Very little reef matrix visible.
- Fork D1 – as D3
- Fork D5 – Back lagoon. Very deep with many plate corals in the shallow waters and smaller branching/soft amongst the coral matrix on the walls. Large boulder corals situated at the base of the walls and thick branching acropora on the sandy bottom in patches.
- Knife D2 – as Fork D1
- Knife D5 – Very high slopes/spur and groove covered in a rich abundance of all coral types and colours. Lots of surge. Turtles, Maori wrasse and schools of fish galore!
- Knife D1 – Slope reef with small coral bushy, lots of CCA, and then going in to sheltered reef.
- Knife D4 – Back bommie minefield. Bommies of 5 – 8 m height consisting predominantly of reef matrix with mid-size branching/soft/encrusting corals topped by plate corals. Branching corals on the sandy bottom in patches.

Snorkel:

- Fork S2 – Flat pavement with few small bushy corals on reef flat leading to sand with small bommies and then steep structure -ridges / patch reefs with sand between to about 8m deep, high coral cover and diversity on structures including acropora plates on top. A lot of fish following.
- Fork S3 – Started on outer slope with high coral cover and fish life, strong surge, flat with a thick cover of algae (caulerpa and halimeda), then into ridges a little less high than S2. Occasional extensive stands of arborescent Acropora in sand in the lagoon.
- Knife S2 – Reef flat was very shallow at the time with swell so couldn't get to outer edge, reef flat with small corals into big bombie structure in lagoon, lots of structure and crevaces.
- Knife S3 – Similar to S2 but we turned the transect north to follow the deeper edge of the lagoon across large bommies.

18 Wednesday (5 June 2019)

People:
All

Weather:
Mostly cloudy sky, 20-25 kn SW wind, Water Temp 24 degree

High 10:00 am

Activities:
7:00 am Snorkel and Dive boat depart for Grub

12:00 pm Return Snorkel and dive boat

1:00 pm travel to Townsville

8:00 pm docked at pier in Townsville

Reef Name: **Grub**	Dive	Snorkel
People (initials)	CR, KM, DS, KJ	EVK, EK, MR
#Quadrat Photos	1578	620
#Photo Transects	5	4 + 1 dive
Total Transects length (m)	2693	2055
#Rugosity photos	13304	5328
#RHIS	5	5
#CoralWatch	5	5
#COTS counts	1	0
#COTS samples	1	0
#CCA samples	9	6
Echosounding pings	7571	4358

.

Map with survey points (Transect, RHIS and Coral Watch sites and Depth pings).

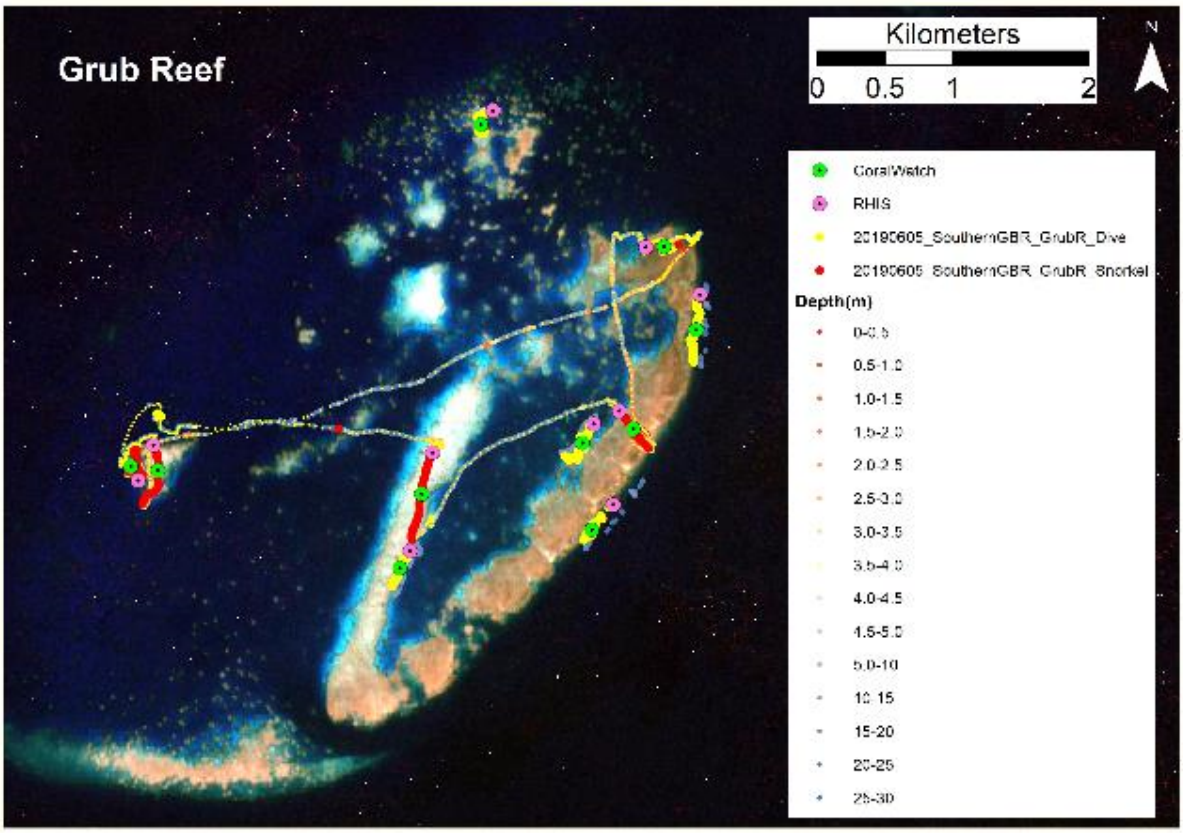


Figure 14: Survey sites

General photos (reef, people actions)

Findings (in regards to methods, team, reef health or other observations)

Snorkel:

- S2 – Northeastern transect starting from the eastern crest travelling to the northern crest and then back into the lagoon. Once away from the crest the current was mixing and difficult to tell which way to go. Hard substrate and some corals near the crest changing to algae dominated reef flat and a hard/coral “border” for the lagoon.
- S3 – Beautiful crest with smaller corals of all types, crossing a reef flat dominated with algae, to end at a beautiful “crest” just before a deep lagoon: BIG swell so crossed the crest and flat in under 10 mins!
- S4 – A lagoon-like transect with white sandy bottom interspersed with rubble patches and small bommies containing small to mid corals.
- S5 – Lee-bommie transect. Top was all beautiful corals (small) and crevices throughout, ending abruptly at a very high wall – didn’t spot the Giant Clam nursery on this transect.

Dive:

- D8 – snorkel team went for a final dive close to the Kalinda. Bommie collection with small corals from the top to the base of the bommies and branching acropora on the sandy bottom. Housed a collection of giant clams.
- D1 – Bommies, very steep overhanging, with between bommies branching coral acropora, walls of bommies low coral cover
- D3 – Sloping reef, with softcoral and bushy coral not high, mixed with turf algae, coral visible in deeper water.
- D5 – Sloping reef, with softcoral and bushy coral not high, mixed with turf algae, coral visible in deeper water.
- D6 – Lagoon Dive, steep drop offs branching coral in deep water and on top of drop off, drop off little coral
- D7 - – Lagoon Dive, steep drop offs branching coral in deep water and on top of drop off, drop off little coral but more branching

19 Thursday (6 June 2019)

People:
All

Weather:

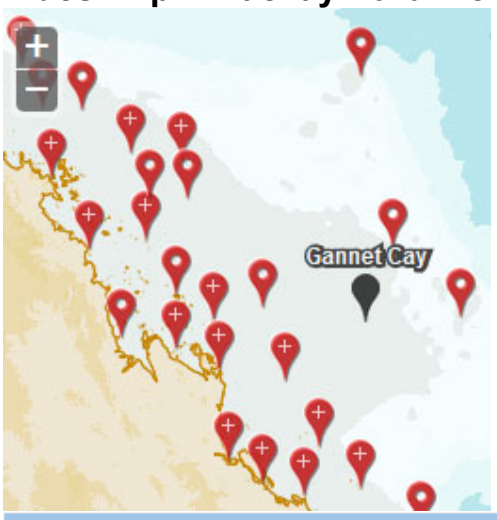
Activities:
07:00 am Breakfast with Habitat Mapping Team including Nick Murray and Australian Institute of Marine Science collaborators, Manu Gonzales and Renate Ferari.

10:00 am CR+Paul Groves GBRMPA habitat mapping project representative.

01:40 am Traveling back to Brisbane

Tides

Tides Trip 1 Mackay Hardline Reefs Mackay



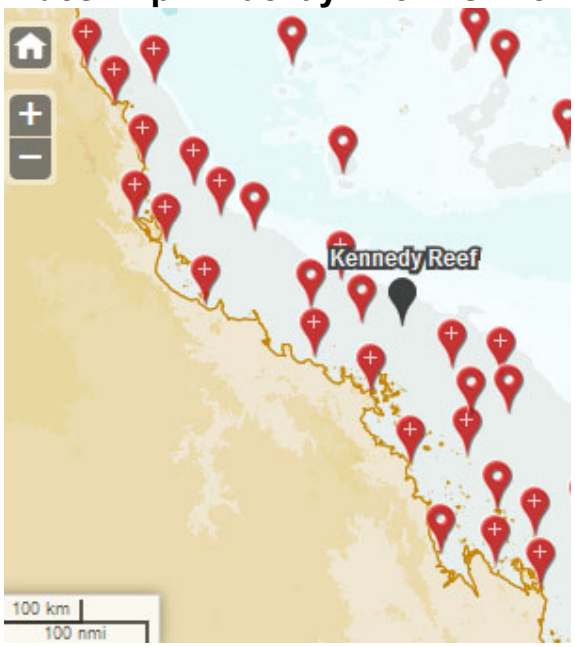
Gannet Cay, QLD – May 2019 PRINT TABLE

MON 20 MAY		TUE 21 MAY		WED 22 MAY		THU 23 MAY		FRI 24 MAY		SAT 25 MAY		SUN 26 MAY	
LOW	5:01 am 0.67 m	LOW	5:44 am 0.81 m	LOW	6:28 am 0.97 m	HIGH	12:36 am 3.35 m	HIGH	1:20 am 3.16 m	HIGH	2:13 am 3.00 m	HIGH	3:15 am 2.89 m
HIGH	10:49 am 3.03 m	HIGH	11:30 am 2.85 m	HIGH	12:11 pm 2.68 m	LOW	7:14 am 1.13 m	LOW	8:06 am 1.27 m	LOW	9:08 am 1.34 m	LOW	10:15 am 1.33 m
LOW	4:46 pm 0.61 m	LOW	5:18 pm 0.79 m	LOW	5:51 pm 1.00 m	HIGH	12:56 pm 2.53 m	HIGH	1:49 pm 2.41 m	HIGH	2:57 pm 2.35 m	HIGH	4:16 pm 2.39 m
HIGH	11:15 pm 3.67 m	HIGH	11:55 pm 3.52 m			LOW	6:27 pm 1.21 m	LOW	7:15 pm 1.42 m	LOW	8:24 pm 1.58 m	LOW	9:47 pm 1.64 m

Gannet Cay, QLD – May / June 2019 PRINT TABLE

MON 27 MAY		TUE 28 MAY		WED 29 MAY		THU 30 MAY		FRI 31 MAY		SAT 1 JUN		SUN 2 JUN	
HIGH	4:24 am 2.86 m	HIGH	5:26 am 2.88 m	LOW	12:07 am 1.42 m	LOW	12:57 am 1.24 m	LOW	1:42 am 1.07 m	LOW	2:25 am 0.91 m	LOW	3:07 am 0.78 m
LOW	11:16 am 1.23 m	LOW	12:06 pm 1.09 m	HIGH	6:17 am 2.94 m	HIGH	7:00 am 2.99 m	HIGH	7:41 am 3.02 m	HIGH	8:21 am 3.04 m	HIGH	9:02 am 3.04 m
HIGH	5:29 pm 2.54 m	HIGH	6:20 pm 2.74 m	LOW	12:46 pm 0.93 m	LOW	1:23 pm 0.77 m	LOW	1:58 pm 0.63 m	LOW	2:34 pm 0.52 m	LOW	3:12 pm 0.46 m
LOW	11:05 pm 1.56 m			HIGH	7:00 pm 2.95 m	HIGH	7:38 pm 3.17 m	HIGH	8:14 pm 3.36 m	HIGH	8:51 pm 3.54 m	HIGH	9:30 pm 3.67 m

Tides Trip 1 Mackay - Townsville



Kennedy Reef, QLD – May / June 2019 PRINT TABLE

TUE 28 MAY		WED 29 MAY		THU 30 MAY		FRI 31 MAY		SAT 1 JUN		SUN 2 JUN		MON 3 JUN	
HIGH	5:33 am 2.11 m	HIGH	6:11 am 2.12 m	LOW	12:36 am 0.93 m	LOW	1:12 am 0.90 m	LOW	1:45 am 0.87 m	LOW	2:17 am 0.85 m	LOW	2:51 am 0.83 m
LOW	12:05 pm 0.61 m	LOW	12:32 pm 0.52 m	HIGH	6:45 am 2.11 m	HIGH	7:17 am 2.09 m	HIGH	7:47 am 2.05 m	HIGH	8:17 am 2.00 m	HIGH	8:51 am 1.93 m
HIGH	6:33 pm 1.91 m	HIGH	7:08 pm 2.05 m	LOW	12:57 pm 0.45 m	LOW	1:18 pm 0.38 m	LOW	1:39 pm 0.32 m	LOW	2:03 pm 0.26 m	LOW	2:34 pm 0.23 m
LOW	11:55 pm 0.95 m			HIGH	7:42 pm 2.17 m	HIGH	8:15 pm 2.29 m	HIGH	8:49 pm 2.40 m	HIGH	9:24 pm 2.50 m	HIGH	10:02 pm 2.58 m

Kennedy Reef, QLD – June 2019 PRINT TABLE

TUE 4 JUN		WED 5 JUN		THU 6 JUN		FRI 7 JUN		SAT 8 JUN		SUN 9 JUN		MON 10 JUN	
LOW	3:30 am 0.84 m	LOW	4:15 am 0.88 m	LOW	5:10 am 0.94 m	HIGH	12:26 am 2.57 m	HIGH	1:26 am 2.50 m	HIGH	2:34 am 2.44 m	HIGH	3:43 am 2.40 m
HIGH	9:27 am 1.85 m	HIGH	10:11 am 1.74 m	HIGH	11:05 am 1.63 m	LOW	6:26 am 1.00 m	LOW	8:30 am 0.97 m	LOW	9:48 am 0.84 m	LOW	10:40 am 0.69 m
LOW	3:09 pm 0.23 m	LOW	3:50 pm 0.29 m	LOW	4:39 pm 0.41 m	HIGH	12:15 pm 1.54 m	HIGH	1:46 pm 1.50 m	HIGH	3:25 pm 1.59 m	HIGH	4:48 pm 1.80 m
HIGH	10:44 pm 2.62 m	HIGH	11:32 pm 2.61 m			LOW	5:41 pm 0.57 m	LOW	7:06 pm 0.71 m	LOW	8:46 pm 0.78 m	LOW	10:06 pm 0.78 m

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Other

General findings:

- Environmental Conditions
    - Temperature generally 24°C across slopes, and reef flat
    - Strong currents in the Hardline Reef area
    - 10-25 m visibility
    - 5-30 kn winds, with 13 out of 16 days more than 15 kn winds
    - First 4-5 days and last 4 days wore challenged by wind and waves, limiting survey locations in some cases.
    - Due to strong winds on 20 May and on 2 June no surveys were conducted instead we steamed from one region to another region.
    - Hardline Reefs are relatively big requiring more time to travel between sites, next to that some reefs had very shallow ridges around lagoons making it hard to pass
- General reef observations
    - Hardline Reef system appeared to have healthy coral cover, little disease and negligible impacts; COTS observed on 3 transects on 3 out of 20 reefs
    - Whitsundays Reef region had in some cases large rubble zones on the windward sites, but leeward sites were usually in better condition.
    - Steep walls around reefs
    - Fork, Knife and Little Broadhurst Reefs near Townsville were in good condition
    - On Grub reef diseases were observed but no extensive bleaching
    - A high diversity of coral types with high coral cover on the windward side of all reefs relative to the leeward side
    - In general, Lagoon pockets had branching coral cover in deeper water with other coral species surrounding the lagoon.

- Methods
    - Photo quadrat and rugosity transects
        - Olympus camera does great underwater photos for transects in combination with GoPro setup for rugosity but this is quite heavy and attaching some kind of float to make the setup more neutrally buoyant would be beneficial
        - The data processing (phototransects) takes a long time, but with the new program made by Josh Passenger there is the potential for an enormous improvement in the time required.
        - Phototransect software (Josh)
            - Linking of photos to coordinates
            - Creating metadata: start, mid and end point of transect, and its total length and number of photos
            - Renaming of photos and creation of GIS file with photo name and its coordinates. However this needs attention so that the shapefile contains the ‘new’ photoquadrat names.

- Water depth surveys, initially there were challenges with the echosounders, however at the start of the second week we regularly collected depth through the Patrol on-board echo sounder, and the old and new UQ echo sounders, where the new one worked and was very reliable.
- Drones could only be used on 2 days
- Additional data collection that was optional and valuable:
    - COTS collection did work but we reassessed the risk involved such that as soon as a collector was stung, they no longer collected COTS samples. This amendment was made so as not to interfere with main survey goal. Thankfully nobody was stung.
    - CCA collection worked easy but required an intense processing time after collection
    - CoralWatch can easily be integrated into the phototransect surveys, but data entry requires time
    - RHIS can be integrated into the phototransect surveys by using an additional dive time of 10 min, which can then also be used for CCA sampling. Data entry however takes time
    - Volunteers are very valuable with respect to citizen science observation and data entry of the optional RHIS and CoralWatch surveys.