JAMES COOK UNIVERSITY AUSTRALIA

Project Report

Looking for Dolphins and Dugong in Cleveland Bay, Townsville

November 2015

Isabel Beasley

30 December 2015

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Acknowledgements

*This project acknowledges the Traditional Owners of the Townsville Region and Cleveland Bay, the **Bindal and Wulgurukaba People**, whose Sea Country these surveys were conducted within.*

*Thanks also to **Lyndon Brooks, Helene Marsh** and **Guido Parra** who assisted with the survey design, and comments on this survey report.*

*Thanks also to the **Port of Townsville Ltd**, which allowed these surveys to be conducted within Townsville Port limits.*

*Many thanks **to WWF-Australia and Tassal** for funding the vessel used to conduct surveys in Cleveland bay, and other regions of northern Australia.*

Figure i. Snubfin dolphin group sighted within the Port of Townsville

Acknowledgements

Special thanks to the great volunteers who assisted with field surveys: ***Mat Golding, Shane Dickeson, Giorgia Farne, Mona Saiki, Rie Hagihara and Kea Lewry****.*

Figure ii. Shane Dickeson and Giorgia Farne

Figure iii. Kea Lewry, Mona Saiki and Rie Hagihara

Executive Summary

This report documents the first comprehensive inshore dolphin surveys to be conducted within Cleveland Bay since the earlier surveys of Parra et al. (2006). This study was conducted as part of the WWF/Tassal funded project – **Looking for Dolphin and Dugongs in Northern Australia**.

Survey Effort

- Boat-based surveys were undertaken throughout Cleveland Bay, surveying A and B transect lines (Figure 6).
    - A transect lines were surveyed from 17-26 November
    - B transect lines were surveyed from 25-29 November

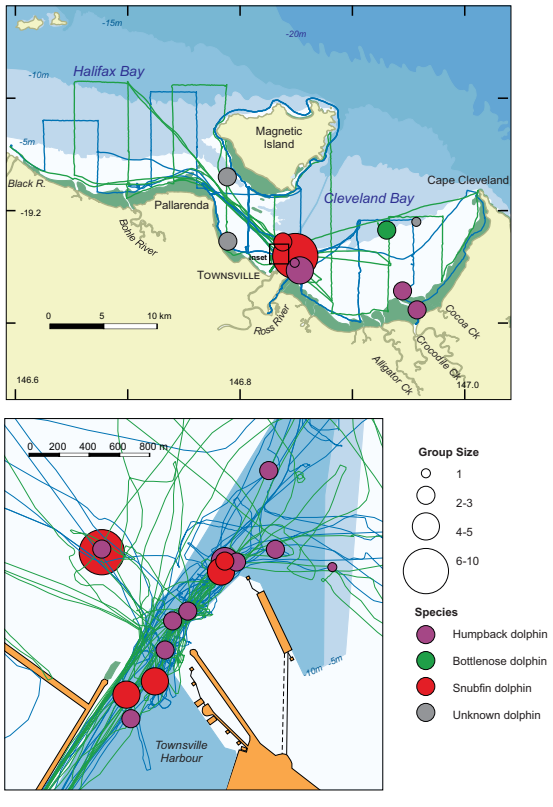
- Over 13 survey days, a total of 888km were travelled over 78hrs, consisting of:
    - 382km over 35hrs for A transect lines
    - 404km over 34hrs for B transect lines
    - 102km over 9hrs conduct off-effort searches resulting from poor weather conditions

- Of this time on the water, a total of **308km (35hrs)** were spent 'on transect' searching for dolphins, dugongs and other marine megafauna, consisting of:
    - 166km over 18hrs for A transect lines.
    - 147km over 17hrs for B transect lines.

Dolphin Sightings

A total of 25 dolphin groups (73 individuals) were sighted during surveys, consisting of:

- 14 humpback dolphin groups (total group size = 35 individuals)
- 7 snubfin dolphin groups (total group size = 33 individuals)
- 1 bottlenose dolphin group (total group size = 3 individuals)
- 3 groups of unknown species (total group size = 6 individuals)



Dolphin sightings in Cleveland Bay

Photo-identification

A total of 4563 images were taken during November 2015 surveys. Twenty-seven individual dolphins were photo-identified, consisting of:

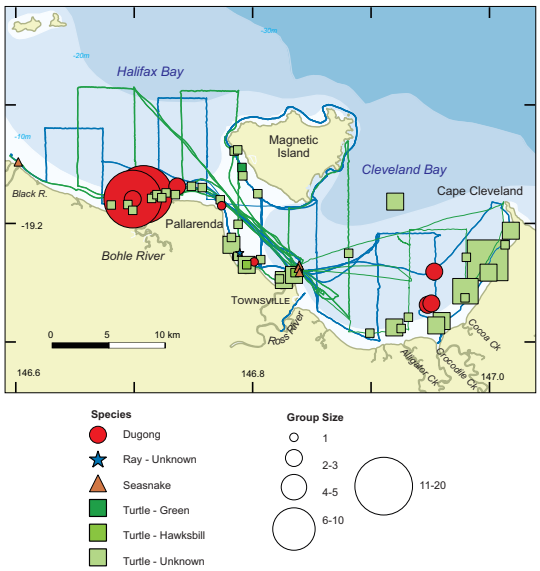
- 15 snubfin dolphins
- 11 humpback dolphins
- 1 bottlenose dolphin

Snubfin dolphin (top), humpback dolphin (middle) and bottlenose dolphin (bottom)

Marine Megafauna

A total of 59 groups of megafauna (116 individuals) were sighted during surveys, consisting of;

- 42 dugongs
- 1 ray
- 4 seasnakes
- 2 green turtles
- 1 hawksbill turtle
- 65 turtles – unknown species



Discussion

- The results of the November 2015 pilot study confirm that the Port of Townville entrance is a particularly important foraging habitat for snubfin and humpback dolphins, at least during November.
- The reliable presence of snubfin dolphins using the Port Entrance makes this site regionally important, as no snubfin dolphin sightings have been recorded north of Townsville during recent JCU surveys.
- Future survey considerations are presented in the final discussion, where a comprehensive boat-based survey program will be conducted in May-August 2016.

Considerations for Future Projects

- **Detailed boat-based surveys should be conducted at regular intervals throughout 2016/2017** to establish seasonal and temporal variations in inshore dolphin abundance and habitat use.
- **Helicopter/drone surveys of Cleveland Bay, Halifax Bay and Bowling Green Bay** to determine what proprtion of inshore dolphins use each of these Bays, and whether the number of dolphins sighted in Cleveland Bay is representative of other bays in the region.
- **Biopsy would be feasible to include with future surveys** given the approachability of dolphin groups. However, the aims and objectives of any biopsy study would need to be carefully considered.
- Consideration should be given to a developing a **dedicated land-based study overlooking the Port of Townsville waters,** to determine fine-scale habitat use of the area, and investigate why this area is such a 'hotspot' for snubfin and humpback dolphins.

Background

The Australian snubfin dolphin (*Orcaella heinsohni*), Australian humpback dolphin (*Sousa sahulensis*), and Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) are tropical inshore dolphins of northern Australia. The Australian snubfin dolphin (hereafter snubfin dolphin) and Australian humpback dolphin (hereafter humpback dolphin) are newly described species (2005 and 2014 respectively), thought to be endemic to northern Australia and Papua New Guinea (Beasley et al. 2005, Jefferson and Rosenbaum 2014, Beasley et al. 2015). These little-known dolphin species occur in small, localised populations in often remote regions of northern Australia, from the Fitzroy River on the east coast of Australia across to the Dampier Peninsula on the west coast (Parra *et al.* 2002, Parra *et al.* 2004, Hanf *et al. In press,* Parra and Cagnazzi *In press*). All three inshore dolphin species are listed as migratory and Matters of National Environmental Significance in Australian legislation. Snubfin and humpback dolphins were recently uplisted as Vulnerable under the Queensland Nature Conservation Act and assessed as 'Vulnerable' under the IUCN Red List (Parra and Cagnazzi *In press*).

Boat–based surveys and photo-identification data collected in the coastal waters of Cleveland Bay Dugong Protected Area (hereafter referred to as Cleveland Bay) from January 1999 to October 2002 provided the first comprehensive estimates of abundance of Australian snubfin and Australian humpback dolphins (Parra et al. 2006). Since then, no survey effort has been carried out to monitor inshore dolphin populations to assess population trends in the region.

This report documents a comprehensive study conducted within Cleveland Bay during November 2015, in order to develop a robust survey design to implement during future surveys in the Townsville region. This pilot study is part of the WWF/Tassal funded project – **Looking for Dolphin and Dugongs in Northern Australia**.

Study Area

Cleveland Bay lies adjacent to Townsville City and is located within the Great Barrier Reef World Heritage Area.

A comprehensive report on the status of Cleveland Bay can be found in Anderson and Roche (2002), where the following is related to the bathymetry of the Bay:

> *"Cleveland Bay is shallow, reaching a maximum depth of 15m at its seaward edge. The coastal plain around the south and east sides of the bay passes into a 1-2 km wide mangrove-fringed intertidal sandflat, seawards of which lies a wide subtidal sand platform on which the 2m isobath is located up to 2.5km offshore. A shallow bottom gradient of less than 1m/km continues across the embayment plain out to a depth of c.10 m. The 10m isobath corresponds to the seaward lip of the main bay sedimentfill, the foreslope ofwhich passes offshore at a steeper angle (c.2 m/km) to merge with the general surface of the open-shelf near the 20m isobath.*

Exceptions to this simple bathymetry occur adjacent to Cape Cleveland and at three locations on the western edge of the bay. For a distance of about 2km southwest of Cape Cleveland, the seaward edge of the bay sediment-fill lies at depths between 12 and 13m, lapping down onto a distinct terrace seawards of the shallow bar which runs southwestwards from Cape Cleveland. The seaward edge of the Cleveland Terrace has a relatively short and steep slope (10-12 m/km) down to the shelf surface. In the west, Cleveland Bay connects through the shallow West Channel, which separates Magnetic Island from the mainland and has a maximum depthof 4m. The access channel to the port of Townsville (Platypus Channel), dredged to a depth of 12-13 m, passes along the northwestern side of the bay, about 2km off Magnetic Island. Further north, at the northeastern corner of the island, a natural tidalyl-scoured channel (named Orchard Channel by Carteret al., 1993) exists at depths of 15-20m between the eastern edge of the fringing sediment prism of Magnetic Island and the western edge of the main Cleveland Bay sediment fill. The seaward parts of indivdual bay sediment wedges off Magnetic Island are similar to Cleveland Terrace, i.e. they comprise constructional platforms at 11-14 m depth, overlapped on their landward side by the more steeply sloping prism of shoreface sand that surrounds the island".

Figure 1. Cleveland Bay adjacent to Townsville City

November 2015 Surveys

As part of the WWF/Tassal funded project – **Looking for Dolphin and Dugongs in Northern Australia**, boat-based surveys were conducted within Cleveland Bay from 17-29 November 2015.

Project Participants

James Cook University
Isabel Beasley
Mat Golding
Shane Dickeson
Giorgia Farne

James Cook University
Mona Saiki
Rie Hagihara

Volunteer
Kea Lewry

Vessel Used

The JCU vessel 'Snubby' a 5.8m Formosa was used for these surveys (Figure 2). This vessel has been sponsored by WWF-Australia and Tassal to be used for inshore dolphin surveys in northern Australian waters, particularly along the north Queensland coast.

Figure 2. The JCU vessel Snubby

Transect Lines

The total study area of Cleveland Bay was estimated as 290km^2.

Boat-based surveys planned to cover pre-determined survey lines in Cleveland Bay during November 2015 surveys (Figure 3). These transect lines consisted of A lines (Figure 4) and B lines (Figure 5), covering 155km and 145km of transect respectively. With a 250m visual buffer assumed on each side of the line (i.e. 500m in total), these lines cover 27% and 25% of the study area respectively, for a total coverage of approximately 52% of Cleveland Bay.

The red shaded polygon shown in Figures 3-5 illustrates the survey area for previous surveys conducted by Parra et al. (2006).

Figure 3. Cleveland Bay A and B survey lines

Figure 4. Cleveland Bay A survey lines

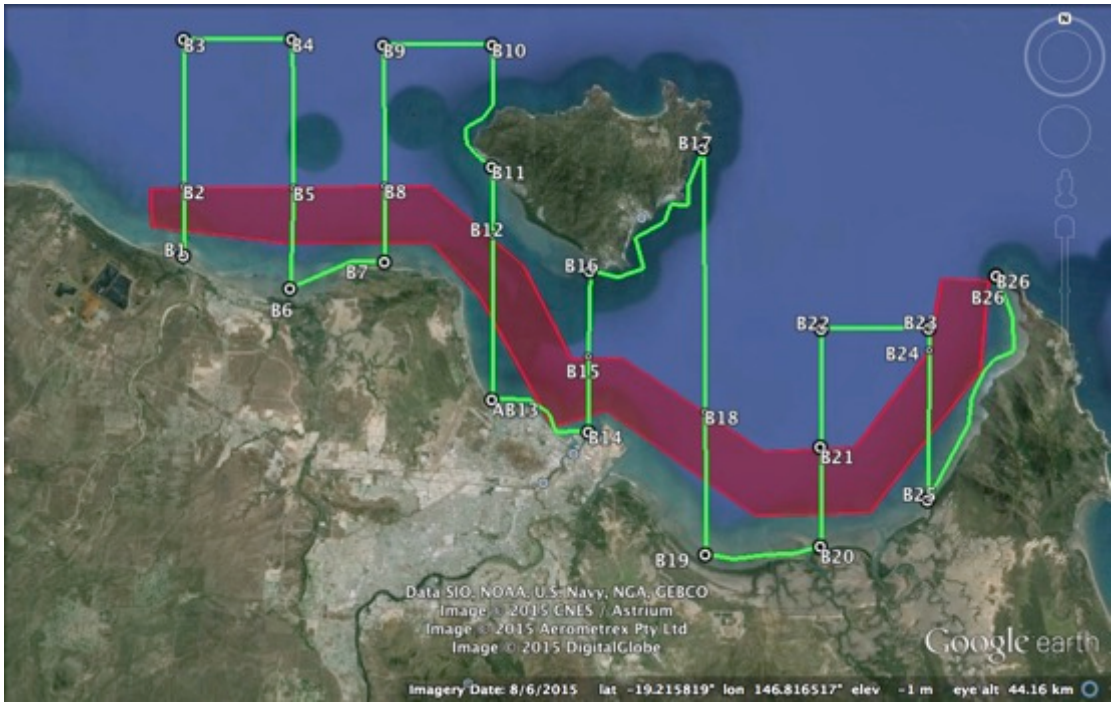


Figure 5. Cleveland Bay B survey lines

Survey Effort

- Boat-based surveys were undertaken throughout Cleveland Bay, surveying A and B transect lines (Figure 6).
    - A transect lines were surveyed from 17-26 November
    - B transect lines were surveyed from 25-29 November

- Over 13 survey days, a total of 888km were travelled on the water over 78hrs, consisting of:
    - 382km over 35hrs for A transect lines
    - 404km over 34hrs for B transect lines
    - 102km over 9hrs conduct off-effort searches resulting from poor weather conditions

- Of this time on the water, a total of **308km (35hrs)** were spent 'on transect' searching for dolphins, dugongs and other marine megafauna, consisting of:
    - 166km over 18hrs for A transect lines
    - 147km over 17hrs for B transect lines

- A total of **102km (9hrs)** were spent searching 'off effort' as a result of poor weather conditions

- Both A and B transects were successfully completed by 29 November 2015 (Table 1)

Table 1. Effort summary information from Cleveland Bay surveys conducted in November 2015

Sample	Number of Days	Total KM Travelled	Total Time	Total KM Transect	Transect Time	Number Group Sightings
A	7	382.2	35:3	166.4	10:49	11
B	5	404.1	34:1	141.3	12:25	10
Off Effort	3	101.6	9:0	0.0	3:25	4
TOTAL	**15**	**887.9**	**78:4**	**307.6**	**26:39**	**25**

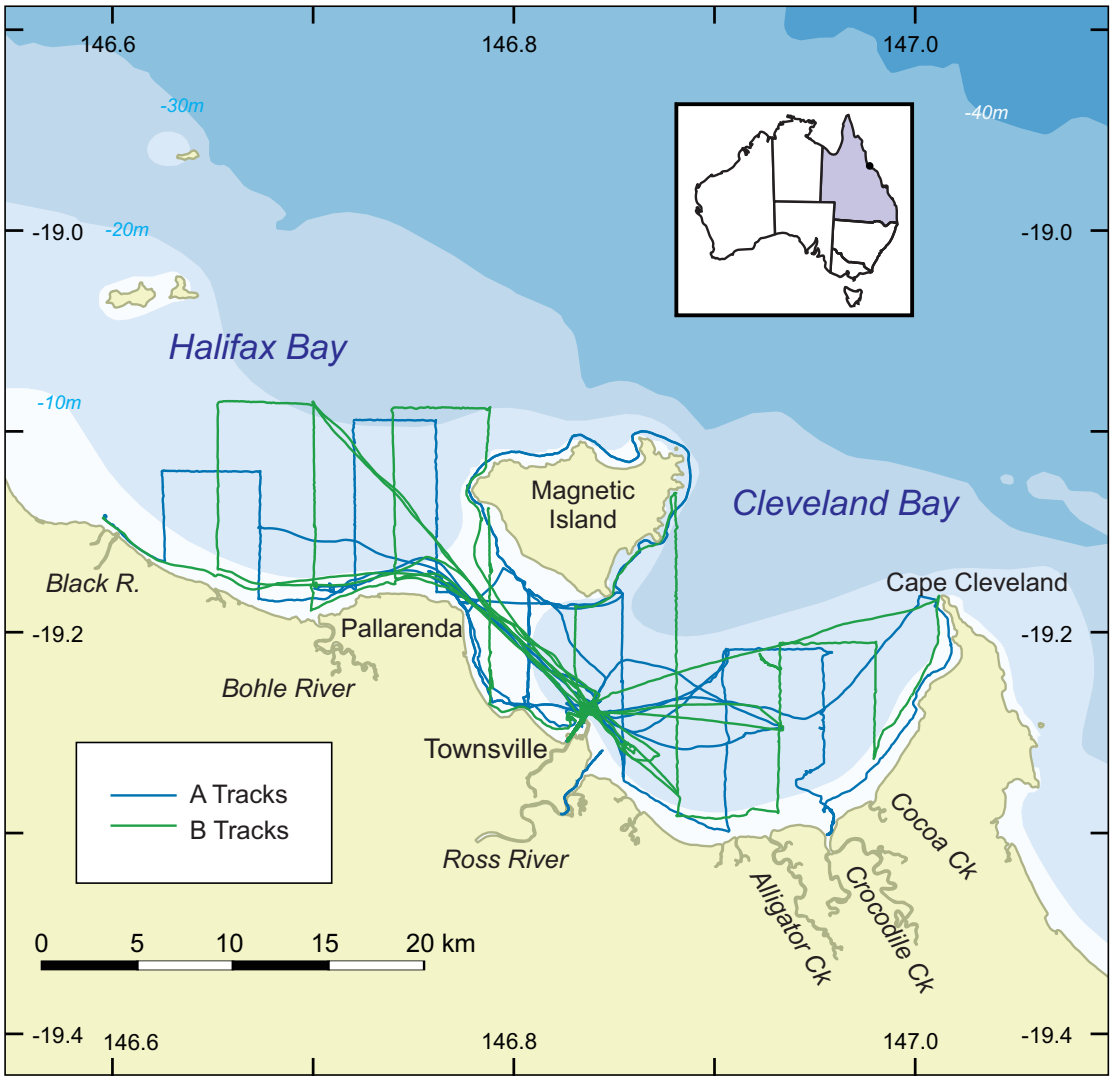


Figure 6. A and B transect lines conducted in Cleveland Bay

Beaufort Conditions

Sea conditions were 'average' during most mornings, generally degrading to un-surveyable by midday. The majority of survey time searching was spent in low Beaufort 3 (236km) and

Beaufort 2 (72km) conditions (Table 2; Figure 7). No surveys were conducted in high Beaufort 3 conditions (i.e. >9knots), or Beaufort 4 (i.e. >11knots).

Table 2. The number of kilometres surveyed in each Beaufort state

Beaufort	Kilometres surveyed
0	0.0
1	0.0
2	72.2
3	235.5
4	0.0
Total	**307.7**

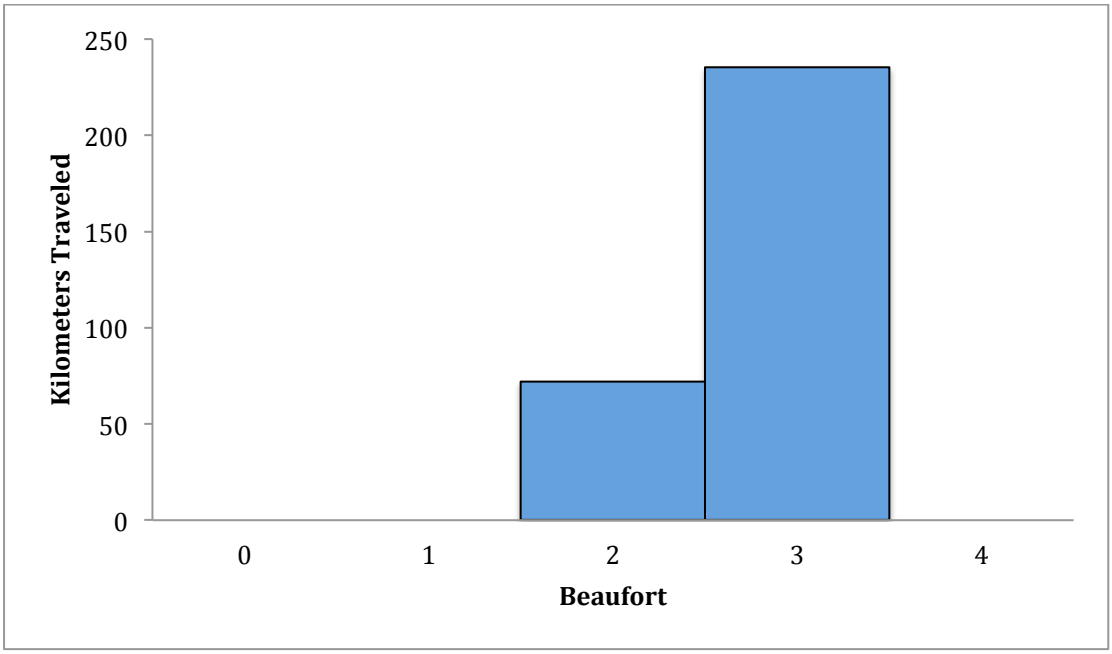


Figure 7. Bar chart showing total kilometres surveyed during transect surveys in each Beaufort state during November 2015 surveys of Cleveland Bay

Dolphin Sightings

A total of 25 dolphin groups (76 individuals) were sighted during surveys (Figure 8), consisting of:

- 14 humpback dolphin groups (total group size = 35 individuals)
- 7 snubfin dolphin groups (total group size = 33 individuals)
- 1 bottlenose dolphin group (total group size = 2 individuals)
- 3 groups of unknown species (total group size = 6 individuals)

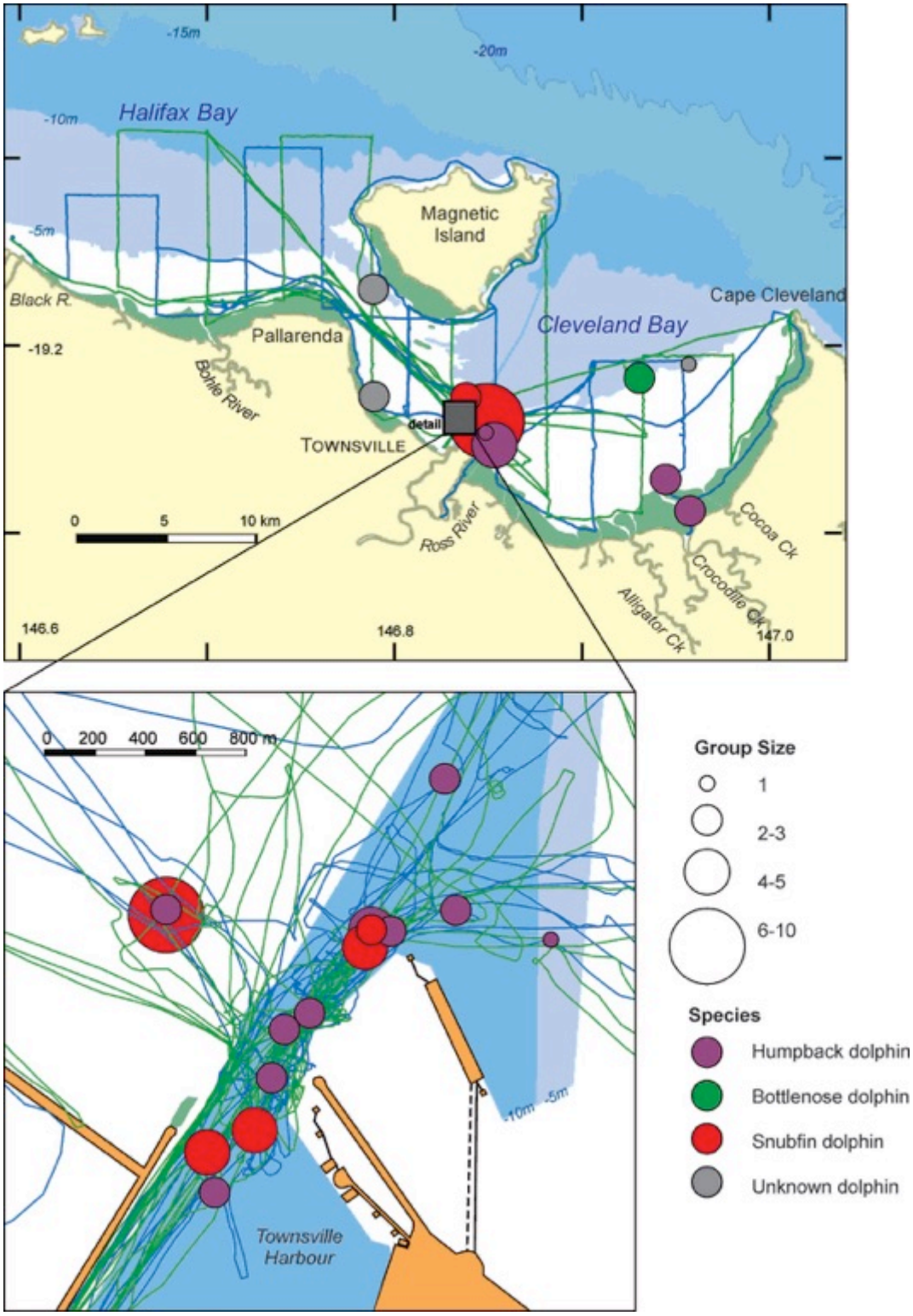


Figure 8. Dolphin sightings in Cleveland Bay during November 2015 surveys

A transects

During A transects, a total of 15 dolphin groups (45 individuals) were sighted, consisting of 4 on-effort sightings and 11 off-effort sightings (Figure 9). Species composition was:

- 9 humpback dolphin groups (22 individuals)
- 5 snubfin dolphin groups (22 individuals)
- 1 group of unknown species (1 individual)

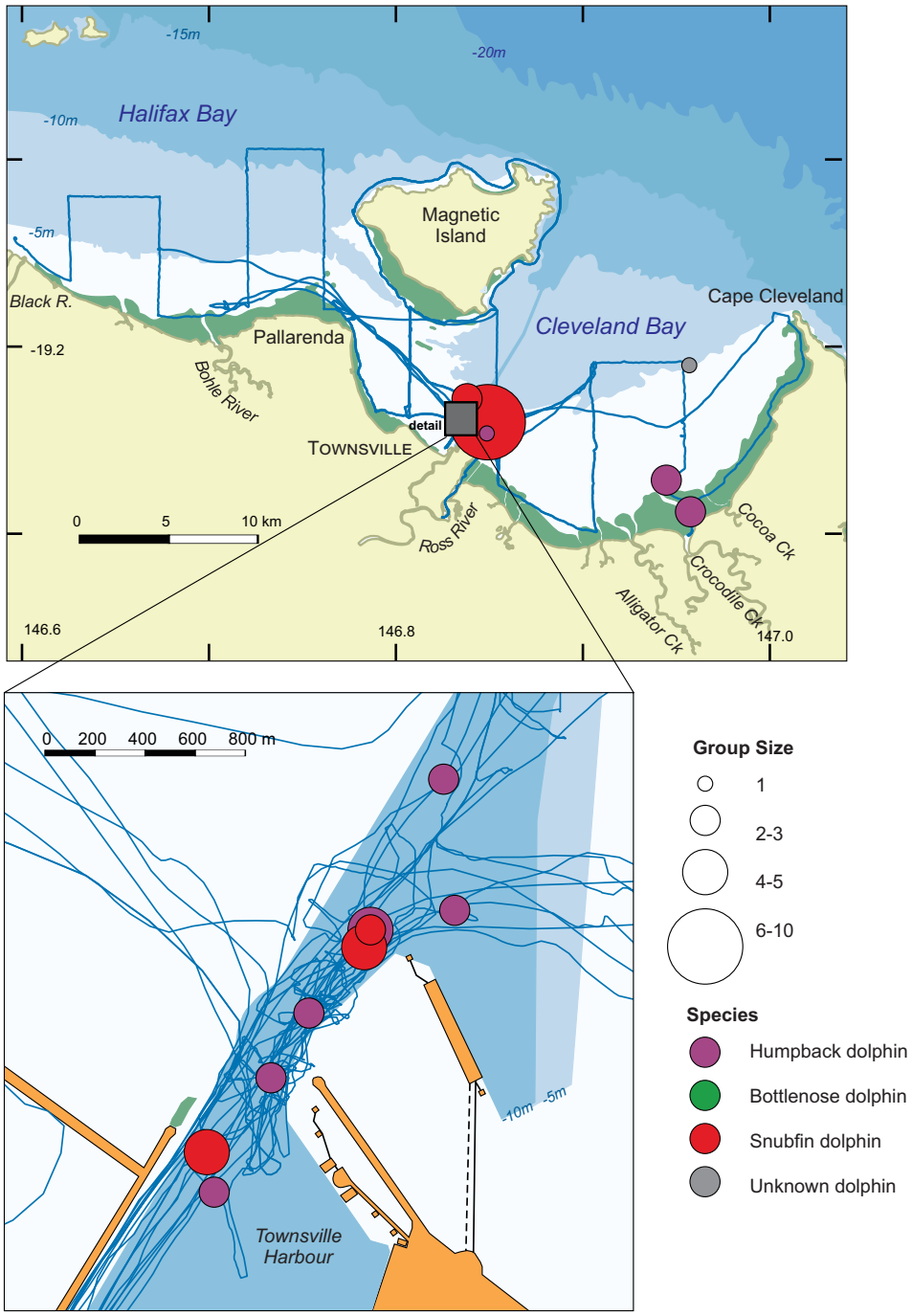


Figure 9. Dolphin sightings in Cleveland Bay when covering A transects during November 2015 surveys.

B transects

During B transects, a total of 10 dolphin groups (31 individuals) were sighted, consisting of 5 on-effort sightings and 5 off-effort sightings (Figure 10). Species composition was:

- 5 humpback dolphin groups (13 individuals)
- 2 snubfin dolphin groups (11 individuals)
- 1 bottlenose dolphin group (2 individuals)

- 2 groups of unknown species (5 individuals)

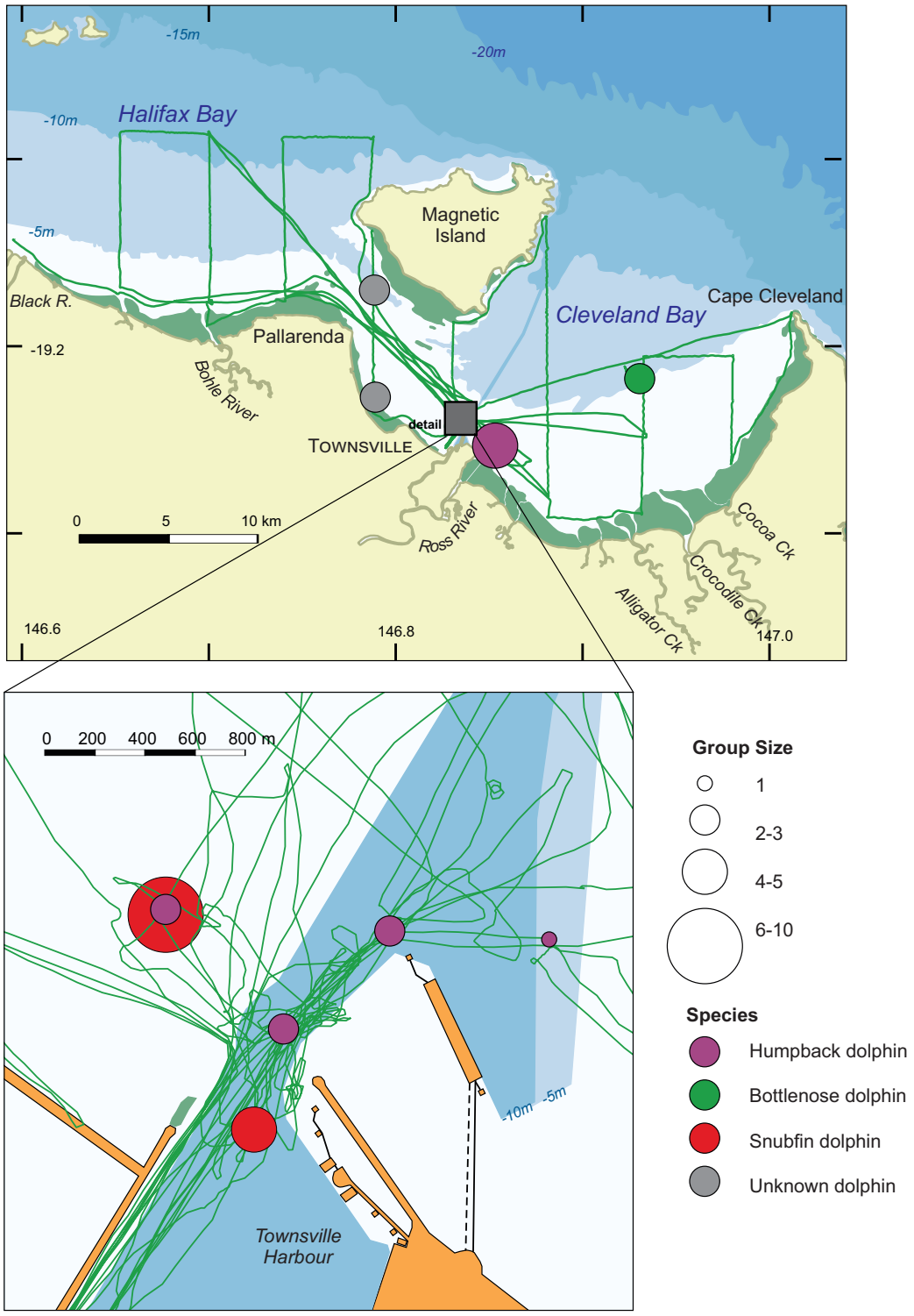


Figure 10. Dolphin sightings in Cleveland Bay when covering B transects during November 2015 surveys.

Surveys were conducted during both spring and neap tides, however the data collected were too minimal to make any comparisons according to moon state.

Surveys were also conducted throughout a variety of tide states (Figure 11), where dolphins were consistently sighted during:

- ebb tides in the southeast section of Cleveland Bay
- high tide south of Magnetic Island
- all tides around the Port of Townsville entrance

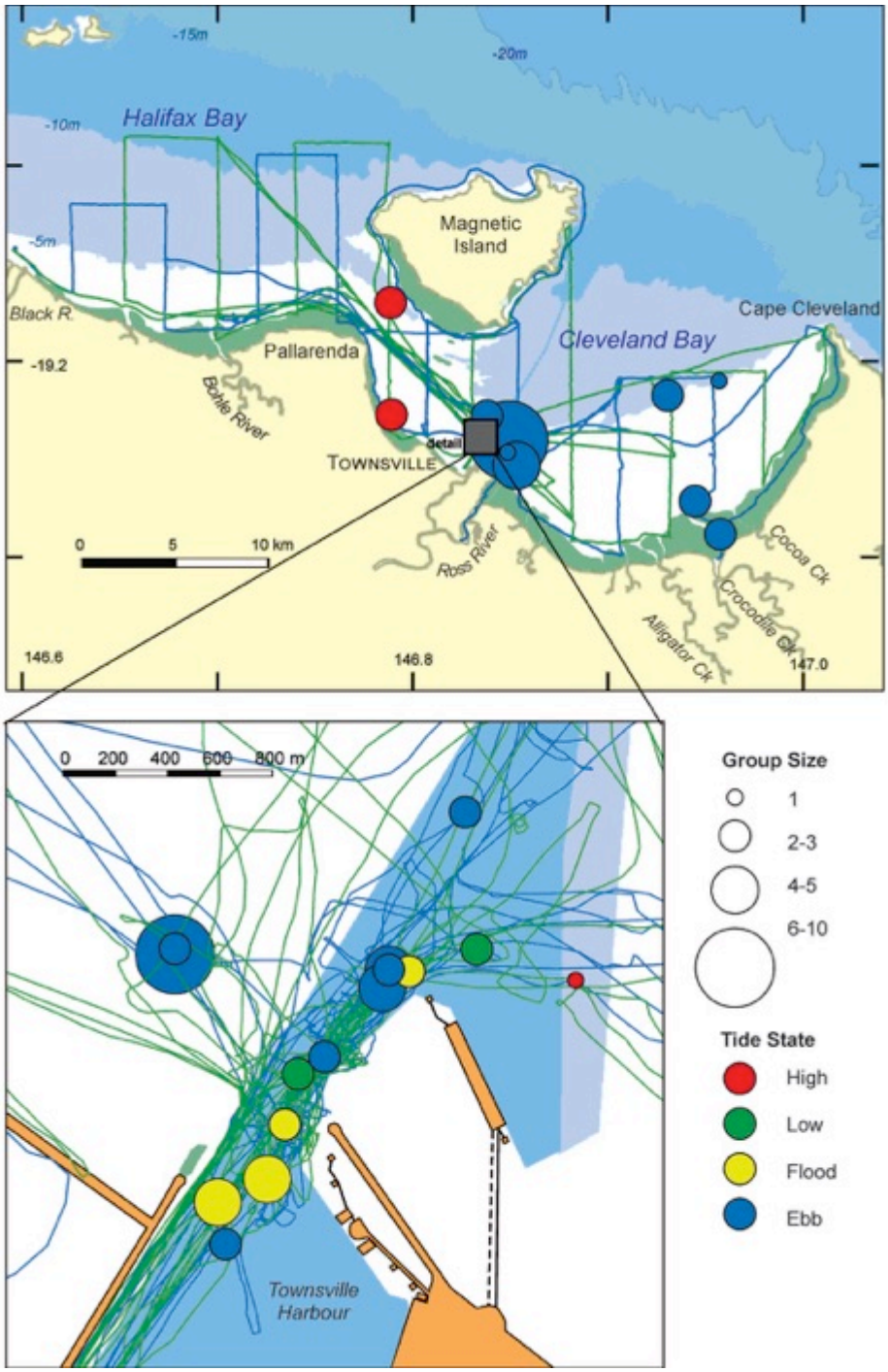


Figure 11. Dolphin sightings in Cleveland Bay according to tide state

Humpback dolphins

A total of 14 humpback dolphin groups (total group size = 35) were sighted during surveys, consisting of:

- 22 adults
- 13 juveniles

No calves or newborns were sighted.

These groups were primarily sighted within the Port of Townsville entrance and the south-eastern section of Cleveland Bay. The Port entrance appeared to be an important foraging area for humpback dolphins. The following environmental parameters collected at sighting locations (Table 4, Figures 12 and 13):

Table 4. Environmental parameters at humpback dolphin sighting locations

	Depth (m)	Temperature (°C)	Salinity (ppt)	Turbidity (NTU)	pH
Average	9.8	28.8	35.0	7.8	8.0
Standard deviation	5.67	1.0	0.4	6.2	0.3
Range	2.1 – 18.2	27.0 – 30.5	34.3 – 35.6	1.7 – 22.8	7.2 – 8.7

Figure 12. Humpback dolphin sighted with the Townsville Port

Figure 12. Humpback dolphin (SSAH10) sighted within Cleveland Bay

On 21 November 2015, a humpback dolphin was sighted in Cocoa River (Figure 9) that had a badly broken rostrum. The top rostrum was snapped upwards and the bottom rostrum snapped in half (Figure 13). It is unknown what could have caused this extensive injury, or whether it was a recent or older injury. Despite this injury, the dolphin appeared in good condition, and was assumed to be a female based on a young calf observed constantly traveling with this individual.

Figure 13. Humpback dolphin (SSAH04) sighted within Cocoa River with its top rostrum snapped up (top image) and lower rostrum snapped in half (bottom image)

Snubfin dolphins

Seven snubfin dolphin groups (total group size = 33) were sighted, consisting of:

- 25 adults
- 8 juveniles

No calves or newborns were sighted.

These groups were only sighted within the Port of Townsville entrance. The Port entrance appeared to be an important foraging area for snubfin dolphins, where the dolphins remained foraging in the area despite heavy vessel traffic.

Two unknown dolphin groups sighted south of Magnetic Island were probably snubfin dolphins, but the species could not be definitely confirmed. The following environmental parameters collected at sighting locations (Table 6, Figures 14 and 15).

Table 6. Environmental parameters at humpback dolphin sighting locations

	Depth (m)	Temperature (°C)	Salinity (ppt)	Turbidity (NTU)	pH
Average	11.7	28.8	35.3	6.3	8.0
Standard deviation	4.4	0.6	0.4	2.7	0.2
Range	5.1 – 16.5	28.1 – 29.4	34.8 – 35.8	3.2 – 10.3	7.9 – 8.3

Figure 14. Snubfin dolphin sighted associating with a brown booby

Figure 15. Snubfin dolphin (OHEI13) sighted in the Port of Townsville channel

Bottlenose dolphins

One bottlenose dolphin group (total group size = 2) was sighted, consisting of:

- 1 adult
- 1 juvenile

No calves or newborns were sighted.

This group was sighted east of Magnetic Island, traveling along the 10m depth contour. The following environmental parameters were collected at the sighting location (Table 5, Figures 16 and 17).

Table 5. Environmental parameters at humpback dolphin sighting locations

	Depth (m)	Temperature (°C)	Salinity (ppt)	Turbidity (NTU)	pH
Average	7.9	29.0	34.1	0.0	8.2
Standard deviation	--	--	--	--	--
Range	--	--	--	--	--

Figure 16. Bottlenose dolphin (TADU01) sighted east of Magnetic Island

Figure 17. Bottlenose dolphin (TADU01) sighted east of Magnetic Island

Relative Sighting Rate

The relative sighting rate for each species during November 2015 Cleveland Bay surveys are shown in Table 3.

Table 3. Group and individual sighting rate for each dolphin species for Cleveland Bay surveys

Species	Groups/km surveyed	Individuals/km surveyed
A transects		
Humpback	0.020	0.060
Snubfin	0.020	0.060
Bottlenose	--	--
B transects		
Humpback	0.010	0.030
Snubfin	0.005	0.030
Bottlenose	0.002	0.005

Photo-identificiation

A total of 4563 images were taken during November 2015 surveys. Twenty-seven individuals were photo-identified:

- 15 snubfin dolphins (Figures 18 and 19)
- 11 humpback dolphins (Figures 20 and 21)
- 1 bottlenose dolphins (Figures 22 and 23)

It is currently not possible to compare dolphin images from this project to previous surveys conducted by Parra et al. (2006) as a result of catalogue incompatibility issues, however comparisons are planned for 2016.

Snubfin Dolphins

The large number of snubfin dolphins sighted and photo-identified during these pilot surveys was a great success, particularly when no subfins have previously been sighted during other surveys along the north Queensland coast. All snubfin dolphin groups were observed within the Port of Townsville or within the dredged channel leading out to Magnetic Island. Of the 15 snubfin dolphins photo-identified:

- 15 were sighted during A transects
- 5 were sighted during B transects

Of the dolphins identified:

- 6 individuals were sighted twice
- 9 individuals were sighted once

Figure 18. OHEI15 – 251115 – Port of Townsville

Figure 19. OHEI15 – 261115 – Port of Townsville

Humpback dolphins

Humpback dolphins were sighted more widely distributed throughout Cleveland Bay than snubfin dolphins. Of the 11 humpback dolphins photo-identified:

- 7 were sighted during A transects
- 5 were sighted during B transects

Of the dolphins identified:

- 4 individuals were sighted twice
- 7 individuals were sighted once

Figure 20. SSAH02– 191115 – Port of Townsville

Figure 21. SSAH02– 211115 – Cleveland Bay

Bottlenose dolphins

Only one bottlenose dolphin was photo-identified during surveys (Figures 22 and 23). The other bottlenose dolphin sighted was a juvenile with an un-identifiable dorsal fin. The bottlenose dolphin group was sighted during B transects.

Figure 22. TADU01 – 271115 – Cleveland Bay

Figure 23. TADU (unknown) – 271115 – Cleveland Bay

Capture Histories

The capture histories for all three species are shown in Table 6.

Table 6. Capture histories for inshore dolphins in Cleveland Bay

ID Snubfin	A	B		ID Humpback	A	B		ID Bottlenose	A	B
OHEI01	o			SSAH01	o			TADU01		o
OHEI02	o	o		SSAH02	o					
OHEI03	o			SSAH03	o					
OHEI04	o			SSAH04	o					
OHEI05	o			SSAH05	o					
OHEI06	o			SSAH06	o	o				
OHEI07	o			SSAH07	o	o				
OHEI08	o			SSAH08		o				
OHEI09	o			SSAH09		o				
OHEI10	o			SSAH10		o				
OHEI11	o	o		SSAH11		o				
OHEI12	o									
OHEI13	o	o								
OHEI14	o	o								
OHEI15	o	o								

Closed capture-recapture analysis was undertaken in the program MARK (White and Burnham 1999), using the Lincoln-Peterson (LP) model (the M*t* model in MARK). The LP model is the simplest method for estimating population size, and involves a single marking and a single recapture episode. Estimates of abundance assume that the:

- population is closed,
- 2. marks are not lost or overlooked, and
- 3. all animals are equally likely to be captured, regardless of whether or not they have been previously captured.

The sample of dolphins captured during the first secondary sample (Transect A lines) were 'marked', with the 'marked' dolphins captured in the second secondary sample (Transect B lines) considered 're-captured'.

Population size in Cleveland Bay during November 2015, was to be based on the following formula (although with likelihood's maximised when run within MARK), where:

- $\widehat{N}$ the estimated population size
- n_1 = the total number of individuals caught on the first occasion
- n_2 = the total number of animals caught on the second occasion
- m_2 = the number of animals caught on both occasions

$$\widehat{N} = \frac{n_1 n_2}{m_2}$$

As Table 6 shows, there were too few captures and recaptures to successfully run a LP model within MARK, where the resulting estimates were 15 snubfin dolphins and 11 humpback dolphins, the number of individuals identified. The re-capture probability for snubfin dolphins was 0.33 and for humpback dolphins 0.28.

Based on the number of individuals identified, it can therefore be assumed that, at a minimum, there are at least 15 snubfin dolphins, 11 humpback dolphins and 2 bottlenose dolphins (i.e. based on observed group size for bottlenose dolphins) that utilised Cleveland Bay during November 2015. Although re-captures were obtained during this study, no reliable abundance estimate could be calculated, indicating that increased survey effort will be required for future surveys.

Marine Megafauna Sightings

A total of 59 groups of marine megafauna (116 individuals) were sighted during surveys (Figure 24), consisting of;

- 42 dugongs
- 1 ray
- 4 seasnakes
- 2 green turtles
- 1 hawksbill turtle
- 65 turtles – unknown species

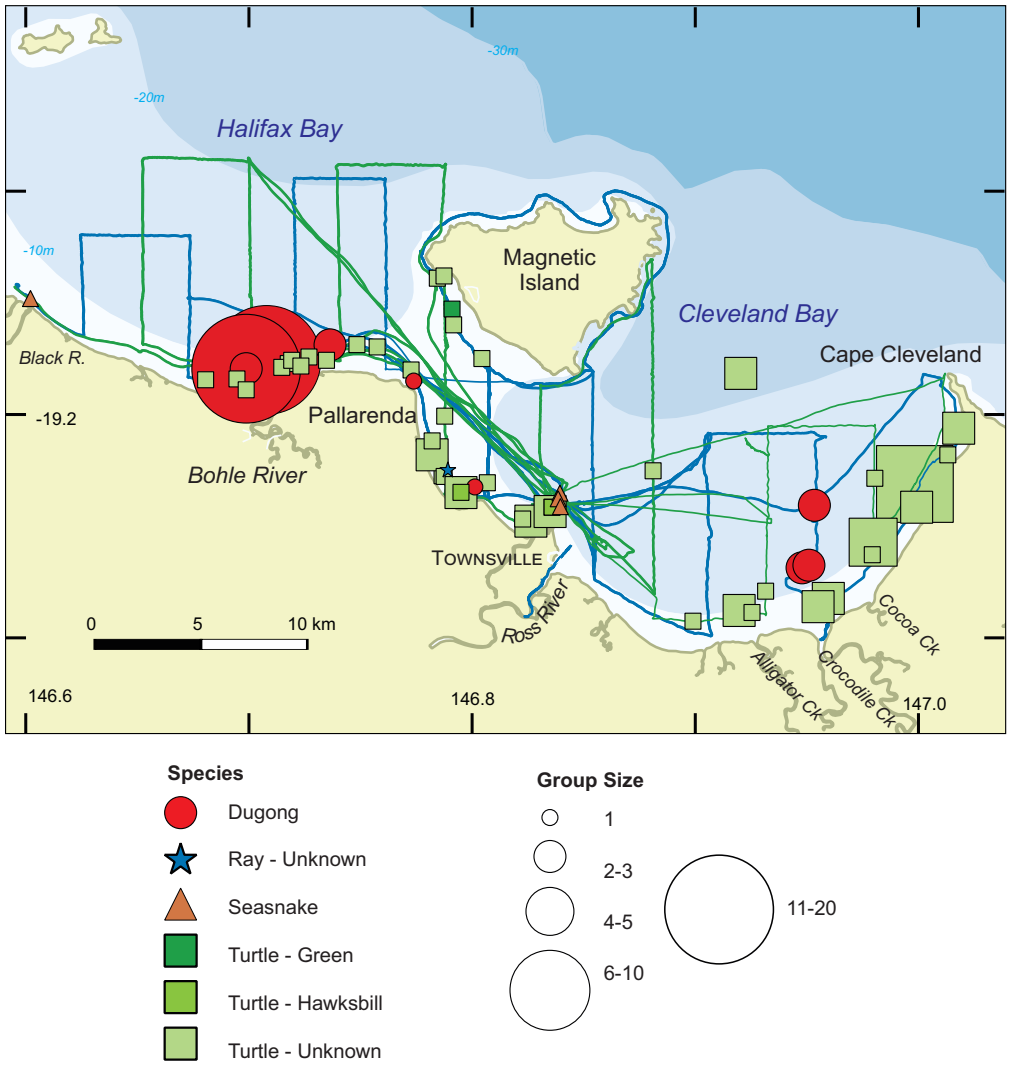


Figure 24. Marine megafauna sightings in Cleveland Bay during November 2015 surveys

Discussion

- The results of the November 2015 pilot study confirm that the Port of Townville entrance is a particularly important foraging habitat for snubfin and humpback dolphins, at least during November.
- The reliable presence of snubfin dolphins using the Port Entrance makes this site regionally important, as no snubfin dolphin sightings have been recorded north of Townsville during recent JCU surveys.

Species Diversity and Sighting Rate

- Consistent sightings of the snubfin and humpback dolphin, despite the average weather conditions, was very encouraging for the potential success of future surveys.
- Bottlenose dolphins were also sighted, which were rarely sighted during the Parra et al. (2006) studies.
- It was particularly encouraging to sight snubfin dolphins, which have not been observed in any other surveys along the north Queensland coast (i.e. Hinchinbrook region, Princess Charlotte Bay, Karumba).
- Similarly, the large number of dugongs and turtles observed were much higher than other areas surveyed along the north Queensland coast.

Photo-identification and Abundance Estimation

- The high number of photo-identifications of both snubfin and humpback dolphins was encouraging for future studies.
- It will be important to compare current photo-identification catalogues with those developed by Parra et al. (2006) to determine:
    - whether there are any matches to Parra et al. (2006) study conducted 13 years previous,
    - if matches, what proportion of dolphins are still using Cleveland Bay,
    - fine-scale habitat preferences and whether these have changed over time.
- As a result of small sample size, it was not possible to estimate abundance of inshore dolphins in Cleveland Bay based on these surveys. However, well-designed future surveys planned during months when weather conditions are more favourable (i.e. April-July) will likely result in estimates of abundance.

Considerations for Future Capture-Recapture Survey Design

- No abundance estimates could be obtained when Transect A and Transect B were each considered a secondary sample. Therefore, **future surveys may consider one set of A and B transects to be a secondary sample**.
- Alternatively, future surveys may also consider **shortening the distance each transect is spaced apart (i.e. 3-4km)**. The transect lines for these surveys were spaced 5km apart, which resulted in a total coverage of approximately 52% of Cleveland Bay. Future surveys may consider spacing transects 4km apart, which would result in a higher percentage of the Bay being searched.

- It is recommended that **intenstive survey effort is conducted around the Port of Townsville and dredged channel out to Magnetic Island**, since this appears to be the area preferred by both snubfin and humpback dolphins.
- The majority of sightings during this study were 'off-effort' around the Townsville Port. Consideration needs to be given on **how best to incorporate these 'off-effort' sightings into the future survey design**, to maximise capture probabilities.
- There were numerous opportunistic reports of snubfin and humpback dolphins being sighted around Magnetic Island and further from the coast. It is therefore recommended the **future survey lines continue to transit out 10km from the coast and around Magnetic Island**, to assist with determining habitat use and movements of inshore dolphins utilising Cleveland Bay.
- Consideration should be given to having **two vessels conducting surveys during good weather periods**, to maximise survey effort in low Beaufort conditions.
- Both snubfin and humpback dolphins were very approachable during surveys, no doubt as a result of being used to vessels around the Port of Townsville entrance.
- It is recommended that future surveys are conducted during **months when weather conditions are potentially more favourable, such as April – July** based on BOM statistics.

Considerations for Future Projects

- **Detailed boat-based surveys should be conducted at regular intervals throughout 2016/2017** to establish seasonal and temporal variations in inshore dolphin abundance and habitat use. The November 2015 pilot surveys have confirmed that the Port entrance is a regionally important foraging area for humpback and snubfin dolphins at least during November. It is therefore important to clarify if it is an important foraging area year round, or just certain periods of the year. It is also important to clarfy if there are particularly areas of Cleveland bay that are important calving areas, as this information remains unknown because of a lack of comprehensive survey effort.
- **Helicopter surveys of Cleveland Bay, Halifax Bay and Bowling Green** are the most important future project for consideration, ideally to be completed at the same time as boat-based surveys (i.e. May-June 2016). It remains unknown what proprtion of inshore dolphins use each of these Bays, and whether the number of dophins sighted in Cleveland Bay is representative of other bays in the region. This is especially important to facilitate comparisons of Parra et al (2006) estimates of abundance, since the Parra et al (2006) study was conducted throughout the year, whereas any future comparisons will only be undertaken during a few months of the year.
- **Biopsy would therefore be feasible to include with future surveys** given the approachability of dolphin groups. However, the aims and objectives of any biopsy study would need to be carefully considered. Biopsy would not be conducted during the capture-recapture surveys, only at the end of a survey day or on days dedicated to biopsy sampling.
- Consideration should be given to a developing a **dedicated land-based study overlooking the Port of Townsville waters,** to determine fine-scale habitat use of the area, and investigate why this area is such a 'hotspot' for snubfin and humpback dolphins.

General Images

Figure 24. Juvenile humpback dolphin

Figure 25. Juvenile humpback dolphin with tern

Figure 26. Snubfin dolphin

Figure 27. Dugong sighted near Black River, west of Pallarenda

Figure 28. Volunteers conducting observations

Figure 29. Volunteers conducting observations

Figure 30. Volunteers taking environmental measures

Figure 31. Seasnake

Figure 32. Booby

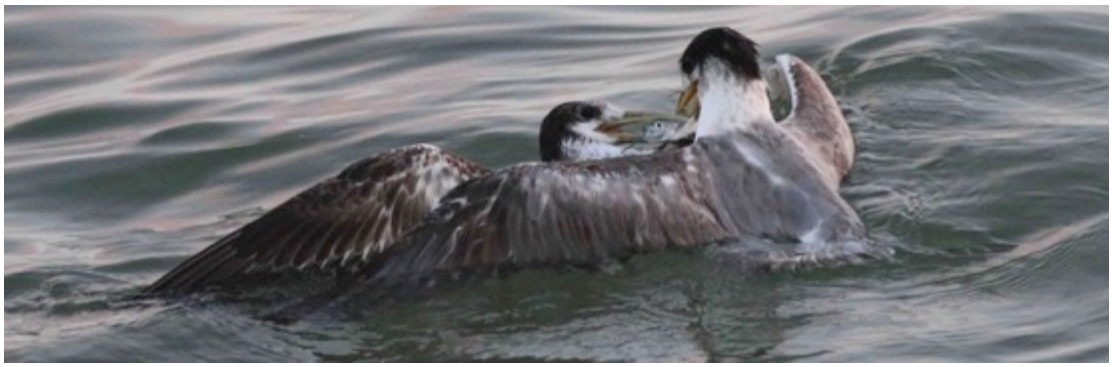


Figure 33. Terns fighting over a fish

Figure 34. Tern