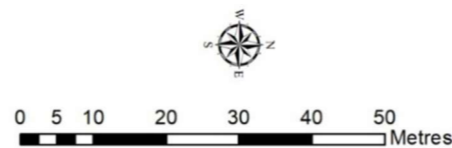




Lighthouse Cay, Frederick Reefs

Area: Approx. 0.213 ha (area above HAT)
 Approx. 1.600 ha (total area of cay)

● Health check



Printed on:
 17/11/2022

NB. Refer north arrow and inset. Note orientation
 of map.

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
 Projection: Mercator Auxiliary Sphere
 Datum: WGS1984

Figure 46 Health Check sites on Lighthouse Cay, Frederick Reefs

2.11. Brodie Cay, Marion Reefs



Figure 47 Brodie Cay

Jake Sanders © Queensland Government

2.11.1 Drone imagery

31 May 2022:

- Drone - Phantom 4 RTK
- Image capture height 60m
- Resolution 1.8cm/px
- Map stitching software – Drone Deploy

2.11.2 Physical description

- Low tide extent 357m x 111m
- Approximate high tide extent 109m x 63m
- Approximate area above high tide 1.17ha

Brodie Cay, shown in [Figure 47](#), is an unvegetated sand and coral rubble cay located 567km east of Townsville, Queensland at -19.286 degrees latitude and 152.215 degrees longitude.

2.11.3 Vegetation

On 31 May 2022 Brodie Cay was unvegetated.

2.11.4 Birds

Table 57 Bird species and their breeding status – Brodie Cay, Marion Reefs

Brodie Cay		31/05/2022			Breeding stages present		Breeding pairs	Adolescents and adults
common name	scientific name	Nests	Chicks	Young				
red-tailed tropicbird	<i>Phaethon rubricauda roseotinctus</i>	0	0	0	0	0	0	
Herald petrel	<i>Pterodroma heraldica</i>	0	0	0	0	0	0	
wedge-tailed shearwater	<i>Ardenna pacifica</i>	0	0	0	0	0	0	
great frigatebird	<i>Fregata minor</i>	0	0	0	0	0	1	
lesser frigatebird	<i>Fregata ariel</i>	0	0	0	0	0	0	
masked booby	<i>Sula dactylatra dactylatra</i>	68	9	0	77	0	0	
brown booby	<i>Sula leucogaster</i>	223	48	2	273	273	0	
red-footed booby	<i>Sula sula</i>	0	0	0	0	0	1	
sooty tern	<i>Onychoprion fuscatus</i>	0	0	0	0	0	1	
bridled tern	<i>Onychoprion anaethetus</i>	0	0	0	0	0	0	
crested tern	<i>Thalasseus bergii</i>	15	20	0	35	67	0	
roseate tern	<i>Thalasseus bengalensis</i>	0	0	0	0	0	0	
black-naped tern	<i>Sterna sumatrana</i>	16		0	16	47	0	
New Caledonian fairy tern	<i>Sternula nereis exsul</i>	0	0	0	0	0	0	
black noddy	<i>Anous minutus</i>	0	0	0	0	0	0	
brown noddy	<i>Anous stolidus</i>	0	0	0	0	0	2	
buff-banded rail	<i>Gallirallus philippensis tounelierii</i>	0	0	0	0	0	0	
purple swamphen	<i>Porphyrio melanotus</i>	0	0	0	0	0	0	
sacred kingfisher	<i>Todiramphus sanctus</i>	0	0	0	0	0	0	
white-faced heron	<i>Egretta novaehollandiae</i>	0	0	0	0	0	0	
Pacific golden plover	<i>Pluvialis fulva</i>	0	0	0	0	0	0	
ruddy turnstone	<i>Arenaria interpres</i>	0	0	0	0	0	0	
wandering tattler	<i>Tringa incana</i>	0	0	0	0	0	0	
grey-tailed tattler	<i>Tringa brevipes</i>	0	0	0	0	0	0	
lesser sand plover	<i>Charadrius mongolus</i>	0	0	0	0	0	0	

Notes

- All breeding seabirds were in early to mid stages of their breeding effort i.e., eggs and chicks
- Brown boobies are recognised as predominantly summer breeders in many areas of the Great Barrier Reef region. The Coral Sea birds may opt for breeding outside of summer due to turtle nesting disturbance through summer
- No threats observed



Photo 99 Crested terns and brown boobies

Collette Bagnato © Queensland Government

2.11.5 Pest and invertebrate sampling

31 May 2022

Rodents – unvegetated cay, no rodent tunnels deployed. No rodents observed.

Table 58 Invertebrates

Collection period	Sampling methods	baited sites	Species
daylight search	ground search	0	Nil

2.11.6 Health Checks and Island Watch

Two Health Checks (HC) sites were assessed at Brodie Cay, Marion Reefs.

The overall condition class of the island’s ecosystem was **Good** (the highest rating, see [Table 59](#))

Detailed criteria for each HC site are included in [Appendix 8](#).

Table 59 Assessed condition class for each HC site

Brodie Cay, Marion Reefs				
HC Site	Overall condition class			
HC33	Good	Good with concern	Significant concern	Critical
HC34	Good	Good with concern	Significant concern	Critical

Table 60 Summary of ecosystem type around each HC site (reference with [Figure 48](#))

HC Site	Ecosystems/vegetation communities
HC33	Unvegetated, sandy substrate, fine sediments with coral rubble
HC34	Unvegetated, sandy substrate, fine sediments with coral rubble

Island Watch

A summarised table of all Island Watch information can be found in [Appendix 9](#).



Photo 100 Health Check site HC33 East



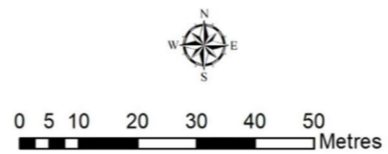
Photo 101 Health Check site HC33 West



Brodie Cay, Marion Reef

Area: Approx. 1.367 ha (area above HAT)
Approx. 3.480 ha (total area of cay)

● Health check



Printed on:
17/11/2022

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Projection: Mercator Auxiliary Sphere
Datum: WGS1984

Figure 48 Health Check sites on Brodie Cay, Marion Reef

2.12 Paget Cay, Marion Reefs

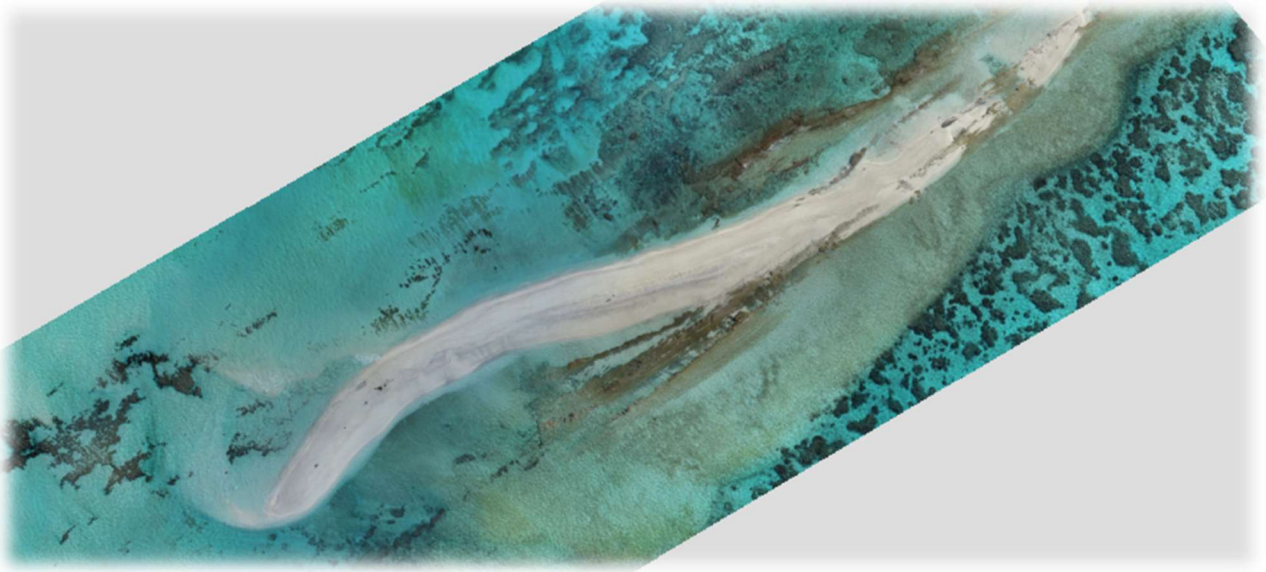


Figure 49 Paget Cay, Marion Reefs

Jake Sanders © Queensland Government

2.12.1 Drone imagery

1 June 2022:

- Drone - Phantom 4 RTK
- Image capture height 60m
- Resolution 1.7cm/px
- Map stitching software – Drone Deploy

2.12.2 Physical description

- Low tide extent 388m x 26m
- Approximate high tide extent 160m x 6m
- Approximate area above high tide 304m²

Paget Cay, shown in [Figure 49](#), is an unvegetated sand and coral rubble cay located 581km east of Townsville, Queensland at -19.256 degrees latitude and 152.348 degrees longitude.

2.12.3 Vegetation

On 1 June 2022 Paget Cay was unvegetated.

2.12.4 Birds

Table 61 Bird species and their breeding status – Paget Cay, Marion Reefs

Paget Cay		Breeding stages present			Breeding pairs	Adolescents and adults
1/06/2022		Nests	Chicks	Young		
common name	scientific name					
red-tailed tropicbird	<i>Phaethon rubricauda roseotinctus</i>	0	0	0	0	0
Herald petrel	<i>Pterodroma heraldica</i>	0	0	0	0	0
wedge-tailed shearwater	<i>Ardenna pacifica</i>	0	0	0	0	0
great frigatebird	<i>Fregata minor</i>	0	0	0	0	0
lesser frigatebird	<i>Fregata ariel</i>	0	0	0	0	0
masked booby	<i>Sula dactylatra dactylatra</i>	0	0	0	0	12
brown booby	<i>Sula leucogaster</i>	0	0	0	0	115
red-footed booby	<i>Sula sula</i>	0	0	0	0	0
sooty tern	<i>Onychoprion fuscatus</i>	0	0	0	0	0
bridled tern	<i>Onychoprion anaethetus</i>	0	0	0	0	0
crested tern	<i>Thalasseus bergii</i>	0	0	0	0	3
roseate tern	<i>Thalasseus bengalensis</i>	0	0	0	0	0
black-naped tern	<i>Sterna sumatrana</i>	19	0	0	19	82
New Caledonian fairy tern	<i>Sternula nereis exsul</i>	*	0	0	*	35
black noddy	<i>Anous minutus</i>	0	0	0	0	4
brown noddy	<i>Anous stolidus</i>	0	0	0	0	125
buff-banded rail	<i>Gallirallus philippensis tounelieri</i>	0	0	0	0	0
purple swamphen	<i>Porphyrio melanotus</i>	0	0	0	0	0
sacred kingfisher	<i>Todiramphus sanctus</i>	0	0	0	0	0
white-faced heron	<i>Egretta novaehollandiae</i>	0	0	0	0	0
Pacific golden plover	<i>Pluvialis fulva</i>	0	0	0	0	0
ruddy turnstone	<i>Arenaria interpres</i>	0	0	0	0	0
wandering tattler	<i>Tringa incana</i>	0	0	0	0	0
grey-tailed tattler	<i>Tringa brevipes</i>	0	0	0	0	0
lesser sand plover	<i>Charadrius mongolus</i>	0	0	0	0	0

Notes

***New Caledonian fairy tern:** 34 out of the 35 adult birds were in full breeding plumage. This species retains full breeding plumage at the time of nesting and raising chicks and young. Breeding colours quickly dissipate as soon as the nesting pulse finishes. It is likely these birds were preparing to nest on Paget Cay or somewhere close by. Birds were seen breeding at Georgina Cay in July 2021 (McDougall, 2022) with the possibility of the earliest eggs laid in mid June. There are some latitudinal differences in breeding events with this species but the presence of these adults in full breeding plumage would indicated breeding was imminent.

We know the cay itself was suitable for breeding as a colony of black-naped terns had already laid eggs. Both black-naped terns and New Caledonian fairy terns shared a breeding colony on Georgina Cay in 2021 (McDougall 2022).

Imminent breeding suggests Paget Cay would be the third known breeding site in Australia (the second for the Coral Sea Marine Park – the other being in the Great Barrier Reef Marine Park).



Photo 102 New Caledonian fairy terns

Collette Bagnato © Queensland Government



Photo 103 Black-naped tern nesting substrate

Collette Bagnato © Queensland Government

2.12.5 Pest and invertebrate sampling

1 June 2022

Rodents – unvegetated cay, no rodent tunnels deployed. No rodents observed.

Table 62 Invertebrates

Collection period	Sampling methods	baited sites	Species
daylight search	ground search	0	0

2.12.6 Health Checks and Island Watch

One Health Check (HC) was assessed at Paget Cay, Marion Reefs.

The overall condition class of the island's ecosystem was **Good** (the highest rating, see [Table 63](#)).

Detailed criteria for each HC site are included in [Appendix 8](#).

Table 63 Assessed condition class for each HC site

Paget Cay, Marion Reefs				
HC Site	Overall condition class			
HC35	Good	Good with concern	Significant concern	Critical

Table 64 Summary of ecosystem type around each HC site (reference with [Figure 50](#))

HC Site	Ecosystems/vegetation communities
HC35	Unvegetated, sandy substrate, fine sediments with coral rubble

Paget Cay's assessment rating of **Good** was based on the ecosystem being suitable for nesting seabirds.



Island Watch

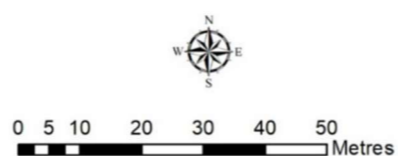
A summarised table of all Island Watch information can be found in [Appendix 9](#).



Paget Cay, Marion Reef

Area: Approx. 0.055 ha (area above HAT)
Approx. 0.969 ha (total area of cay)

- Health check



Printed on:
17/11/2022

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Projection: Mercator Auxiliary Sphere
Datum: WGS1984

Figure 50 Health Check sites on Paget Cay, Marion Reef

2.13. Carola Cay, Marion Reef

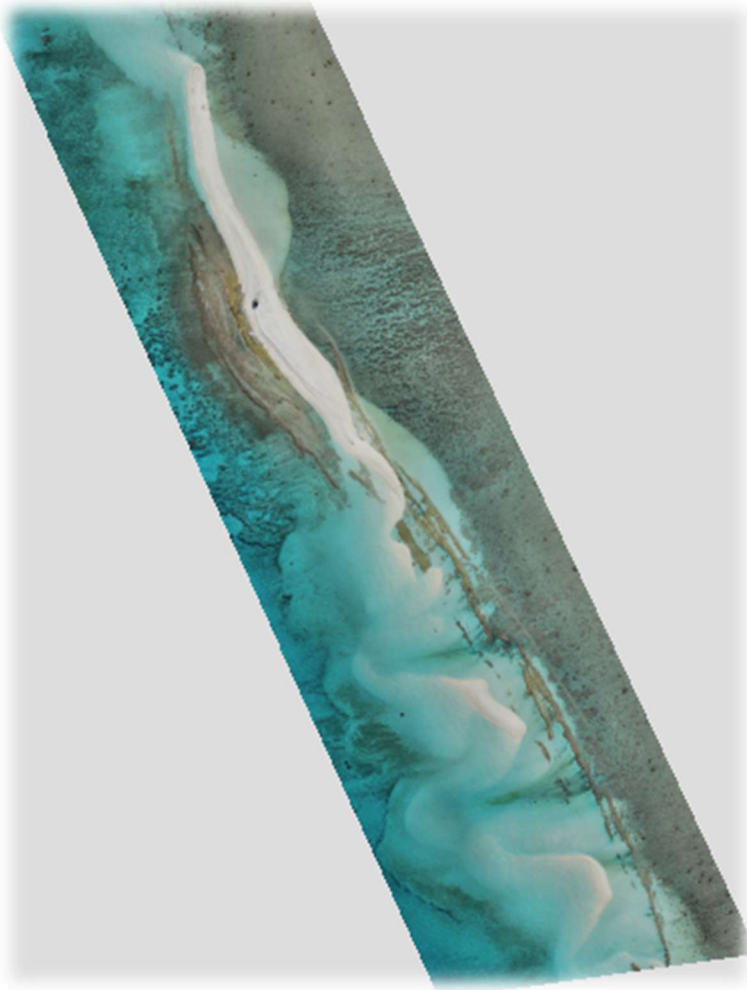


Figure 51 Carola Cay and sand bank complex.
Jake Sanders © Queensland Government

2.13.1 Drone imagery

1 June 2022:

- Drone - Phantom 4 RTK
- Image capture height 70m
- Resolution 2cm/px
- Map stitching software – Drone Deploy

2.13.2 Cay description

- Low tide extent 561m x 41m
- Approximate high tide extent 260m x 25m
- Approximate area above high tide 0.42ha

Carola Cay, shown in *Figure 51*, is an unvegetated sand and coral rubble cay located 587km east of Townsville, Queensland at -19.095 degrees latitude and 152.390 degrees longitude.

2.13.3 Vegetation

On 1 June 2022 Carola Cay was unvegetated.

2.13.4 Birds

Table 65 Bird species and their breeding status – Carola Cay, Marion Reefs

Carola Cay		Breeding stages present			Breeding pairs	Adolescents and adults
1/06/2022		Nests	Chicks	Young		
common name	scientific name					
red-tailed tropicbird	<i>Phaethon rubricauda roseotinctus</i>	0	0	0	0	0
Herald petrel	<i>Pterodroma heraldica</i>	0	0	0	0	0
wedge-tailed shearwater	<i>Ardenna pacifica</i>	0	0	0	0	0
great frigatebird	<i>Fregata minor</i>	0	0	0	0	2
lesser frigatebird	<i>Fregata ariel</i>	0	0	0	0	0
masked booby	<i>Sula dactylatra dactylatra</i>	48	5	0	53	85
brown booby	<i>Sula leucogaster</i>	9	5	1	15	126
red-footed booby	<i>Sula sula</i>	0	0	0	0	13
sooty tern	<i>Onychoprion fuscatus</i>	0	0	0	0	0
bridled tern	<i>Onychoprion anaethetus</i>	0	0	0	0	0
crested tern	<i>Thalasseus bergii</i>	0	0	0	0	0
roseate tern	<i>Thalasseus bengalensis</i>	0	0	0	0	0
black-naped tern	<i>Sterna sumatrana</i>	0	0	0	0	3
New Caledonian fairy tern	<i>Sternula nereis exsul</i>	0	0	0	0	0
black noddy	<i>Anous minutus</i>	0	0	0	0	0
brown noddy	<i>Anous stolidus</i>	0	0	0	0	360
buff-banded rail	<i>Gallirallus philippensis tounelierii</i>	0	0	0	0	0
purple swamphen	<i>Porphyrio melanotus</i>	0	0	0	0	0
sacred kingfisher	<i>Todiramphus sanctus</i>	0	0	0	0	0
white-faced heron	<i>Egretta novaehollandiae</i>	0	0	0	0	0
Pacific golden plover	<i>Pluvialis fulva</i>	0	0	0	0	0
ruddy turnstone	<i>Arenaria interpres</i>	0	0	0	0	0
wandering tattler	<i>Tringa incana</i>	0	0	0	0	0
grey-tailed tattler	<i>Tringa brevipes</i>	0	0	0	0	0
lesser sand plover	<i>Charadrius mongolus</i>	0	0	0	0	0

Notes

- Surprisingly, no small seabirds were nesting on Carola Cay. Most other cays had at least one nesting species of small seabird.
- Roosting numbers were low but this may have been due to the low end of the tide.
- No threats observed.



Photo 105 A lone masked booby nest (yellow arrow) 315m away on a dynamic sand bank.
Collette Bagnato © Queensland Government

2.13.5 Pest and invertebrate sampling

1 June 2022

Rodents – unvegetated cay, no rodent tunnels deployed. No rodents observed.

Table 66 Invertebrates

Collection period	Sampling methods	baited sites	Species
daylight search	ground search	0	0

2.13.6 Health Checks and Island Watch

Two Health Checks (HC) were assessed at Carola Cay, Marion Reefs.

The overall condition class of the cay’s ecosystem was **Good** (the highest rating, see [Table 67](#)).

Detailed criteria for each HC site are included in [Appendix 8](#).

Table 67 Assessed condition class for each HC site

Carola Cay, Marion Reefs				
HC Site	Overall condition class			
HC36	Good	Good with concern	Significant concern	Critical
HC37	Good	Good with concern	Significant concern	Critical

Table 68 Summary of ecosystem type around each HC site (reference with [Figure 52](#))

HC Site	Ecosystems/vegetation communities
HC36	Unvegetated, sandy substrate, fine sediments with coral rubble
HC37	Unvegetated, sandy substrate, fine sediments with coral rubble



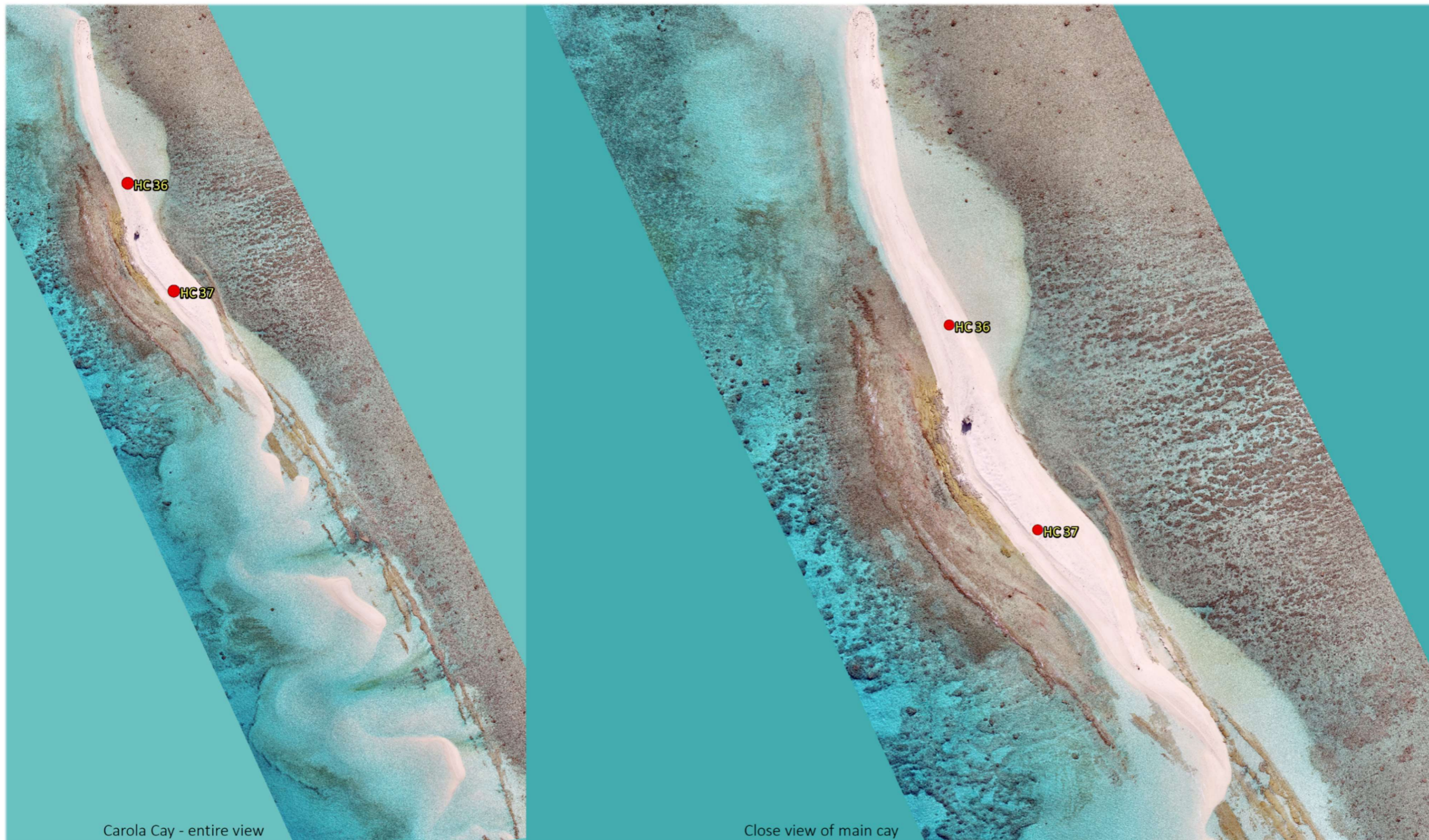
Photo 106 Health Check site HC37 South



Photo 107 Health Check site HC38 North

Island Watch

A summarised table of all Island Watch information can be found at [Appendix 9](#).



Carola Cay, Marion Reef

Area: 0.354 ha (area above HAT)
 1.671 ha (total area of cay)

● Health check



Printed on:
 30/11/2022

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
 Projection: Mercator Auxiliary Sphere
 Datum: WGS1984

Figure 52 Health Check sites on Carola Cay, Marion Reef

2.14 East Diamond Islet, Diamond Islets, Tregrosse Reefs

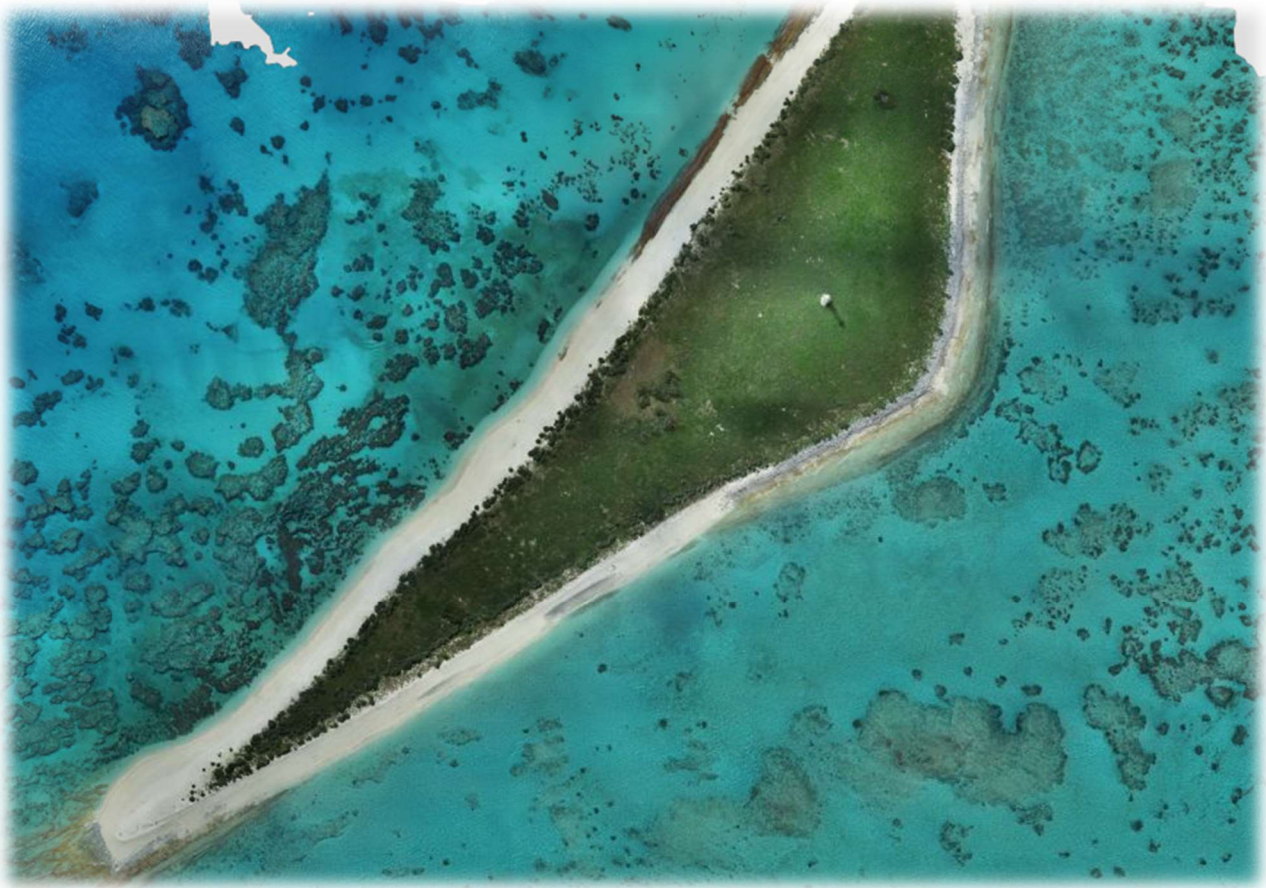


Figure 53 East Diamond Islet

Ben Sale © Queensland Government

2.14.1 Drone imagery

2 June 2022:

Cay not mapped due to frigatebird interference. This location was not originally scheduled for drone mapping.

2.14.2 Physical description

- Low tide extent 988m x 262m
- Approximate high tide extent 923m x 228m
- Approximate area above high tide 10.9ha
- Vegetated area 10.4ha

East Diamond Islet, shown in [Figure 53](#), is a vegetated cay located 536km east of Innisfail, Queensland at -17.441 degrees latitude and 151.075 degrees longitude.

2.14.3 Vegetation

Much of the vegetation adjacent to the shoreline was inspected as well as vegetation along a traverse from the eastern beach across the centre of the cay via the light tower and the central *Cordia subcordata* (sea trumpet) patches to BioCondition monitoring site M06 on the southwestern shoreline.

No weeds were observed.

Some plant species were recollected to replace specimens that developed mould on the 2021 voyage.

The location of the single plant of *Scaevola taccada* (Cardwell cabbage) observed during the July 2021 visit was revisited. The *Scaevola* was no longer present at this site (on the shoreline close to the northern spit) in June 2022 and none were observed anywhere else on the cay during this visit.

On the traverse between the eastern beach and the light tower, patches of scale infested *Achyranthes aspera* (chaff flower) were observed similar to those observed and reported on South West Cay and Hermit Crab Cay on the Lihou Reef during the 2021 voyage.



Photo 108 Scale on *Achyranthes aspera*, East Diamond Islet Tregrosse Reef
Joy Brushe ©

BioCondition monitoring site data

BioCondition monitoring site M06, was established in an *Argusia argentea* (octopus bush) shoreline vegetation community during the July, 2021 voyage and a partial survey of the site was done at that time. Large numbers of nesting frigatebirds and red footed boobies in the branches of the *Argusia* shrubs prevented access to most parts of the site at that time. Although bird nesting at this site was again present during the June, 2022 visit (including a red-tailed tropic bird nesting under an *Argusia argentea* bush within the site) and it was not possible to run the measuring tape through the centre of the site, a 50 metre tape was laid out on the adjacent shoreline allowing a close approximation of distance within the site. Using this method, access into the site at a few locations combined with estimates made from the edge of the site allowed most data to be recorded, albeit with some degree of inaccuracy. The count of individual shrubs was particularly difficult and there is likely to be a high error in the total number of shrubs per hectare.

The location of the centre transect of this site is shown as the red line in [Figure 54](#).

[Table 69](#) contains the data recorded at this site. The photographs included with the BioCondition attributes in this section are four of the 10 site photographs taken of this site. Photographs shown are all taken from

close to the centre point of the centre transect, the first facing along the transect bearing and then consecutively facing 90°, 180° and 270° from the direction of the centre transect bearing.



Figure 54 Location of BioCondition monitoring site M06 on East Diamond Islet, Tregrosse Reef

BioCondition attributes

Table 69 BioCondition attribute data recorded in monitoring site M06, East Diamond Islet on 02 June 2022

Site M06	
Cay	East Diamond
Vegetation community description	<i>Argusia argentea</i> shrubland with a sparse ground layer dominated by <i>Boerhavia albiflora</i> var. <i>albiflora</i>
Transect start (WGS 84)	-17.442676 151.072484
Transect centre (WGS84)	-17.442849 151.072325
Transect end (WGS 84)	-17.443022 151.072165
Transect bearing (degrees)	215
Median canopy height/range (metres)	2/1.8-2.5
Tree canopy cover %	n/a
Shrub canopy cover %	66%
Basal area m ² /ha (at 30 cm height, calculated from stem diameters)	n/a
Total number of large trees/ha	0
Total no of trees per ha	n/a
Total number of tree stems/ha	n/a
Total no. shrubs/ha	1000 approx. (high error in count)
Total no. shrub stems/ha	not counted*
Large shrubs - mean diameter at 30 cm height	not measured*
Recruitment of ecologically dominant layer (%)	Nil
Tree species richness	0
Tree species present	n/a
Shrub species richness	1
Shrub species present (layer in brackets)	<i>Argusia argentea</i> (S1)
Median ground layer height/range (metres)	0.2/0.05-0.25
Total ground layer cover of native cay species (%)	15%
Grass species richness	2
Grass cover (%)	1.2%
Grass species present in order of decreasing cover - most abundant first (cover in brackets)	<i>Lepturus repens</i> (0.8%), <i>Stenotaphrum micranthum</i> (0.4%)
Forb (including vines) species richness	4
Forb species cover (%)	13.8%
Forb species present in order of decreasing cover - most abundant first (cover in brackets)	<i>Boerhavia albiflora</i> var. <i>albiflora</i> (10.2%), <i>Portulaca oleracea</i> (3.6%), <i>Achyranthes aspera</i> , (<0.1%), <i>Tribulus cistoides</i> (<0.1%)
Native shrub ground cover (%)	0%
Non-native plant cover (all strata) (%)	0%
Litter cover (%)	46.6%
Bare ground (%)	38.4%
Woody debris (m/ha of logs >0.5m long and >10cm wide)	0
Soil pH	Not measured



Photo 109
Monitoring
Site M06 East
Diamond Islet
facing SW



Photo 110
Monitoring
Site M06 East
Diamond Islet
facing NW



Photo 111
Monitoring
Site M06 East
Diamond Islet
facing NE

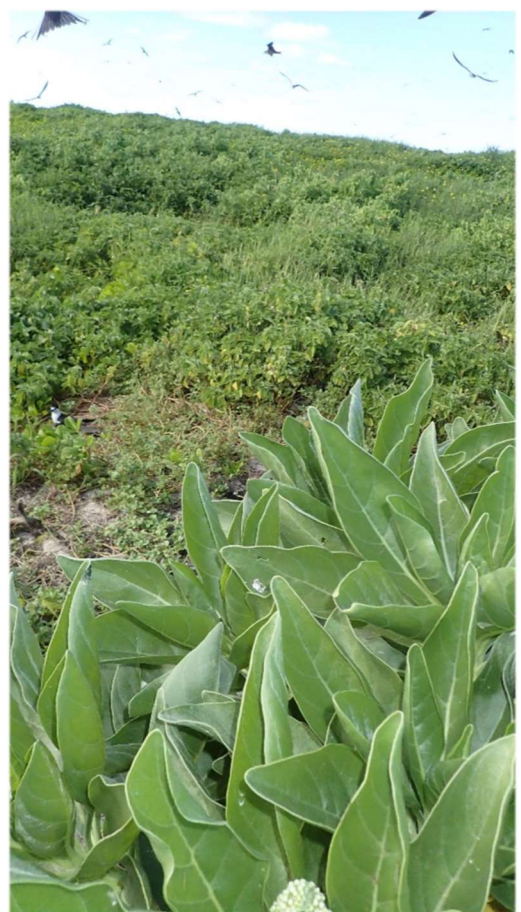


Photo 112
Monitoring
Site M06 East
Diamond Islet
facing SE

Joy Brushe ©

2.14.4 Birds

Table 70 Bird species and their breeding status – East Diamond Islet, Tregrosse Reefs

East Diamond Islet 2/06/2022		Breeding stages present			Breeding pairs	Adolescents and adults
common name	scientific name	Nests	Chicks	Young		
red-tailed tropicbird	<i>Phaethon rubricauda roseotinctus</i>	20	4	3	27	21
Herald petrel	<i>Pterodroma heraldica</i>	0	0	0	0	0
wedge-tailed shearwater	<i>Ardenna pacifica</i>	0	0	0	0	0
great frigatebird	<i>Fregata minor</i>	P	P	P	N/R	P
lesser frigatebird	<i>Fregata ariel</i>	P	P	P	N/R	P
masked booby	<i>Sula dactylatra dactylatra</i>	P			N/R	P
brown booby	<i>Sula leucogaster</i>	P			N/R	P
red-footed booby	<i>Sula sula</i>	P			N/R	P
sooty tern	<i>Onychoprion fuscatus</i>	P			N/R	P
bridled tern	<i>Onychoprion anaethetus</i>	0	0	0	0	0
crested tern	<i>Thalasseus bergii</i>	0	0	0	0	13
roseate tern	<i>Thalasseus bengalensis</i>	0	0	0	0	0
black-naped tern	<i>Sterna sumatrana</i>	0	0	0	0	5
New Caledonian fairy tern	<i>Sternula nereis exsul</i>	0	0	0	0	0
black noddy	<i>Anous minutus</i>	P	P	P	N/R	P
brown noddy	<i>Anous stolidus</i>	P			N/R	P
buff-banded rail	<i>Gallirallus philippensis tounelieri</i>	0	0	0	0	P
purple swamphen	<i>Porphyrio melanotus</i>	0	0	0	0	0
sacred kingfisher	<i>Todiramphus sanctus</i>	0	0	0	0	0
white-faced heron	<i>Egretta novaehollandiae</i>	0	0	0	0	0
Pacific golden plover	<i>Pluvialis fulva</i>	0	0	0	0	5
ruddy turnstone	<i>Arenaria interpres</i>	0	0	0	0	0
wandering tattler	<i>Tringa incana</i>	0	0	0	0	3
grey-tailed tattler	<i>Tringa brevipes</i>	0	0	0	0	0
lesser sand plover	<i>Charadrius mongolus</i>	0	0	0	0	0

N/R – not recorded.

Notes

- This was an opportunistic, short visit. Survey effort was focused on red-tailed tropicbird breeding status and general species diversity. Red-tailed tropicbird breeding effort was comparable to data collected in winter 2021 (McDougall, 2022)
- Green boxes in the table with no information are intended to show these age classes were probable considering the other breeding effort, but no direct observations were possible.
- Three wandering tattlers were observed with at least one in full breeding plumage (*Photo 113*). Overwintering birds in breeding plumage are sometimes encountered.



Photo 113 Wandering tattler in breeding plumage

Andrew McDougall © Queensland Government

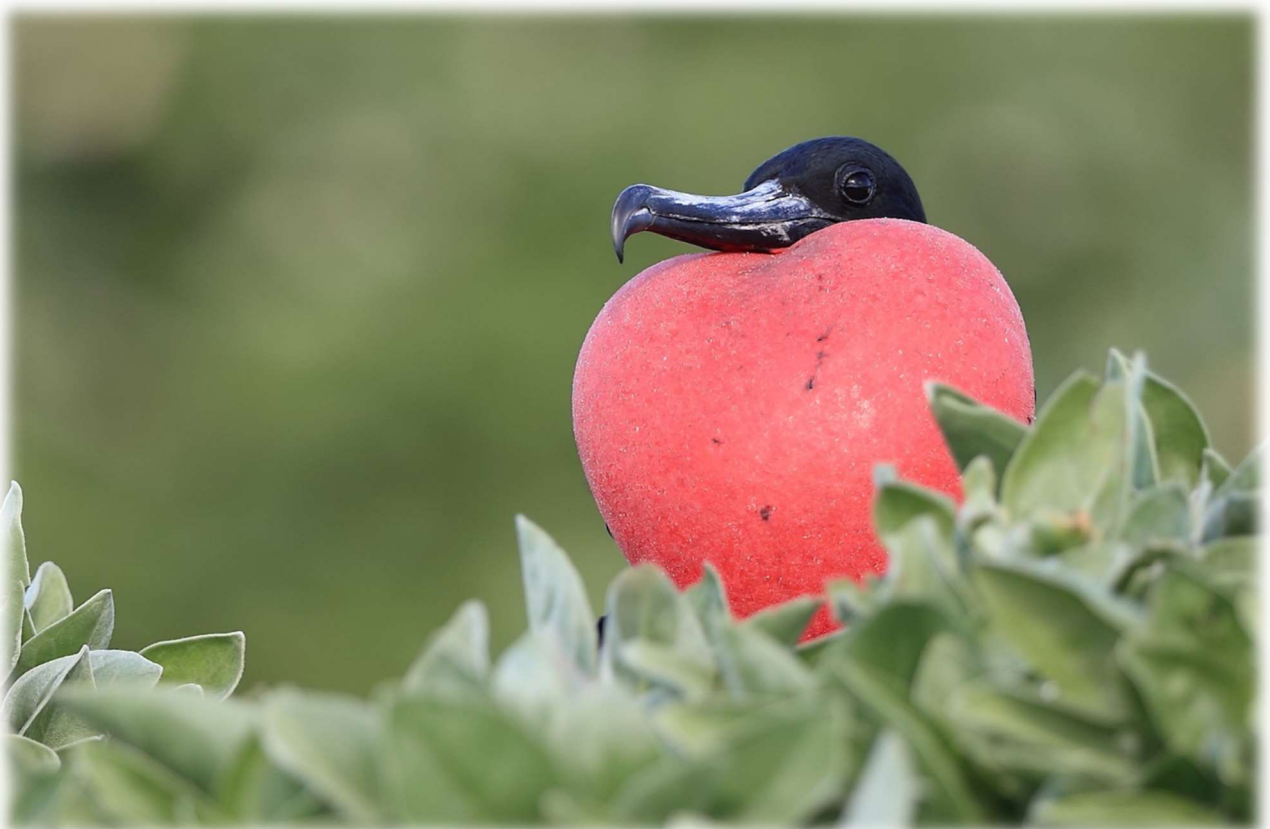


Photo 114 Great frigatebird, male displaying gular sac

Andrew McDougall © Queensland Government



Photo 115 Adult red-tailed tropicbird

Andrew McDougall © Queensland Government



Photo 116 Black nody chick

Andrew McDougall © Queensland Government

2.14.5 Pest and invertebrate sampling

(Refer to Health Check section for map)

2 June 2022

Table 71 Rodents

Collection period	Sampling methods	Sampling sites	Rodent species
daylight search	ground search for signs	general	nil

Table 72 Invertebrates

Collection period	Sampling methods	Sampling sites	Species
daylight search	bait station and ground search	7	See below

Order	Family	Species identification	common name
Araneae	Lycosidae	<i>Hogna crispipes</i>	wolf spider
Blattodea	Ectobiidae	Ectobiidae	wood cockroach
Hymenoptera	Formicidae	<i>Tetramorium simillimum</i>	tramp ant
Hymenoptera	Formicidae	<i>Cardiocondyla nuda / atalanta</i>	ant
Hymenoptera	Formicidae	<i>Nylanderia 'obscura'</i>	ant
Ixodida	Argasidae	<i>Ornithodoros capensis</i>	Argasid tick
Orthoptera	Acrididae	<i>Aiolopus thalassinus</i>	grasshopper
Pseudoscorpiones		Pseudoscorpiones	false scorpion
		Isopoda	isopod

2.14.6 Health Checks and Island Watch

This was an opportunistic visit to East Diamond Islet. No Health Checks or Island Watch summaries were conducted.

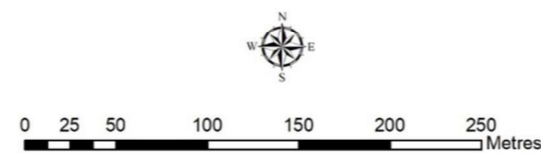


East Diamond Islet, Tregrosse Reefs

Area: 10.43 ha (area above HAT)

Vegetation communities

Ant bait station



Printed on:
30/11/2022

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Projection: Mercator Auxiliary Sphere
Datum: WGS1984

Figure 55 Ant bait station sites on East Diamond Islet, Tregrosse Reefs

2.15 North East Cay, Herald Cays



Figure 56 North East Cay, Herald Cays

© Queensland Globe

2.15.1 Drone imagery

- Opportunistic visit, no drone footage scheduled.

2.15.2 Physical description

- Low tide extent 1240m x 520m
- Approximate high tide extent 1194m x 487m
- Approximate area above high tide 42.53ha
- Vegetated area 41.5ha

North East Cay (Herald Cays), shown in [Figure 56](#), is a vegetated cay located 365km east of Cairns, Queensland, at -16.9431 degrees latitude and 149.1987 degrees longitude. The physical features of North East Cay have been described by Batianoff et al. (2008).

2.15.3 Vegetation

The visit to North East Herald Cay was also opportunistic and not part of the original trip plan. The vegetation of this cay was surveyed and mapped in December 2019 (Hemson et al., 2020). As much of the island as possible was traversed to record species, particularly weeds that may not have been apparent in the 2019 survey as a result of the poor condition of the vegetation in the extremely dry conditions at that time.

Large numbers of frigatebird chicks were present on nests in the *Abutilon albescens* (lantern bush) shrublands. The presence of these chicks, the density of the vegetation and the presence of *Ipomoea violacea* (moon flower) vines tangled through the *Abutilon albescens* shrubs made traversing through this vegetation almost impossible. Consequently, only the edges of this vegetation community was observed during the June 2022 visit.

Areas mapped in December 2019 as “*Abutilon albescens* open shrubland to shrubland with emergent dead *Cordia subcordata*” or “Patches of fallen dead *Cordia* stems over bare sand” were revisited to observe whether there was any evidence of *Cordia subcordata* (sea trumpet) regeneration following the wetter seasons since the 2019 visit. Data was recorded in the three sites shown in [Figure 57](#) in these areas (Sites 56, 57 and 58). Vegetation at these sites is shown in [Photo 117](#), [Photo 118](#) and [Photo 119](#).



Figure 57 Survey sites in areas of previous concern in *Cordia subcordata* communities shown on the December 2019 drone image (Hemson et al., 2019). The red lines are the polygon boundaries of the December 2019 vegetation mapping.

There was no evidence of *Cordia subcordata* regeneration in Site 56 with the vegetation of the area currently dominated by *Abutilon albescens* shrubs. Sites 57 and 58, however, showed good *Cordia* regeneration with some of the regrowth currently greater than three meters tall. There was evidence that some of the regrowth had suffered further dieback on some stems and these were reshooting also at the time of the June 2022 visit.

There was evidence of heavy chewing of the *Cordia subcordata* leaves by flying insects in some places.

These observations support previous observations (Batianoff et al, 2010) that *Cordia subcordata* typically dies back during prolonged dry periods but has strong ability to reshoot during wetter periods. One patch on North East Herald Cay revisited during the 2022 voyage, however, had not recovered indicating that this species may not survive increased frequency and duration of dry periods and increase in frequency and duration of drought conditions, may result in permanent loss of *Cordia subcordata* communities from the Coral Sea cays. *Cordia* is listed as threatened on the IUCN Red List due to extensive clearing for timber and development throughout its global distribution.

Previous observations (Hicks, 1983; Hicks, 1984; Donaldson, 1994; Freebairn, 2006 & 2007; Smith and Papacek, 2001; Batianoff et al., 2010) indicate that *Cordia* dieback is caused by a combination of leaf eating insects and drought. Insects that may be responsible include noctuid moth (*Armatia columbina*), the giant grasshopper (*Valanga irregularis*) and possibly other grasshoppers and the larvae of hawk moth (*Hippotion velox*).



Photo 117 Site 56 - Areas mapped in 2019 as dead *Cordia subcordata* over bare sand are now being replaced with *Abutilon albescens* shrubland.

Joy Brushe ©



Photo 118 Site 57 showing *Cordia subcordata* regrowth from stems which appeared to be dead in December 2019. The leaves of the *Cordia* in the vicinity of this site had been heavily chewed by flying insects.
Joy Brushe ©



Photo 119 Site 58 - healthy *Cordia subcordata* in an area recorded as showing severe dieback in December 2019- Darker green trees in the background are *Pisonia grandis*.
Joy Brushe ©



Photo 120 Frigatebird chick on a nest in a dead *Cordia subcordata* in an *Abutilon albescens* (lantern bush) /*Ipomoea violacea* (moon flower) shrubland near site 57
Joy Brushe ©

Rubble bank shoreline vegetation was dominated by *Portulaca oleracea*.

No weeds were observed anywhere on the cay. Traverses included as much of the interior of the cay as possible as well as the vegetation adjacent to the entire shoreline of the cay. A pile of wood indicating human activity was found in the vicinity of the old PAD sign adjacent to the southwestern spit. This area was thoroughly searched, but no weeds were found.

The old PAD sign was no longer visible from the beach due to vegetation encroachment since erection of the sign. The old sign was replaced with a new sign in a more visible location during the 2022 visit. [Photo 121](#) shows the dense vegetation obscuring the old sign.



Photo 121 Encroachment of *Argusia argentea* (octopus bush) and *Abutilon albescens* (lantern bush) around the old sign. A new sign was erected in a more suitable location during the June 2022 visit.
Joy Brushe ©

Lepidium englerianum (beach peppergrass) which was not present during the 2019 survey was observed growing in small numbers on the shoreline adjacent to the southwestern spit. This species is an ephemeral shoreline species and was probably absent during the December 2019 survey as a result of turtle disturbance, shoreline erosion, prevailing dry conditions or a combination of these.

Large numbers of red-tailed tropic birds were nesting under the *Argusia argentea* (octopus bush) shrubs and under large slabs of coral rubble around the shoreline.

2.15.4 Birds

Table 73 Bird species and their breeding status – North East Cay, Herald Cays

North East Cay		Breeding stages present			Breeding pairs	Adolescents and adults
3-4/06/2022		Nests	Chicks	Young		
common name	scientific name					
red-tailed tropicbird	<i>Phaethon rubricauda roseotinctus</i>	660-700			660-700	498
Herald petrel	<i>Pterodroma heraldica</i>	0	0	0	0	0
wedge-tailed shearwater	<i>Ardenna pacifica</i>	0	0	0	0	0
great frigatebird	<i>Fregata minor</i>	N/R	N/R	N/R	N/R	P
lesser frigatebird	<i>Fregata ariel</i>	P	N/R	N/R	P	P
masked booby	<i>Sula dactylatra dactylatra</i>	N/R	N/R	N/R	N/R	P
brown booby	<i>Sula leucogaster</i>	N/R	N/R	N/R	N/R	P
red-footed booby	<i>Sula sula</i>	N/R	N/R	N/R	N/R	P
sooty tern	<i>Onychoprion fuscatus</i>	0	0	0	0	3
bridled tern	<i>Onychoprion anaethetus</i>	0	0	0	0	0
crested tern	<i>Thalasseus bergii</i>	0	0	0	0	0
roseate tern	<i>Thalasseus bengalensis</i>	0	0	0	0	0
black-naped tern	<i>Sterna sumatrana</i>	0	0	0	0	2
New Caledonian fairy tern	<i>Sternula nereis exsul</i>	0	0	0	0	0
black noddy	<i>Anous minutus</i>	P	P	N/R	N/R	P
brown noddy	<i>Anous stolidus</i>	P	P	P	N/R	P
buff-banded rail	<i>Gallirallus philippensis tounelieri</i>	0	0	0	0	P
purple swamphen	<i>Porphyrio melanotus</i>	0	0	0	0	3
sacred kingfisher	<i>Todiramphus sanctus</i>	0	0	0	0	0
white-faced heron	<i>Egretta novaehollandiae</i>	0	0	0	0	0
Pacific golden plover	<i>Pluvialis fulva</i>	0	0	0	0	3
ruddy turnstone	<i>Arenaria interpres</i>	0	0	0	0	0
wandering tattler	<i>Tringa incana</i>	0	0	0	0	1
grey-tailed tattler	<i>Tringa brevipes</i>	0	0	0	0	0
lesser sand plover	<i>Charadrius mongolus</i>	0	0	0	0	1

Notes

- An opportunistic visit to North East Cay has allowed us to discover one of the largest breeding events for red-tailed tropicbirds in Australia. Initial observations on the afternoon of 3 June indicated huge numbers of breeding pairs – certainly too many for one or two observers in the time available. Thankfully all voyage participants assisted with all or part of a monitoring exercise the next day. From the starting location, two teams were formed and surveyed beach rock, strand vegetation and Pisonia forest (with success) until the teams met again on the opposite side of the cay. Nests can be easily overlooked so a confidence interval of 660 (actual count) to 700 breeding pairs has been proposed.
- The adult red-tailed tropicbird number is in stark contrast to zero adults seen in November/December 2019. The adult number in the table being less than the breeding pair total reflects many sites being occupied by chicks or young only.
- No time was available to survey other breeding species. N/R represents not recorded or unknown.



Photo 122a and b Buff-banded rail forms on North East Cay. Top – Typical spp. *tounelieria* (top) and leucistic form of *tounelieria* (bottom) of which there are over 20 on the cay.
Andrew McDougall @ Queensland Government



Photo 123 Adult male brown booby Andrew McDougall © Queensland Government



Photo 124 Adult red-tailed tropicbird at nest in beach rock void
Andrew McDougall © Queensland Government



Photo 125 Male lesser frigatebird (L) and red-tailed tropicbird (R)
Andrew McDougall © Queensland Government

2.15.5 Pest and invertebrate sampling

(Refer to Health Check section for map)

3/4/ June 2022

Table 74 Rodents

Collection period	Sampling methods	Sampling sites	Rodent species
overnight	Baited ink pad tunnels	8	0

Table 75 Invertebrates

Collection period	Sampling methods	Sampling sites	Species
daylight search	bait station and ground search	10	See below

Order	Family	Spp ID	common name
Hymenoptera	Formicidae	<i>Tetramorium bicarinatum</i>	tramp ant
Hemiptera	Not supplied	Not supplied	scale insects

2.15.6 Health Checks and Island Watch

Nine Health Checks (HC) were assessed at North East Cay (Herald Cays). These are the second round of Health Checks at this location after sites were established in November 2019.

The overall condition class of the cay's vegetation communities was Good (the highest rating, see [Table 76](#))

Detailed criteria for each site are included in [Appendix 8](#).

Table 76 Assessed condition class for each HC site

North East Cay, Herald Cays				
HC Site	Overall condition class			
HC38	Good	Good with concern	Significant concern	Critical
HC39	Good	Good with concern	Significant concern	Critical
HC40	Good	Good with concern	Significant concern	Critical
HC41	Good	Good with concern	Significant concern	Critical
HC42	Good	Good with concern	Significant concern	Critical
HC43	Good	Good with concern	Significant concern	Critical
HC44	Good	Good with concern	Significant concern	Critical
HC45	Good	Good with concern	Significant concern	Critical
HC46	Good	Good with concern	Significant concern	Critical

Table 77 Summary of vegetation communities around each HC site (reference with [Figure 58](#))

HC Site	Ecosystems/vegetation communities
HC38	<i>Argusia agentea</i> open shrubland to open scrub
HC39	<i>Pisonia</i> closed scrub
HC40	<i>Pisonia</i> closed scrub to low closed forest
HC41	<i>Argusia agentea</i> open shrubland to open scrub
HC42	<i>Pisonia</i> closed scrub to low closed forest
HC43	<i>Pisonia</i> closed scrub to low closed forest
HC44	<i>Abutilon albescens</i> open shrubland to shrubland
HC45	<i>Pisonia</i> closed scrub and <i>Pisonia</i> wind-sheared closed scrub
HC46	<i>Abutilon albescens</i> open shrubland to shrubland



Photo 126 Health Check site HC38 South



Photo 127 Health Check site HC39 East

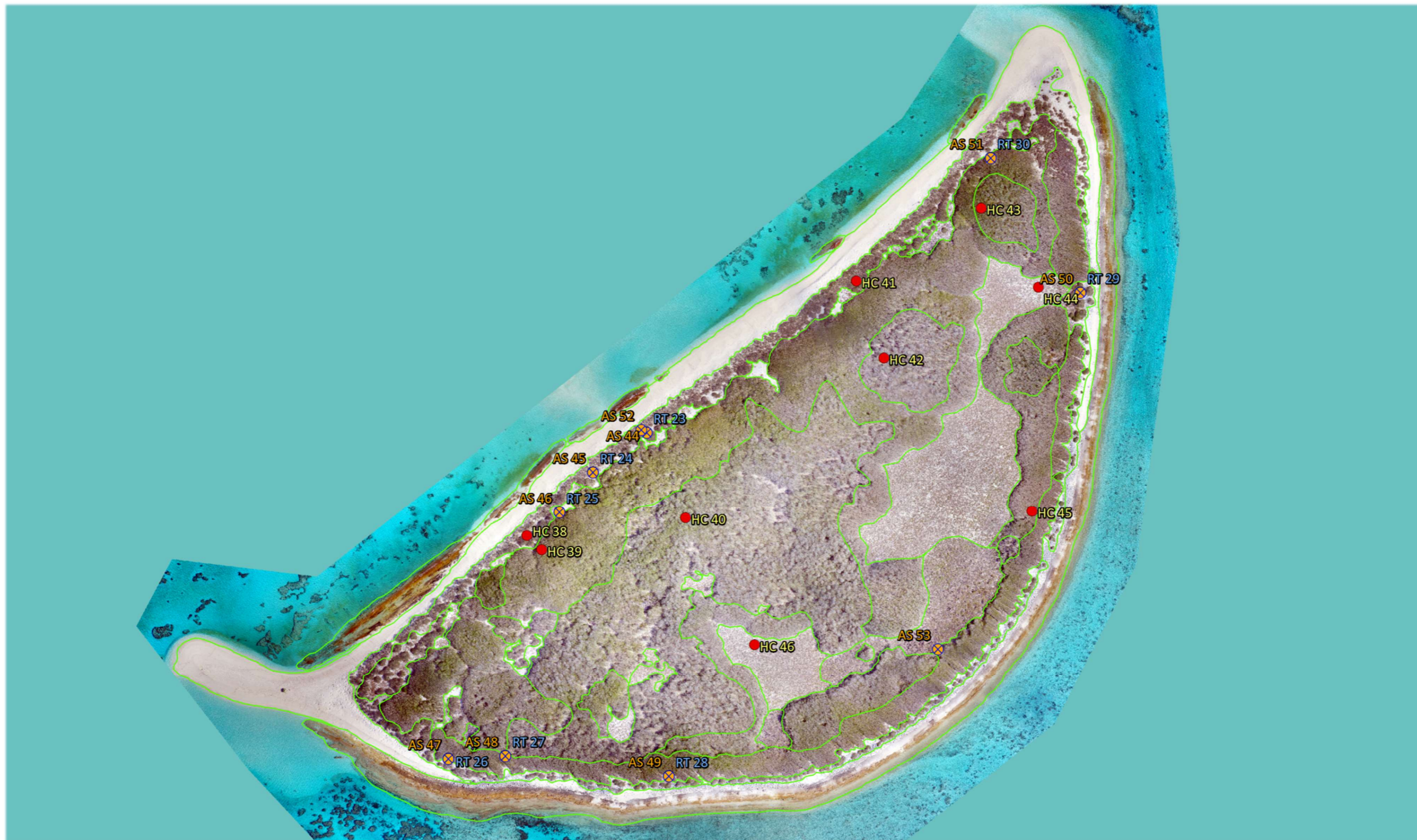


Photo 128 Health Check site HC44 East

The value of conducting Health Checks in different seasons was highlighted during these assessments. Of note was the complete transformation of the *Abutilon albescens* shrublands to open shrublands communities from dry, leafless plants to impenetrable, lush shrublands.

Island Watch

A summarised table of all Island Watch information can be found in [Appendix 9](#).



North East Herald Cay. Herald Cays

Area: Approx. 42.5 ha (area above HAT)

□ Vegetation communities

● Health check

⊕ Rodent tunnel

⊗ Ant bait station



Printed on:
30/11/2022

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Projection: Mercator Auxiliary Sphere
Datum: WGS1984

Figure 58 Health Check, rodent tunnel and ant bait station sites on North East Cay, Herald Cays

2.16 South West Cay, Herald Cays



Figure 59 South West Cay
Queensland Globe © Queensland Government

2.16.1 Drone imagery

4 June 2022:

- None captured. Opportunistic visit, no drone footage scheduled.

2.16.2 Physical description

- Low tide extent 900m x 240m
- Approximate high tide extent 870m x 208m
- Approximate area above high tide 15.33ha
- Vegetated area 14.5 ha

South West Cay, shown in [Figure 59](#), is a vegetated cay located 358km east of Cairns, Queensland at -16.9333 degrees latitude and 149.1833 degrees longitude. The physical features of South West Cay have been described by Batianoff et al. (2008).

2.16.3 Vegetation

Vegetation adjacent to the shoreline was inspected during a walk around the entire cay.

No weeds were detected.

Abutilon albescens (lantern bush) shrublands reaching a height of approximately 2 metres were the dominant vegetation in the interior of the cay.

Nesting sooty terns were abundant on *Sporobolus virginicus* (marine couch) grasslands growing in swales just landward of the shoreline (shown in [Photo 129](#)).

Stenotaphrum micranthum (beach buffalo grass) and *Lepidium englerianum* (beach peppercress), recorded by Batianoff et al in 2006/2007, were not seen during the December 2019 voyage. Neither of these species were seen during the shoreline traverse during the July 2022 visit.



Photo 129 Vegetation adjacent to eastern shoreline of NW Herald Cay - *Argusia argentea* shrubland in foreground, *Sporobolus virginicus* grassland in centre and *Abutilon albescens* shrubland further landward
Joy Brushe ©



Photo 130 *Sporobolus virginicus* open grassland at southern end of NW Herald Cay.
Joy Brushe ©



Photo 131 looking across NW Herald Cay showing the condition and density of the vegetation in June 2022
Joy Brushe ©



Photo 132 Sooty tern colony spread through strand *Argusia argentea* and open sand areas
Collette Bagnato © Queensland Government

2.16.4 Birds

Table 78 Bird species and their breeding status – South West Cay, Herald Cays

South West Cay 4/06/2022		Breeding stages present			Breeding pairs	Adolescents and adults
common name	scientific name	Nests	Chicks	Young		
red-tailed tropicbird	<i>Phaethon rubricauda roseotinctus</i>	112-120			112-120	118
Herald petrel	<i>Pterodroma heraldica</i>	0	0	0	0	0
wedge-tailed shearwater	<i>Ardenna pacifica</i>	0	0	0	0	0
great frigatebird	<i>Fregata minor</i>	P	unknown	unknown	N/R	P
lesser frigatebird	<i>Fregata ariel</i>	unknown	unknown	unknown	N/R	P
masked booby	<i>Sula dactylatra dactylatra</i>	P	unknown	unknown	N/R	P
brown booby	<i>Sula leucogaster</i>	unknown	unknown	unknown	N/R	
red-footed booby	<i>Sula sula</i>	P	0	0	N/R	P
sooty tern	<i>Onychoprion fuscatus</i>	*4480-6000			4480-6000	>6000
bridled tern	<i>Onychoprion anaethetus</i>	0	0	0	0	0
crested tern	<i>Thalasseus bergii</i>	0	0	0	0	0
roseate tern	<i>Thalasseus bengalensis</i>	0	0	0	0	0
black-naped tern	<i>Sterna sumatrana</i>	0	0	0	0	0
New Caledonian fairy tern	<i>Sternula nereis exsul</i>	0	0	0	0	0
black noddy	<i>Anous minutus</i>	0	0	0	0	0
brown noddy	<i>Anous stolidus</i>	0	0	0	0	P
buff-banded rail	<i>Gallirallus philippensis tounelieri</i>	0	0	0	0	0
purple swamphen	<i>Porphyrio melanotus</i>	0	0	0	0	0
sacred kingfisher	<i>Todiramphus sanctus</i>	0	0	0	0	0
white-faced heron	<i>Egretta novaehollandiae</i>	0	0	0	0	0
Pacific golden plover	<i>Pluvialis fulva</i>	0	0	0	0	0
ruddy turnstone	<i>Arenaria interpres</i>	0	0	0	0	0
wandering tattler	<i>Tringa incana</i>	0	0	0	0	0
grey-tailed tattler	<i>Tringa brevipes</i>	0	0	0	0	0
lesser sand plover	<i>Charadrius mongolus</i>	0	0	0	0	0

Notes

- A brief visit to South West Cay allowed for a summary of red-tailed tropicbird breeding effort in the Herald Cays. Breeding effort was restricted to the eastern littoral zone.
- *The sooty tern breeding pair total is a very rough count of the western beach and littoral zone and the northern and southern ends of the cay. No time was available to investigate breeding activity inside the cay. No drone flights were scheduled to assist with internal cay counts.

2.16.5 Pest and invertebrate sampling

4 June 2022

Rodents

- Brief visit, no rodent tunnels deployed. No rodents observed.

Invertebrates

- Brief visit, no invertebrate sampling scheduled.

2.16.8 Health Checks and Island Watch

- Brief visit, no Health Checks scheduled
- No Health Check map to display
- No Island Watch was conducted

2.17 North Cay, Willis Islets



Figure 60 North Cay

Jake Sanders © Queensland Government

2.17.1 Drone imagery

3/4 June 2022:

- Drone – Phantom 4 RTK
- Image capture height 110m
- Resolution 3.1cm/px
- Map stitching software – Drone Deploy

2.17.2 Physical description

- Low tide extent 1580m x 265m
- Approximate high tide extent 1430m x 229m
- Approximate area above high tide 19.86ha
- Vegetated area 18.9 ha

North Cay (Willis Islets), shown in [Figure 60](#), is a vegetated cay located 480 km ENE of Cairns at -16.113 degrees latitude and 149.999 degrees longitude. It is the largest scheduled cay (excluding the unscheduled North East Cay) visited on the 2022 voyage. [Figure 61](#) shows surface elevation profiles of North Cay (Willis Islets).

2.17.3 Vegetation

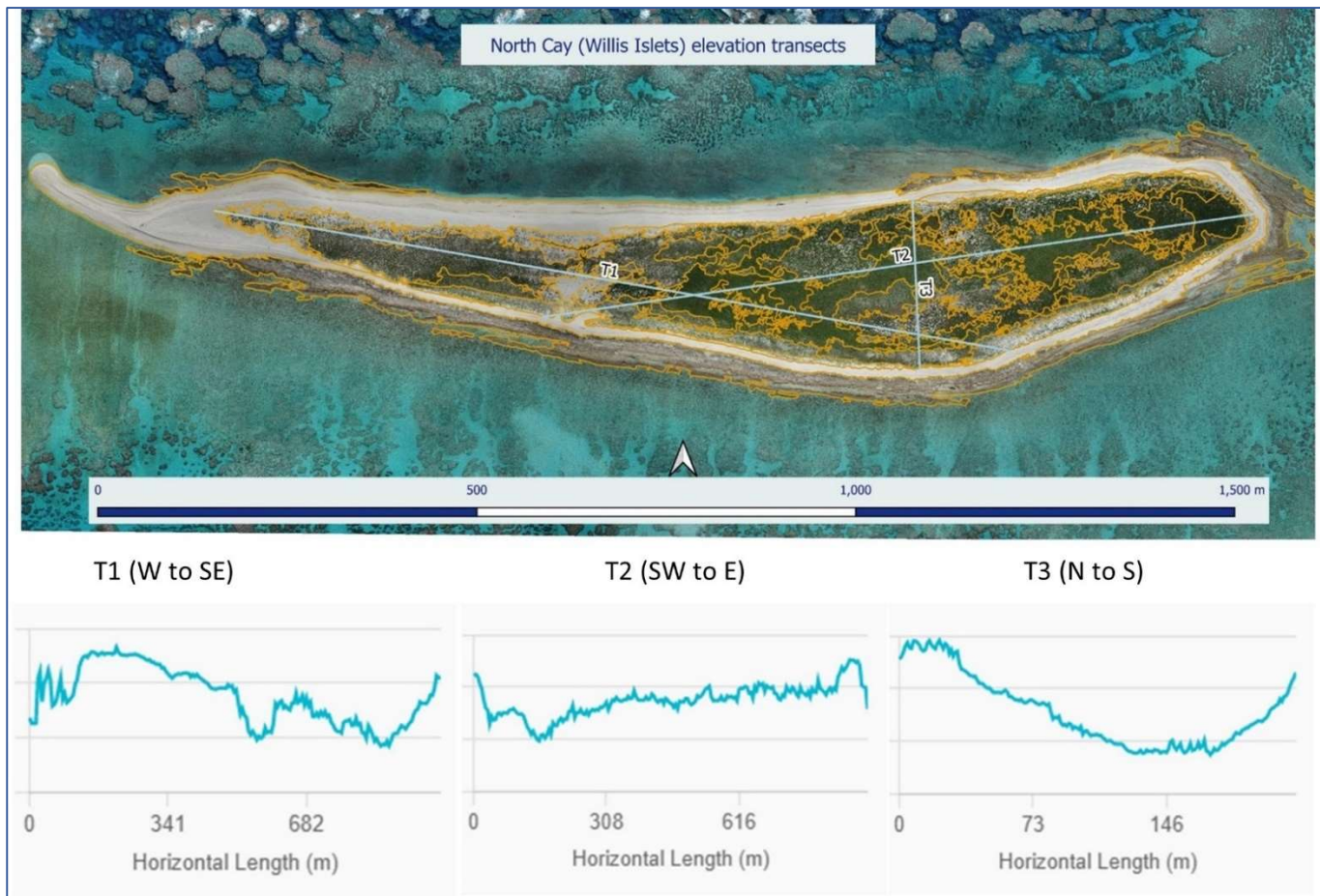


Figure 61 Surface profiles of North Cay (Willis Islets)

Note: Maximum elevation is approximately three metres ASL. Vertical heights and scale are not included in surface profile diagrams as accurate datum information was not available.

Survey intensity

Two people each spent approximately 6.2 hours surveying the vegetation of North Cay (Willis Islets). Vegetation data was recorded at 32 ground-truthing sites and one permanent monitoring site (M20). The locations of these sites are shown in [Figure 62](#). The orange lines are the boundaries of the vegetation communities shown on the vegetation map in [Figure 63](#).

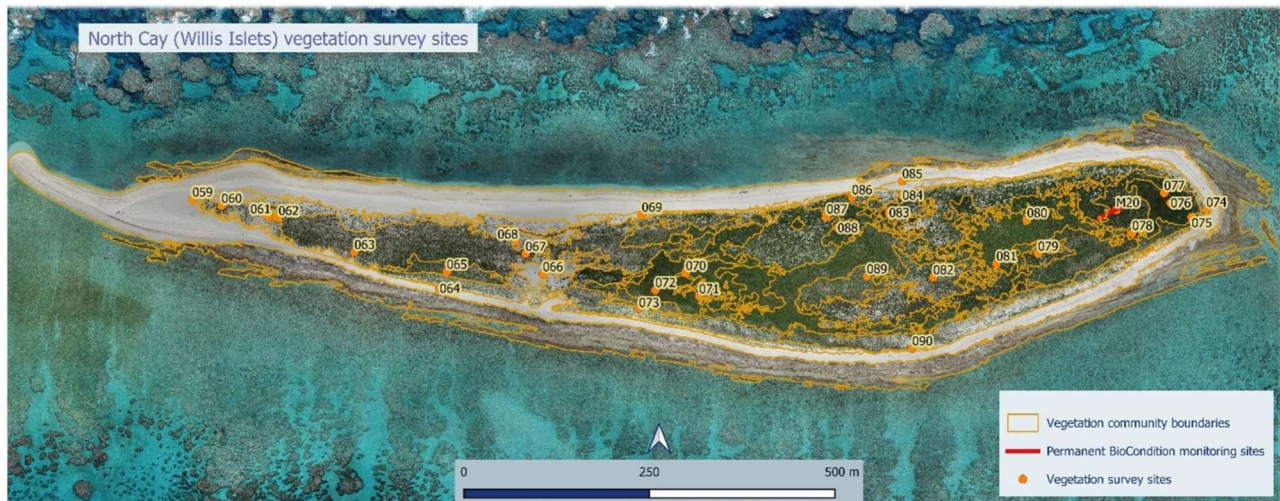


Figure 62 North Cay (Willis Islets) showing the number and location of ground-truthing vegetation survey sites and the BioCondition monitoring site relative to the vegetation map unit boundaries

Vegetation condition

The vegetation on the cay was all in good condition at the time of the survey.

Floristic data

Eight plant species were recorded on North Cay (Willis Islets).

Boerhavia albiflora var. *albiflora* (tar vine), *Portulaca oleracea* (pigweed) and *Stenotaphrum micranthum* (beach buffalo grass) were the most abundant and widespread species present at the time of the survey.

Plant species recorded during the 2022 survey are listed in [Table 79](#) together with frequency in sites, the averaged cover for each species for sites in which the species was present and their averaged cover over the entire cay. Data for species cover at each site plus occurrence of each species in relation to vegetation community and landform are contained in [Table 81](#).

Table 79 Plant species recorded on North Cay (Willis Islets) (05-06/06/2022)

Layers: (G) = ground;

Lifeform: G = grass, Ga = annual grass, Gp = perennial grass, H = herb, Ha = annual Herb, Hp = perennial herb

Scientific name	Common name	Family	Life form	Presence in sites (% of sites)	Average % cover for each layer (averaged cover only for sites in which species was present)	Overall average % cover for each layer- (averaged cover over all sites including 0% covers at sites where species was absent)
<i>Achyranthes aspera</i>	chaff flower	Amaranthaceae	Ha	21.2%	9.6% (G)	2.0% (G)
<i>Boerhavia albiflora</i> var. <i>albiflora</i>	tar vine	Nyctaginaceae	Hp	97%	20.2% (G)	19.6% (G)
<i>Lepidium englerianum</i>	beach peppergrass	Brassicaceae	Ha	3.0%	2.5% (G)	0.1% (G)
<i>Lepturus repens</i>	stalky grass	Poaceae	Gp	33.3%	20.0% (G)	6.7% (G)
<i>Portulaca oleracea</i>	pig weed	Portulacaceae	H	75.8%	17.0% (G)	12.9% (G)
<i>Sporobolus virginicus</i>	marine couch	Poaceae	Gp	9.1%	77.5% (G)	7.0% (G)
<i>Stenotaphrum micranthum</i>	beach buffalo grass	Poaceae	Ga	75.8%	10.9% (G)	8.3% (G)
<i>Tribulus cistoides</i>	bull's head burr	Zygophyllaceae	Ha	51.5%	14.6% (G)	7.5% (G)
Total no of species = 8						

Vegetation communities

The vegetation on this cay appeared to be less well established and generally more open than other vegetated Coral Sea cays. Some parts of the vegetated areas are at quite low elevation and are likely to be periodically inundated by storm/cyclonic wave surges.

No *Pisonia grandis* (pisonia) communities or other tree or shrub dominated communities were present on the cay.

The vegetation of the western end of the cay is relatively sparse and is dominated by *Stenotaphrum micranthum* (beach buffalo grass) grassland and open grassland communities. The centre and eastern ends of the cay consist of a mosaic of open to closed grassland and herbland communities including *Portulaca oleracea* (pigweed) closed herblands, grasslands dominated by either *Stenotaphrum micranthum* or *Lepturus repens* (stalky grass) or co-dominated by both of these grasses. Open to closed herblands dominated by *Boerhavia albiflora* var. *albiflora* (tar vine) are also present.

Vegetation communities present on North Cay (Willis Islets) in June 2022, the area of each and representative survey sites within each vegetation community are listed in [Table 80](#). The spatial distribution and extent of these vegetation communities are shown in the vegetation map in [Figure 63](#). Comparisons with equivalent and similar communities on other Coral Sea cays are shown in [Appendix 3](#).

Table 80 Vegetation communities on North Cay (Willis Islets)

Veg map unit	Summary description	Additional descriptions	Total area (ha)	Sites
Unvegetated areas				
A	sandy shores		7.469	
B	lithified shores		6.168	
Vegetation of shorelines, beaches and sand spits				
1a	sparse to open grassland to herbland on sandy shorelines		0.631	59, 64, 69, 74, 85
Grasslands				
3a	<i>Lepturus repens</i> closed grassland	<i>Lepturus repens</i> closed grassland with <i>Boerhavia albiflora</i> var. <i>albiflora</i> , <i>Tribulus cistoides</i> and <i>Portulaca oleracea</i>	1.730	71, 78
4	<i>Lepturus repens</i> / <i>Boerhavia albiflora</i> var. <i>albiflora</i> / <i>Stenotaphrum micranthum</i> open to closed grassland	<i>Lepturus repens</i> / <i>Boerhavia albiflora</i> var. <i>albiflora</i> / <i>Stenotaphrum micranthum</i> open to closed grassland with <i>Portulaca oleracea</i> +/- <i>Tribulus cistoides</i>	1.828	88
4a	<i>Lepturus repens</i> / <i>Stenotaphrum micranthum</i> / <i>Boerhavia albiflora</i> var. <i>albiflora</i> / open grassland		0.504	82
5	<i>Stenotaphrum micranthum</i> open grassland		0.224	61
5a	<i>Stenotaphrum micranthum</i> open grassland	<i>Stenotaphrum micranthum</i> open grassland with <i>Boerhavia albiflora</i> var. <i>albiflora</i> +/- <i>Portulaca oleracea</i>	1.851	60, 62, 68, 84
5b	<i>Stenotaphrum micranthum</i> / <i>Boerhavia albiflora</i> var. <i>albiflora</i> grassland to closed grassland		3.457	63, 67, 73
17	<i>Sporobolus virginicus</i> closed grassland	<i>Sporobolus virginicus</i> closed grassland with <i>Boerhavia albiflora</i> var. <i>albiflora</i> +/- <i>Achyranthes aspera</i> +/- <i>Stenotaphrum micranthum</i> +/- <i>Tribulus cistoides</i>	0.087	80, 83, 87
Herblands				
6a	<i>Boerhavia albiflora</i> var. <i>albiflora</i> / <i>Portulaca oleracea</i> herbland to closed herbland	<i>Boerhavia albiflora</i> var. <i>albiflora</i> / <i>Portulaca oleracea</i> herbland to closed herbland +/- <i>Tribulus cistoides</i>	0.957	65, 75
6b	<i>Boerhavia albiflora</i> var. <i>albiflora</i> / <i>Stenotaphrum micranthum</i> open herbland to herbland	<i>Boerhavia albiflora</i> var. <i>albiflora</i> / <i>Stenotaphrum micranthum</i> open herbland to herbland with <i>Portulaca oleracea</i> +/- <i>Tribulus cistoides</i>	2.093	86, 90
6c	<i>Boerhavia albiflora</i> var. <i>albiflora</i> / <i>Achyranthes aspera</i> / <i>Portulaca oleracea</i> open herbland to herbland	<i>Boerhavia albiflora</i> var. <i>albiflora</i> / <i>Achyranthes aspera</i> / <i>Portulaca oleracea</i> open herbland to herbland +/- <i>Lepturus repens</i> +/- <i>Stenotaphrum micranthum</i> +/- <i>Tribulus cistoides</i>	0.400	79, 89
6d	<i>Boerhavia albiflora</i> var. <i>albiflora</i> sparse herbland		0.171	66
6e	<i>Boerhavia albiflora</i> var. <i>albiflora</i> closed herbland	<i>Boerhavia albiflora</i> var. <i>albiflora</i> closed herbland with <i>Portulaca oleracea</i> , <i>Stenotaphrum micranthum</i> and <i>Tribulus cistoides</i> +/- <i>Lepturus repens</i>	0.538	76, 77, M20
16a	<i>Portulaca oleracea</i> herbland to closed herbland	<i>Portulaca oleracea</i> herbland to closed herbland with <i>Achyranthes aspera</i> , <i>Boerhavia albiflora</i> var. <i>albiflora</i> and <i>Tribulus cistoides</i>	1.985	70, 81
16b	<i>Portulaca oleracea</i> closed herbland with <i>Lepturus repens</i>		1.965	72
16c	<i>Portulaca oleracea</i> herbland with <i>Stenotaphrum micranthum</i> and <i>Boerhavia albiflora</i> var. <i>albiflora</i>	<i>Portulaca oleracea</i> herbland with <i>Stenotaphrum micranthum</i> and <i>Boerhavia albiflora</i> var. <i>albiflora</i> +/- <i>Tribulus cistoides</i>	0.455	
Total vegetated area (ha)			18.877	

Note: Areas of sandy shores and rocky shores, particularly those of the rocky shores are only approximate due to the difficulty in determining the location of the boundary between the edge of the shoreline and the surrounding reef flat using the imagery.

The following pages contain photographs and detailed descriptions of all the vegetation communities observed at the time of the June 2022 survey.

Photographs and descriptions of North Cay (Willis Islets) vegetation communities

Shoreline, beaches and sand spit vegetation

1a sparse to open grassland or herbland on sandy shorelines

Ground truthing sites: 59, 64, 69, 74, 85



Photo 133 Veg map unit 1a, Site 85 North Cay (Willis Islets)

Joy Brushe ©



Photo 134 Veg map unit 1a, Site 59 North Cay (Willis Islets)

Joy Brushe ©

Vegetation community 1a was growing along parts of the shoreline in coarse sand with medium sized coral rubble. It was difficult to separate from the open herblands and grasslands along much of the shoreline. Dominant species in this unit were *Boerhavia albiflora* var. *albiflora* (tar vine), *Stenotaphrum micranthum* (beach buffalo grass and *Portulaca oleracea* (pigweed). *Lepidium englerianum* (beach pepper cress) was present in site 74.

Grasslands

3a *Lepturus repens* closed grassland with *Boerhavia albiflora* var. *albiflora*, *Tribulus cistoides* and *Portulaca oleracea*

Ground truthing sites: 71, 78



Photo 135 Veg map unit 3a, Site 78 North Cay (Willis Islets)
Joy Brushe ©

Vegetation community 3a was scattered throughout the more elevated areas on the eastern half of the cay. Soil was light brown coarse sand with fine coral rubble.

4 *Lepturus repens*/ *Boerhavia albiflora* var. *albiflora*/*Stenotaphrum micranthum* open grassland to grassland to closed herbland with *Portulaca oleracea* +/- *Tribulus cistoides*

ground truthing site: 88

Vegetation community 4 was also growing on the eastern end of the cay on light-coloured coarse sand with occasional coral rubble on the surface.



Photo 136 Veg map unit 4, Site 88 North Cay (Willis Islets)
Joy Brushe ©

4a *Lepturus repens*/*Stenotaphrum micranthum*/*Boerhavia albiflora* var. *albiflora*/ open grassland with *Achyranthes aspera*

ground truthing site 82



Photo 137 Veg map unit 4a, Site 82 North Cay (Willis Islets)
Joy Brushe ©

Vegetation community 4a was more open than vegetation community 4 and contained *Achyranthes aspera* (chaff flower). Soil was brown loamy sand with high organic content and abundant medium coral rubble surface fragments.

5 ***Stenotaphrum micranthum* open grassland**

ground truthing site: 61



Photo 138 Veg map unit 5, Site 61 North Cay (Willis Islets)

Joy Brushe ©

Vegetation community 5a was growing in low lying depressions on the western side of the cay. Soil was white sand with fine coral rubble surface fragments.

5a ***Stenotaphrum micranthum* open grassland to grassland with *Boerhavia albiflora* var *albiflora* +/- *Portulaca oleracea***

ground truthing sites: 60, 62, 68, 84

Vegetation community 5a formed an open grassland around much of the shoreline of the cay and was most prevalent on the shorelines on the western end of the cay. It was growing in white sand with some coral fine rubble surface fragments



Photo 139 Veg map unit 5a, Site 60 North Cay (Willis Islets)
Joy Brushe ©

5b *Stenotaphrum micranthum*/*Boerhavia albiflora* var. *albiflora* grassland to closed grassland
ground truthing sites: 63, 67, 73



Photo 140 Veg map unit 5b, Site 73 North Cay (Willis Islets)
Joy Brushe ©

Vegetation community 5b dominated the interior of the western end of the cay with some patches also present in the central and eastern interior as well. It was a more closed community with a little more soil development than vegetation communities 5 and 5a. *Portulaca oleracea* (pig weed) was also present in low abundance in this community. Soil was typically light brown sand with some organic content and contained fine coral rubble.

17 ***Sporobolus virginicus* closed grassland with *Boerhavia albiflora* var. *albiflora* +/- *Achyranthes aspera* +/- *Stenotaphrum micranthum* +/- *Tribulus cistoides***

ground truthing sites: 80, 83, 87



Photo 141 Veg map unit 17, site 83 North Cay (Willis Islets)
Joy Brushe ©

The distribution of vegetation community 17 was restricted to 4 patches on the northern margin of the cay's interior. Soil was mostly poorly developed white coarse sand with fine surface coral rubble.

Herblands

6a ***Boerhavia albiflora* var. *albiflora*/ *Portulaca oleracea* herbland to closed herbland +/- *Tribulus cistoides***

ground truthing sites 65, 75

Vegetation community 6a was located in low lying swales or depressions. Soil was light brown sand with some organic content and contained abundant fine coral rubble fragments.



Photo 142 Veg map unit 6a, Site 65 North Cay (Willis Islets)
Joy Brushe ©

6b *Boerhavia albiflora* var. *albiflora*/ *Stenotaphrum micranthum*/open herbland/herbland with *Portulaca oleracea* +/- *Tribulus cistoides*

ground truthing sites 86, 90



Photo 143 Veg map unit 6b, site 86 North Cay (Willis Islets)
Joy Brushe ©

Vegetation community 6b dominated the vegetation along the southern shoreline. Soil was poorly developed, consisting of white coarse sand with coral rubble fragments. *Lepturus repens* (stalky grass) was also present in site 86.

6c *Boerhavia albiflora* var. *albiflora*/ *Achyranthes aspera*/ *Portulaca oleracea* open herbland to herbland +/- *Lepturus repens* +/- *Stenotaphrum micranthum* +/- *Tribulus cistoides*

ground truthing sites: 79, 89



Photo 144 Veg map unit 6c, Site 89 North Cay (Willis Islets)
Joy Brushe ©

Vegetation unit 6c was present in depressions in the central and eastern interior and was growing in dark brown loamy sand with high organic content with fine coral rubble on the surface.

6d *Boerhavia albiflora* var. *albiflora* sparse herbland

ground truthing site: 66

Vegetation community 6d was sparsely vegetated and growing in a low-lying depression, possibly washed over by high tides and storm surges. Soil was white sand with fine coral rubble surface fragments.



Photo 145 Veg map unit 6d, Site 66 North Cay (Willis Islets)

Joy Brushe ©

6e *Boerhavia albiflora* var. *albiflora* closed herbland with *Portulaca oleracea*, *Stenotaphrum micranthum* and *Tribulus cistoides* +/- *Lepturus repens*

ground truthing sites: 76, 77; BioCondition monitoring site: M20



Photo 146 Veg map unit 6e, Site 76 North Cay (Willis Islets). The yellow flowering plant is *Tribulus cistoides* (bull's head burr).

Joy Brushe ©

Vegetation community 6e was growing on the eastern end of the cay interior. As can be seen from the photo above, the vegetation was very dense.

Herblands to closed herblands (vegetation units 16a, 16b and 16c) dominated by *Portulaca oleracea* (pig weed) formed dense vegetation communities in the higher elevation areas in the centre of the cay interior.

16a *Portulaca oleracea* herbland to closed herbland with *Achyranthes aspera*, *Boerhavia albiflora* var. *albiflora* and *Tribulus cistoides*

ground truthing site: 70, 81



Photo 147 Veg map unit 16a, Site 70 North Cay (Willis Islets)

Joy Brushe ©

16b *Portulaca oleracea* closed herbland with *Lepturus repens*

ground truthing site 72



Photo 148 Veg map unit 16b, Site 72 North Cay (Willis Islets)

Joy Brushe ©

16c *Portulaca oleracea* herbland with *Stenotaphrum micranthum* and *Boerhavia albiflora* var. *albiflora* +/- *Tribulus cistoides*

no site data or photographs for this unit

North Cay (Willis islets) Vegetation Map

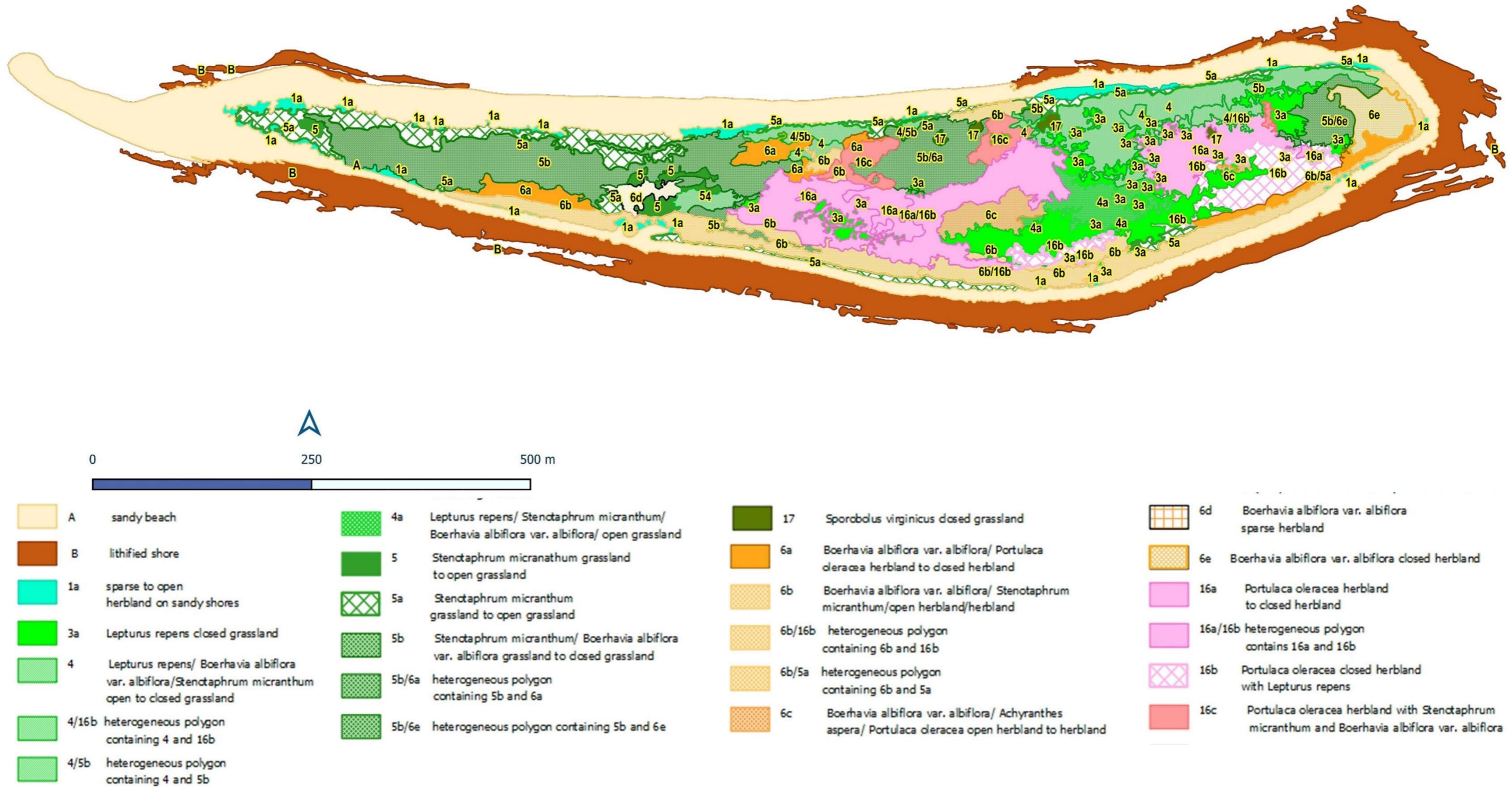


Figure 63 North Cay (Willis Islets) vegetation map

Table 81 Site data recorded on North Cay (Willis Islets) 05/06/2022

Datum = WGS 84; green shading = site dominants

Site	Lat	Long	Number of photos	Landform	Aspect	Estimated altitude	Soil Description	Total weed cover %	Veg map unit code	Community	Achyranthes aspera	Boerhavia albiflora var. albiflora	Lepidium englerianum	Lepturus repens	Portulaca oleracea	Sporobolus virginicus	Stenotaphrum micranthum	Tribulus cistoides	Litter	Plant specimens collected	Notes	Birds	Turtle activity	Start	Finish	Dominant growth form	Ground FPC	
059	-16.112399	149.992108	2	Spit		1	white sand with fine coral rubble surface fragments	0	1a	Stenotaphrum micranthum sparse grassland							trace-5%					high	9:51:11	9:57:51	grass	very sparse (<10%)		
060	-16.112475	149.992461	3	flat		1	white sand with fine coral rubble surface fragments	0	5a	Stenotaphrum micranthum/Boerhavia albiflora var. albiflora/ open grassland		5-25%			trace-5%		5-25%		trace-5%			large numbers brown noddies	high	10:00:12	10:04:39	herb	sparse (10-30%)	
061	-16.112604	149.993026	2	depression		1	white sand with fine coral rubble surface fragments	0	5	Stenotaphrum micranthum open grassland		trace-5%					5-25%					occasional masked boobies, large numbers brown noddies	medium	10:07:29	10:12:15	grass	sparse (10-30%)	
062	-16.112624	149.993151	2	mid slope	S	2	light coloured sand with some organic content	0	5a	Stenotaphrum micranthum/Boerhavia albiflora var. albiflora grassland		25-50%			trace-5%		5-25%		5-25%		On eastern edge of 161	abundant sooty terns	low	10:14:18	10:20:20	herb	mid-dense (>30-70%)	
063	-16.113034	149.994070	3	lower slope	S	1	light coloured sand with fine coral rubble surface fragments	0	5b	Stenotaphrum micranthum/Boerhavia albiflora var. albiflora grassland		5-25%			trace-5%		5-25%		5-25%			abundant sooty terns	low	10:27:33	10:32:07	grass	mid-dense (>30-70%)	
064	-16.113475	149.995102	2	dune		1	white sand with fine coral rubble fragments in soil abundant medium coral rubble surface fragments	0	1a	Boerhavia albiflora var. albiflora sparse herbland		5-25%									Very narrow unit 3 m wide at the most,	occasional masked boobies	low	10:36:59	10:41:12	forb	very sparse (<10%)	
065	-16.113273	149.995187	3	depression		1	light brown sand with some organic content, abundant fine coral rubble fragments in soil, abundant coral rubble surface fragments	0	6a	Boerhavia albiflora var. albiflora/ Portulaca oleracea herbland		25-50%			25-50%				trace-5%	5-25%			abundant sooty terns, some brown noddies		10:46:49	10:51:15	forb	mid-dense (>30-70%)
066	-16.113303	149.996350	2	flat		1	white sand with fine coral rubble surface fragments	0	6d	Boerhavia albiflora var. albiflora sparse herbland		trace-5%							trace-5%			large numbers brown noddies, some sooty terns, occasional masked boobies		10:57:39	11:05:20	forb	very sparse (<10%)	
067	-16.113056	149.996141	3	mid slope	S	2	light brown sand with some organic content, abundant fine coral rubble fragments in soil, abundant fine coral rubble surface fragments	0	5b	Stenotaphrum micranthum/Boerhavia albiflora var. albiflora grassland		5-25%		trace-5%	5-25%		5-25%		5-25%			large numbers brown noddies, large numbers sooty terns		11:05:45	11:10:59	herb	mid-dense (>30-70%)	
068	-16.112909	149.996019	3	upper slope	S	3	white coarse sand with abundant fine coral rubble surface fragments	0	5a	Stenotaphrum micranthum/Boerhavia albiflora var. albiflora open grassland		5-25%			trace-5%		5-25%		trace-5%			large numbers brown noddies, some sooty terns		11:12:25	11:17:26	grass	sparse (10-30%)	
069	-16.112582	149.997548	3	beach	N	1	white sand with occasional fine coral rubble surface fragments	0	1a	Stenotaphrum micranthum open grassland		trace-5%			trace-5%		5-25%						medium	11:24:09	11:27:49	grass	sparse (10-30%)	

Site	Lat	Long	Number of photos	Landform	Aspect	Estimated altitude	Soil Description	Total weed cover %	Veg map unit code	Community	Achyranthes aspera	Boerhavia albiflora var. albiflora	Lepidium englerianum	Lepturus repens	Portulaca oleracea	Sporobolus virginicus	Stenotaphrum micranthum	Tribulus cistoides	Litter	Plant specimens collected	Notes	Birds	Turtle activity	Start	Finish	Dominant growth form	Ground FPC	
070	-16.113288	149.998080	3	flat		2	dark brown coarse sand with high organic content, fine coral rubble fragments in soil, coral rubble surface fragments	0	16a	Portulaca oleracea/ Tribulus cistoides/ Achyranthes aspera closed herbland	5-25%	5-25%			50-75%			25-50%	5-25%					11:37:16	11:43:29	forb	dense (>70)	
071	-16.113569	149.998242	4	flat		2	light brown coarse sand with some organic content, abundant fine coral rubble fragments in soil, abundant fine coral rubble surface fragments	0	3a	Lepturus repens/ Tribulus cistoides/ Boerhavia albiflora var. albiflora closed grassland	trace-5%	5-25%		25-50%	5-25%		trace-5%	25-50%	5-25%					11:47:54	11:53:08	herb	dense (>70)	
072	-16.113494	149.997712	2	flat		2	light coloured coarse sand with fine coral rubble fragments in soil abundant fine coral rubble surface fragments	0	16b	Portulaca oleracea/ Lepturus repens closed herbland	trace-5%	trace-5%		5-25%	75-95%		trace-5%	trace-5%	trace-5%					11:57:31	12:03:48	herb	dense (>70)	
073	-16.113714	149.997513	2	swale		1	light coloured coarse sand with fine coral rubble fragments in soil abundant coral rubble surface fragments	0	5b	Stenotaphrum micranthum/ Boerhavia albiflora var. albiflora grassland		5-25%			trace-5%		25-50%		trace-5%				low	12:06:19	12:10:58	grass	mid-dense (>30-70%)	
074	-16.112522	150.004381	1	beach		1	white coarse sand with fine coral rubble fragments in soil abundant medium coral rubble surface fragments	0	1a	Boerhavia albiflora var. albiflora/ Portulaca oleracea open herbland		trace-5%	trace-5%		5-25%		trace-5%			Lepidium englerianum, Portulaca oleracea, Boerhavia albiflora var. albiflora			high	13:18:20	13:23:47	forb	sparse (10-30%)	
075	-16.112612	150.004203	2	swale		1	light brown sand with some organic content, abundant coral rubble fragments in soil, abundant coral rubble surface fragments	0	6a	Boerhavia albiflora var. albiflora/ Portulaca oleracea closed herbland		50-75%			25-50%				5-25%						13:29:16	13:33:35	forb	dense (>70)
076	-16.112441	150.003949	2	crest		2	light brown sand with occasional fine coral rubble fragments in soil fine coral rubble surface fragments	0	6e	Boerhavia albiflora var. albiflora/ Tribulus cistoides closed herbland		50-75%			trace-5%		trace-5%	25-50%	5-25%					13:36:52	13:41:51	herb	dense (>70)	
077	-16.112319	150.003871	2	crest		3	light coloured coarse sand with fine coral rubble surface fragments	0	6e	Boerhavia albiflora var. albiflora/ Portulaca oleracea/ Stenotaphrum micranthum closed herbland		25-50%		trace-5%	5-25%		5-25%	5-25%	5-25%	Stenotaphrum micranthum				13:59:35	14:04:11	herb	dense (>70)	
078	-16.112805	150.003484	3	flat		2	light brown coarse sand with occasional coral rubble surface fragments	0	3a	Lepturus repens/ Tribulus cistoides closed grassland		5-25%		50-75%	5-25%		trace-5%	5-25%	5-25%	Lepturus repens, Tribulus cistoides				14:08:16	14:13:52	grass	dense (>70)	
079	-16.113053	150.002344	2	depression		2	dark brown loamy sand with high organic content, fine coral rubble surface fragments	0	6c	Boerhavia albiflora/ var. albiflora/ Portulaca oleracea/ Lepturus repens open herbland	trace-5%	5-25%		5-25%	5-25%		trace-5%	5-25%	5-25%					14:24:04	14:29:26	grass	sparse (10-30%)	

Site	Lat	Long	Number of photos	Landform	Aspect	Estimated altitude	Soil Description	Total weed cover %	Veg map unit code	Community	Achyranthes aspera	Boerhavia albiflora var. albiflora	Lepidium englerianum	Lepturus repens	Portulaca oleracea	Sporobolus virginicus	Stenotaphrum micranthum	Tribulus cistoides	Litter	Plant specimens collected	Notes	Birds	Turtle activity	Start	Finish	Dominant growth form	Ground FPC		
080	-16.112651	150.002211	3	mid slope	SE	2	brown coarse sand with some organic content, fine coral rubble fragments in soil, fine coral rubble surface fragments	0	17	Sporobolus virginicus/ Tribulus cistoides closed grassland		5-25%				50-75%	5-25%	5-25%	Sporobolus virginicus	Only a small patch approximately 15 m diameter			14:36:57	14:41:05	grass	dense (>70)			
081	-16.113174	150.001840	2	lower slope	SE	2	grey-brown fine sand with some organic content, coral rubble fragments in soil, abundant coral rubble surface fragments	0	16a	Portulaca oleracea/ Achyranthes aspera/ Tribulus cistoides closed herbland with Boerhavia albiflora var. albiflora	5-25%	5-25%			5-25%		5-25%	5-25%	Achyranthes aspera		large numbers brown noddies, large numbers sooty terns			14:47:36	14:53:01	herb	dense (>70)		
082	-16.113340	150.001076	2	flat		2	brown loamy sand with high organic content, abundant medium coral rubble surface fragments	0	4a	Lepturus repens/ Stenotaphrum micranthum/ Boerhavia albiflora var. albiflora/ open grassland	5-25%	5-25%		5-25%	trace-5%		5-25%	5-25%				abundant sooty terns			14:58:03	15:04:11	grass	sparse (10-30%)	
083	-16.112558	150.000541	3	flat		3	white coarse sand with occasional fine coral rubble surface fragments	0	17	Sporobolus virginicus closed grassland		5-25%				75-95%	trace-5%	trace-5%	trace-5%						15:12:55	15:17:29	grass	dense (>70)	
084	-16.112347	150.000703	3	dune		2	white sand with occasional medium coral rubble surface fragments	0	5a	Stenotaphrum micranthum/ Portulaca oleracea/ Boerhavia albiflora var. albiflora open grassland		5-25%			5-25%		5-25%		trace-5%			some brown noddies, some sooty terns	medium	15:20:04	15:24:59	herb	sparse (10-30%)		
085	-16.112176	150.000700	2	beach		1	white coarse sand with medium coral rubble surface fragments		1a	Boerhavia albiflora var. albiflora sparse herbland		5-25%												15:26:04	15:29:27	forb	very sparse (<10%)		
086	-16.112372	150.000092	2	dune		3	white coarse sand with occasional coral rubble surface fragments	0	6b	Boerhavia albiflora var. albiflora/ Lepturus repens/ Stenotaphrum micranthum herbland		25-50%		5-25%	5-25%		5-25%		5-25%			High point	abundant sooty terns, abundant brown noddies	high	15:33:49	15:39:23	grass	mid-dense (>30-70%)	
087	-16.112605	149.999785	0	flat			white coarse sand with occasional fine coral rubble surface fragments	0	17	Sporobolus virginicus closed grassland		5-25%				75-95%	trace-5%	trace-5%	trace-5%		Equals previous marine couch site			15:43:19	0:00:00	grass	dense (>70)		
088	-16.112741	149.999918	2	mid slope	S	3	light coloured coarse sand with occasional coral rubble surface fragments	0	4	Lepturus repens/ Boerhavia albiflora var. albiflora/ Stenotaphrum micranthum grassland		25-50%		25-50%	trace-5%		5-25%	trace-5%	5-25%				abundant sooty terns			15:46:56	15:52:30	grass	mid-dense (>30-70%)
089	-16.113328	150.000272	2	depression		2	dark brown loamy sand with high organic content, abundant coral rubble surface fragments	0	6c	Boerhavia albiflora var. albiflora/ Portulaca oleracea/ Achyranthes aspera herbland	5-25%	5-25%		trace-5%	5-25%		trace-5%	trace-5%	5-25%				abundant sooty terns			15:57:07	16:01:58	herb	mid-dense (>30-70%)
090	-16.114200	150.000822	2	dune	N	1	white coarse sand with fine coral rubble fragments in soil abundant medium coral rubble surface fragments		6b	Boerhavia albiflora var. albiflora/ Portulaca oleracea/ Stenotaphrum micranthum herbland		5-25%			5-25%		5-25%	5-25%	trace-5%			large numbers brown noddies, large numbers sooty terns	medium	16:08:13	16:14:15	herb	mid-dense (>30-70%)		
M20	-16.112525	150.003292	10					0	6e	Boerhavia albiflora var. albiflora/ Stenotaphrum micranthum/ Portulaca oleracea closed herbland		25-50%		5-25%	5-25%		5-25%	5-25%	trace-5%			large numbers of brown noddies, large numbers sooty terns			7:35:00	8:30:00	herb	dense (>70)	