Lalang-garram Joint Management Body tropical inshore jigeedany (dolphin) survey in Lalang-garram Marine Parks, 10-18 Sept 2020

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Non-technical summary

A survey of tropical inshore dolphins[1] (*jigeedany*) was recently done in Prince Regent River (PRR), Lalang-garram Marine Parks. The survey involved vessels following line transects with observers recording all sightings of dolphins. Photographs were taken of dorsal fins of all dolphins sighted to be used to identify individual animals based on the unique shape and markings of their fins. This information can be used to assess the number of dolphins that were using the PRR during the survey, and to collect life history information on individual animals.

Based off *PV Worndoom*, two tender vessels, *Goolaan* and *Pinyjiri*, covered a total of 467.5 kms of survey transect lines over four days (12-16th September 2020), equating to 37 hours dedicated searching for dolphins in the PRR area (and an additional 124.5km and 21 hours off effort transiting or with groups). The survey effort resulted in sightings of 83 dolphins from 27 groups (including resights over multiple days) of snubfin and humpback dolphins and an encounter rate of 0.15 dolphins per km of transect line or 1.9 dolphins per hour of survey effort. Snubfin dolphins (*Orcaella heinsohni*) were the predominant dolphin species sighted during the survey, with an encounter rate ranging from 0.06 to 0.22 dolphins per km of transect line across the four days. A total of 16 individual snubfin dolphins, including two juveniles and two calves, and 7 individual humpback dolphins, including two calves, were sighted over the four days (excluding resights).

While 16 individual snubfins were counted, this included three snubfins with clean dorsal fins that lacked markings for individual identification and would not be recognisable if later resighted. Of the 13 individual snubfins with marked fins that could be identified, 84% (11) have been seen in previous surveys. One individual known as OhLG02 has been observed in each survey year, and with a calf in 2016, 2019 and 2020. Most (81% of snubfin and 43% of humpback) dolphins were successfully photographed to a standard that they could be identified based on distinct markings on their dorsal fins. This makes it possible to recognise them as individuals and potentially track their life history if the marks remain stable over time.

In addition to the 83 dolphins sighted in the PRR area, 20 false killer whales (*Pseudorca crassidens*) and three humpback whales (*Megaptera novaengliae*, two adults one calf) were sighted from *PV Worndoom* north-west of Viney Island near Montgomery Reef, two bottlenose dolphins (*Tursiops aduncus*) were sighted in Brecknock Harbour (mother and calf) and five were sighted near the Traverse Islands and four humpback whales including one calf in Camden Sound. Observations of the five cetacean species recorded in the survey are important to ensuring the target of species diversity within the marine park is maintained. While spinner dolphins (*Stenella longirostris*) have not been recorded in the past three survey years, they have been observed in the marine park and it is expected that they may be more transient. Similarly, false killer whales are not recorded during every survey year.

Most dolphins were sighted in the upper section of the PRR near the mouth of Paralba Creek with no sightings within approximately 4.6 kms of King Cascades, similar to previous years. Tissue samples (blubber with skin) were successfully collected from five individual snubfin dolphins, (three full samples and two partial samples) using a biopsy dart gun.

This survey confirms that the PRR area supports approximately 20 snubfin dolphins at any one time and that this includes a potentially resident community. Eleven of the dolphins sighted this year have been observed in previous surveys (2016, 2018 & 2019) with four individuals present in all four surveys, suggesting a high degree of site faithfulness at this time of year. Given their local value and conservation status this survey highlights the importance of identifying and monitoring such a small population that use marine park, where pressures can be actively managed to benefit the conservation status and persistence of the species. This is particularly important given the increasing boat activity (recreational and commercial) in the PRR area and greater Lalang-garram Marine Parks.

If surveys of tropical inshore dolphins in the Lalang-garram marine parks are to continue in the future, we recommend that surveys are repeated every 2 years, post the 2020 survey, using the same methodology to ensure that any changes to dolphin presence and use of the area would be detected and managed. The distinct dorsal fins in PRR have remained relatively stable over the last four surveys with only some being subtly modified. However, regular survey effort will be necessary to track these evolving dorsal fins ('natural tags') which will improve our understanding of the individual life histories of dolphins in the marine park. Waiting longer than two years between surveys may lead to mis-identifying animals as their fins can change substantially and can also mean that catastrophic events or impacts on the dolphin population are not recognised, leading to delayed management intervention.

1. Introduction

A small population of tropical inshore dolphins[1] (*jigeedany*), including Australian snubfin (*Orcaella heinsohni*) and Australian humpback dolphins (*Sousa sahulensis*), are known to inhabit Prince Regent River (PRR) in the Lalang-garram Marine Parks (LGMP). Snubfins are endemic to tropical waters of northern Australia and southern Papua New Guinea. Generally, little is known about them across most of their range with the exception of several important areas (e.g. Roebuck Bay). Snubfins are known to occur in small populations that may have limited range patterns. Humpback dolphins have a somewhat larger distribution than snubfin dolphins and can be found from the Pilbara in WA through the Northern Territory and Queensland in Australia. They also occur in small populations with a presumed larger distribution than snubfin. Both species are vulnerable to coastal impacts including disturbance, habitat degradation and fragmentation, climate change and potentially entanglement in fishing nets.

Growing numbers of recreational and large commercial vessels visiting PRR are likely to increase pressure on dolphin populations inhabiting these protected waters. While Roebuck Bay is recognised as a stronghold for snubfin in the Kimberley, with the largest local population, small local populations are still important to the species' conservation. Vessel traffic may pose a more significant pressure in PRR compared to Roebuck Bay given the nature of the environment, with narrow water ways where dolphins may not be able to move away from vessels if disturbed. Given the conservation status of the dolphin species present in the region, there is a need to better understand the populations and the potentially increasing pressures upon them. Dr Raudino in the Marine Science Program has led a research project to better understand these populations and their place in the context of the broader Kimberley. The aim of the overall project is to provide the joint park managers with the capacity to confirm and quantify the

[1] Australian snubfin (*Orcaella heinsohni*), Australian humpback (*Sousa sahulensis*) and Indo-Pacific bottlenose (*Tursiops aduncus*) dolphins.

site-fidelity and long-term dynamics of the dolphins that inhabit the PRR in the LGMP, providing the basis to detect any response to increasing human pressures with future monitoring effort. While the main emphasis is on the snubfin dolphin population, given its propensity for small local populations, monitoring would also include the humpback dolphins and other marine mammals in the park.

An initial research expedition was conducted in 2016 by the Department of Biodiversity, Conservation and Attractions (DBCA) – Dambimangari Joint Management team and an external scientist. They surveyed tropical inshore dolphins[1] (*jigeedany*) in LGMP, with a focus on the PRR and adjacent waters. This was followed by a second and third expedition in 2018 and 2019 with scientists from the Marine Science Program (Dr Holly Raudino and Ellen D'Cruz). These initial surveys have been used to refine research design and survey methodology, train staff and establish baseline information on dolphin presence and identification in the study area to underpin any future long-term monitoring program for these species.

Between 11 and 18 Sept 2020, a fourth research expedition on *PV Worndoom* was undertaken involving DBCA (regional staff and scientists), Dambimangari Rangers and traditional owners. This report describes the field trip activities, data collection and results of the survey and makes recommendations for adopting these surveys into a long-term monitoring program to inform management of dolphin populations in LGMP.

The objectives of this research expedition were:
1. To collect data on the distribution and relative abundance of tropical inshore dolphins/*jigeedany* within the study area using photo-identification.
2. To opportunistically collect biopsy samples from tropical inshore dolphins/*jigeedany* for assessments of genetic connectivity between populations across the Kimberley.
3. To finalise the recommendations and other requirements (e.g. animal ethics permits) for any future monitoring of tropical inshore dolphins/*jigeedany* in the PRR area as a part of prioritised marine monitoring in Kimberley marine reserves conducted by DBCA and joint management partners. .

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2. Research activities

10 Sep: Arrive at Koolan Island and transit to Wotjalum.
11 Sep: Depart Wotjalum and transit to St George Basin.
12 Sep: Prince Regent River dedicated dolphin survey.
13 Sep: Prince Regent River dedicated dolphin survey.

14 Sep: Prince Regent River dedicated dolphin survey.
15 Sep: Prince Regent River dedicated dolphin survey.
16 Sep: Prince Regent River dedicated dolphin survey (morning only). Depart Prince Regent River and transit to Munster Waters.
17 Sep: Depart Munster Waters and transit to Wotjalum.
18 Sep: Wotjalum and transit to Koolan and depart.

More detail on the dolphin surveys is included below under Methods.

Methods

Survey Design

A key objective of this project has been to develop a survey design and protocol that is reproducible and can be implemented by the joint management team to produce an indicator of the condition of the dolphin population (i.e. numbers are consistent and the same individuals are sighted) within the survey area.

The survey design consists of two transects that adequately cover the study area and would likely capture all dolphins in the area on a given day. The study area and transects were selected based on several important factors:

1) the survey area is reportedly regularly used by reasonable numbers of both snubfin and humpback dolphins;
2) it is the focal point of the majority of commercial (cruises, tours and fishing) and recreational boating within the broader area;
3) its sheltered waters increase the likelihood that planned survey activities can be completed in suitable calm sea conditions;
4) the length of transect route can be completed within a single good weather day given moderate numbers of dolphin sightings; and
5) the narrowness of the waterway increases the chances of a survey detecting dolphins if they are present.

During each dolphin expedition, the transects have been repeated a minimum of two times (though ideally three times where possible) over a three day to weeklong period. This has been repeated annually over a three-year period at roughly the same time of year to build an adequate baseline dataset on number of dolphins using PRR. The transects need to be repeated a minimum of two times over a short period but ideally three times each survey as dolphins will be missed on individual transects. This may occur because 1. the dolphins are at the water surface but missed by observers (perception bias due to observer fatigue) or 2. the dolphins are submerged during a dive and not available to be detected (availability bias).

Surveys were only conducted when sea conditions were considered suitable (i.e. Beaufort Sea State [BSS] ≤3). The dolphins present in PRR (snubfin and humpback) have a low surfacing profile, so may be missed in conditions where white caps are present (i.e. BSS >2), resulting in a misleading underestimate of the number of dolphins using the area.

Data Collection

During this expedition, daily surveys were conducted from tenders, Goolaan and Pinyjiri, following pre-determined routes (transects) through the study area. When both tenders were on survey at the same time in the same area, they followed separate transects and travelled towards opposite ends of the river as far as the tide would allow, ensuring spatial separation across the survey area. In addition, several hours of survey effort were conducted from the roof of *PV Worndoom* on transit from Koolan Island to the southern mangrove arm in St George Basin.

During a survey, vessels maintained 8-10 knots while on transect, slowed during dolphin sightings and transited between transects at faster speeds. A minimum of three people were onboard each vessel; the skipper and two observers dedicated to scanning for dolphins (with the naked eye) ahead and on each side of the vessel. When dolphins were sighted, the point where the transect was left was noted by the skipper using the onboard navigation system and the dolphin group was approached to collect data on group size, composition (i.e. species, sex and age class) and behavioural activity. The location (latitude and longitude) of the sighting was recorded using a hand-held Garmin GPS. Photographs of the dorsal fins of all dolphins in the group were taken for the purpose of photo-identification of individual animals. Each vessel had at least one person using a DSLR camera with a 400mm zoom lens for photo-identification.

When conditions were suitable, and the group composition (no newborn calves) and behaviour was conducive (dolphins were approachable and not avoiding the boat) an attempt was made to get biopsy samples from individual dolphins. This was done using a PAXARMS biopsy system with specially designed floating darts. The dart was aimed to hit just below the dorsal fin of the individual dolphin and took a core of tissue which contained both skin and blubber. These samples can be analysed to answer genetic questions on relatedness between individuals and/or connectivity between populations. Complete methods for dolphin surveys using photo-identification and biopsy sampling are outlined in standard operating procedures 'Vessel-based Cetacean Surveys Using Photo Identification' and 'Sampling cetaceans using a remote biopsy system'.

Data Analysis

Individual dolphins were identified from photographs primarily based on patterns of nicks and notches on the trailing and leading edge of the dorsal fin as well as secondary marks such as pigmentation, scars, rake marks, wounds and lesions on the surface of the dorsal fin. Scars, wounds and lesions on other parts of the body visible at the surface were also used when present. These are evolving tags that can change relatively quickly in some populations due to interactions with conspecifics, predation attempts, and vessel and fisheries interactions. If the dorsal fin is substantially modified individual dolphins may be mis-identified during a later survey which will lead to misleading population estimates because dolphins are being double counted.

Sighting histories (produced from repeat sightings of the same individual dolphin on multiple occasions over time) provide valuable information on the age and composition of the population, group dynamics and on residency patterns. Annual or more frequent surveys would provide better data on life history parameters of the population including recruitment such as calving and weaning. It would also be possible to estimate home range size of individual dolphins through repeat sightings of the same individuals, but tens of sightings of an individual (i.e. 30-50 sightings on different days) would be required.

After the survey, all photographs were qualitatively analysed for focus, contrast, angle, visibility and proximity of the fin and the best photos of each individual were retained. Individuals were categorised by

the degree of marks on the dorsal fin as either distinctive (D1), subtle (D2) or clean (D3). The overall number of clean fins was calculated for each group and for each day, however, the same clean fin individuals could potentially have been resighted between days as they had no distinguishing features.

All images and sighting information were entered into the DolFin database. Attempts to match distinct individual dolphins to those already in the photo-identification catalogue were made by two researchers independently. If a match was not made, then the individual was added to the photo-identification catalogue and given a new ID code. If fins had no distinguishing features they were not added to the catalogue as they would not be recognisable through time.

3. Results

The 2020 dolphin expedition covered 467.5 km and 37 hours of transects on effort in the PRR area and an additional 124.5 km and 21 hours off effort transiting or with dolphin groups. Transit from Koolan Island to PRR covered an additional ~225 km.

Five species of cetaceans were observed, bottlenose dolphin (*Tursiops aduncus*), humpback dolphin (*Sousa sahulensis*) snubfin dolphin (*Orcaella heinsohni*), false killer whale (*Pseudorca crassidens*) and humpback whale (*Megaptera novaengliae*). The bottlenose dolphins (6 adults, 1 calf), false killer whales (20 individuals) and humpback whales (5 adults, 2 calves) were recorded during the transit from Koolan Island through the LGMP to PRR and return (**Error! Reference source not found.**). Two groups of bottlenose dolphins were sighted, one (mother calf pair) in Brecknock Harbour near Kuri Bar and the other (5 adults) near the Traverse Islands. A single group of false killer whales containing 20 individuals and a humpback whale group (2 adults one calf) were sighted north-west of Viney Island near Montgomery Reef and the two other sightings of humpback whales (one mother calf pair and one with two adults) were recorded in Camden Sound.

In PRR two species of dolphin were sighted (snubfin and humpback, **Error! Reference source not found.**). The combined effort in the study area resulted in 83 dolphins (of the two species) being sighted in 27 groups, 71 (in 25 groups) were on transect. This equated to 0.15 dolphins per km of transect or 1.9 dolphins per hour of survey effort. This included repeated sightings of the same individual dolphins.

Dolphin sightings

Results are presented according to the two areas: (1) Lalang-garram / Camden Sound; (2) Prince Regent River.

Table 3.1 Dolphin and whale sightings: Lalang-garram marine parks

Species	# group sightings	Group size range; mean	Number of calves detected
Bottlenose dolphin (*Tursiops*)	2	2-5; 2	1
Humpback whale (*Megaptera*)	3	2-3; 2	2
False killer whale (*Pseudorca*)	1	20	4

Sightings off survey effort (i.e. opportunistic).

Table 3.2 Dolphin sightings: Prince Regent River

Species	# group sightings	Group size range; mean	Number of calves detected	Number of juveniles detected

Snubfin (*Orcaella*)	22	1-8; 3	2	2
Humpback (*Sousa*)	8	2-5; 3	2	0

Includes sightings while both on and off (i.e. opportunistic) survey effort.

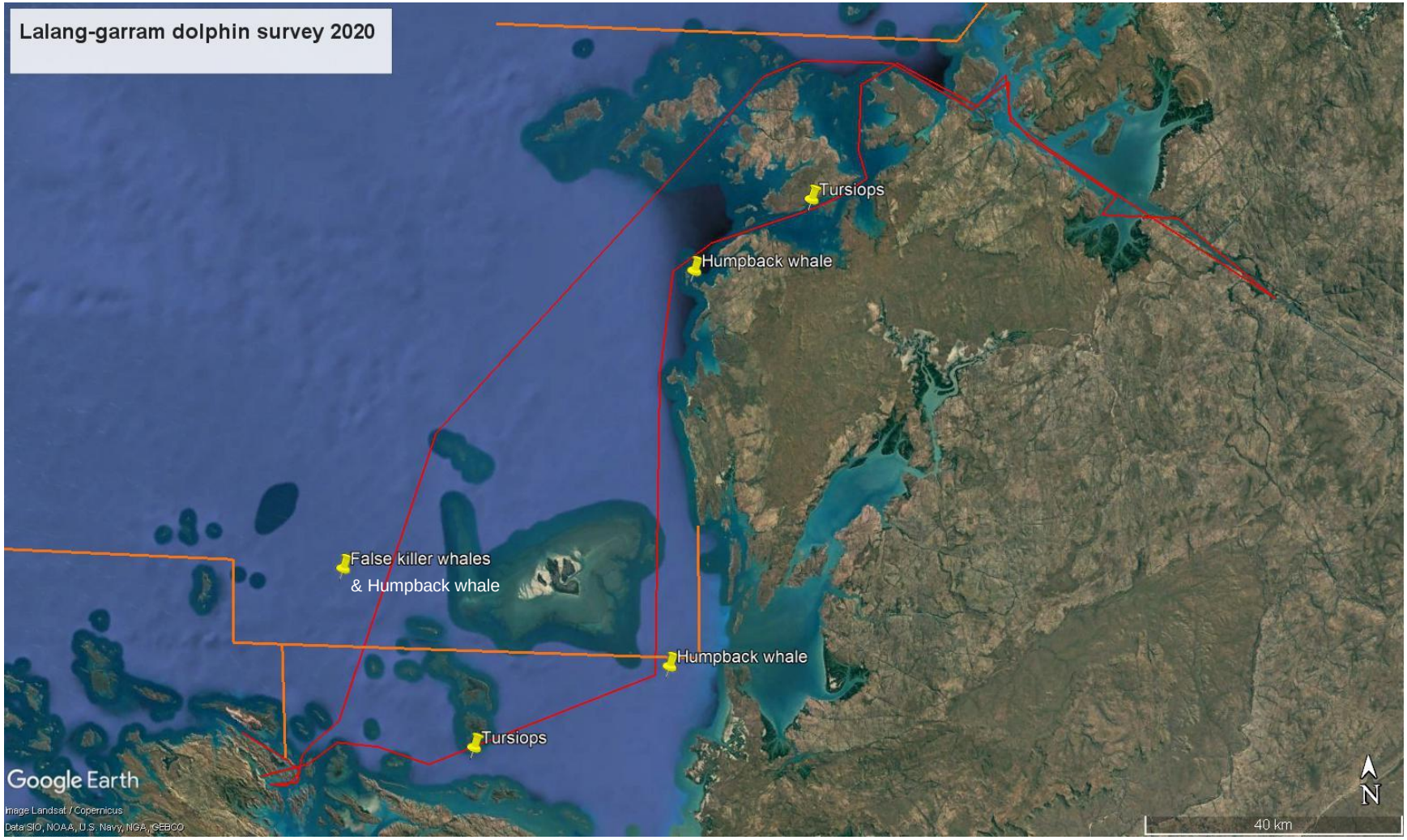


Figure 1 Cetacean sightings in the Lalang-garram marine parks during transit between Koolan Island and Prince Regent River 2020.

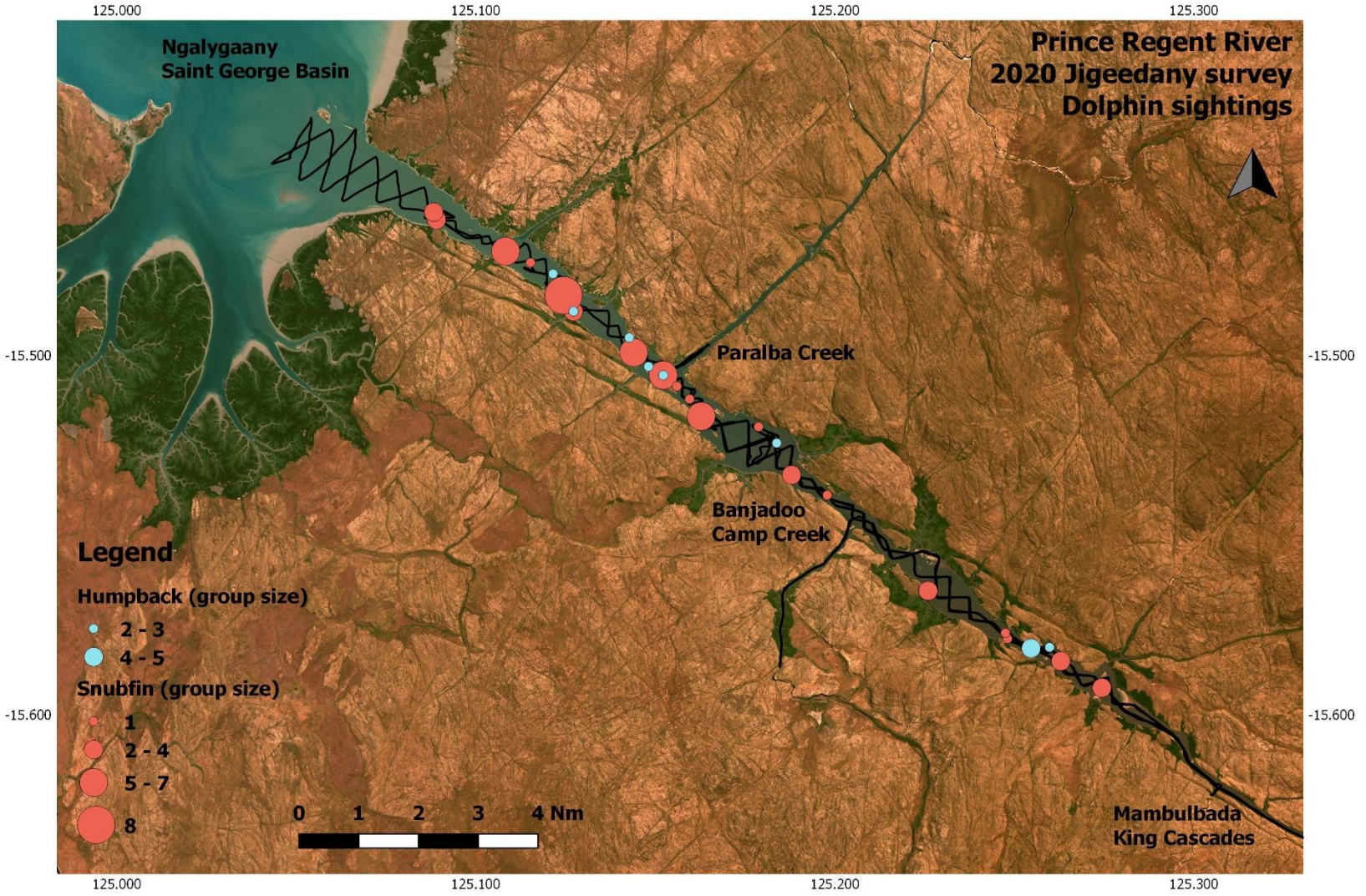


Figure 2 Dolphin sightings in the Prince Regent River during the 2020 dolphin survey.

Encounter rates

Encounter rates were calculated as a measure of the number of dolphins observed per km of survey effort. Encounter rates were calculated per km per day, illustrating how variable this measure can be between days (Tables 3.4 & 3.5).

Encounter rates were calculated using the best estimate of group size for each sighting, including any calves present. If the same individual is observed more than once in one day (shown by photo-ID), then it is only counted once. Some snubfin dolphins were resighted multiple times over the week-long survey. Dolphins observed opportunistically while not on survey effort (e.g. while motoring at speed between areas) were not included.

Table 3.4 Overall encounter rates: PRR

Date	km effort	# snubfin dolphins per km effort	# humpback dolphins per km effort
2020_09_12	82.9	0.06	0.024
2020_09_13*	119	0.143	-
2020_09_14 *	115.5	0.078	0.11
2020_09_15*	105.5	0.1	0 (both sightings were off effort)
2020_09_16	44.6	0.22	-

**on 3 days there were 2 vessels surveying at the same time. For encounter rate by individual boat, see Table 3.5.*

Table 3.5 Encounter rates when two boats were operating concurrently. Encounter rates for each boat are presented separately where two boats were used concurrently.

Date	km effort	# snubfin dolphins per km effort	# humpback dolphins per km effort	Boat name
2020_09_13	53.8	0.28	-	Goolaan
2020_09_13	65.2	0.03	-	Pinyjiri
2020_09_14	54	0.148	0.111	Goolaan
2020_09_14	61.5	0.016	0.114	Pinyjiri
2020_09_15	59	0.012	0 (both sightings were off effort)	Goolaan
2020_09_15	46.5	0.2	-	Pinyjiri

Table 3.6 Resighting history of individual snubfins identified in the Prince Regent River study area, ticks indicate sighted and present, crosses indicate absent or missed.

Dolphin ID code	2016	2018	2019	2020
OhLG01	✓	x	✓	x
OhLG02	✓	✓	✓	✓
OhLG03	✓	x	?	x
OhLG04	✓	✓	✓	✓
OhLG05	✓	x	✓	✓
OhLG06	✓	✓	✓	✓
OhLG07	✓	x	✓	✓
OhLG08	✓	x	✓	✓
OhLG09	✓	✓	✓	✓
OhLG10	x	✓	x	x
OhLG11	x	✓	x	✓
OhLG12	x	✓	x	x
OhLG13	x	✓	✓	✓
OhLG14	x	x	✓	x
OhLG15	x	x	✓	✓
OhLG23	x	x	✓	✓
OhLG24	x	x	x	✓
OhLG25	x	x	x	✓

3.7 Resighting history of individual humpback dolphins identified in the Prince Regent River study area, ticks indicate sighted and present, crosses indicate absent or missed.

Dolphin ID code	2016	2018	2019	2020
SsLG02	✓	✓	✓	✓
SsLG03	✓	x	✓	x
SsLG04	✓	x	✓	x
SsLG05	✓	x	x	x
SsLG24	x	✓	x	x
SsLG28	x	✓	x	x
SsLG29	x	x	✓	✓
SsLG30	x	x	✓	x
SsLG31	x	x	✓	x
SsLG32	x	x	✓	x
SsLG33	x	x	✓	x
SsLG34	x	x	✓	x
SsLG35	x	x	✓	x
SsLG36	x	x	✓	x
SsLG37	x	x	x	✓

Photo-identification ('Photo-ID')
Photo-ID data collection was very successful: 81% of snubfin and 43% of humpback dolphins sighted were successfully photographed to a suitable standard so that they could be identified based on distinct marks on their dorsal fins.

For the PRR area, 13 distinctive snubfin and 7 distinctive humpback dolphins were identified using photographs. Two juvenile snubfin, two calf and two humpback dolphin calves were sighted. Eleven of the 19 snubfin dolphins that were identified in 2016, 2018 and 2019 were resighted in the 2020 survey suggesting strong site fidelity to the PRR area at this time of year (Table 3). This brings the total to 18 individually distinctive snubfin dolphins that have been photo-identified for PRR, excluding calves and clean fins across the four years where surveys have been undertaken (Appendix 1).

Biopsy darting
This year we used the PAXARMS (**Error! Reference source not found.**) biopsy system instead of the Dan-Inject. We were successful in getting five (3 full and two partial) samples (i.e. 'plugs' of blubber with skin). The five individuals biopsied were OhLG04, OhLG02 (Mum), OhLG11, OhLG07 and an unidentified cleanfin (**Error! Reference source not found.**).

Figure 3 PAXARMS biopsy system (a) Assembled 0.22 calibre rifle with Pro-Point red-dot sight. (b) Biopsy dart and biopsy tip. Photos taken from Murdoch University Cetacean Research Unit.

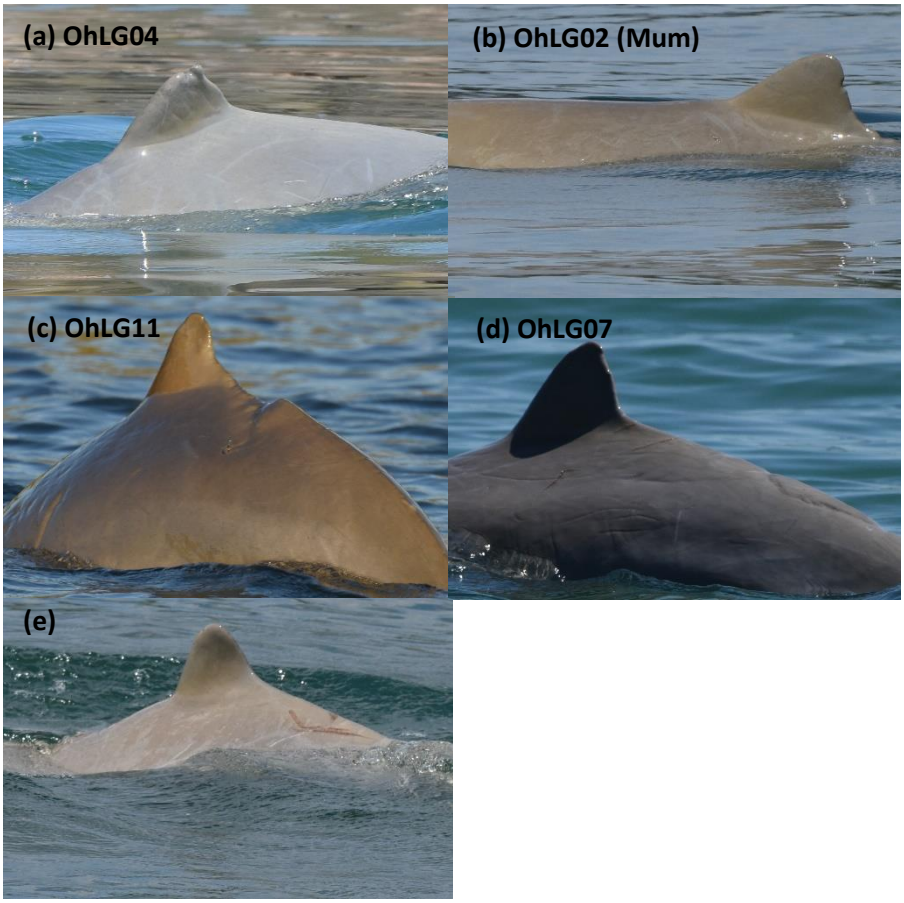


Figure 4 The five individuals biopsied were (a) OhLG04, (b) OhLG02 (Mum), (c) OhLG11, (d) OhLG07 and (e) an unidentified cleanfin.

Trends over time

Fewer individual snubfin and humpback dolphins were identified based on the photo id in the 2020 survey (16) compared to 2019 (19) but more than in 2018 (8) and 2016 (8). However, the numbers are comparable between years where survey effort is similar i.e. 2016 and 2018 had a similar number of hours on effort as did 2019 and 2020 (**Error! Reference source not found.**). Similarly, the number of dolphin group sightings for both species was also higher in the 2019 and 2020 surveys compared to 2016 and 2018 (**Error! Reference source not found.**), noting that a group sighting included from 1 to 8 individuals but may also include re-sightings of the same individuals throughout the duration of the survey. Fewer unique humpback dolphin individuals were identified in the 2020 survey (Figure 5) despite there being the same number of sightings as in the 2019 survey (**Error! Reference source not found.**).

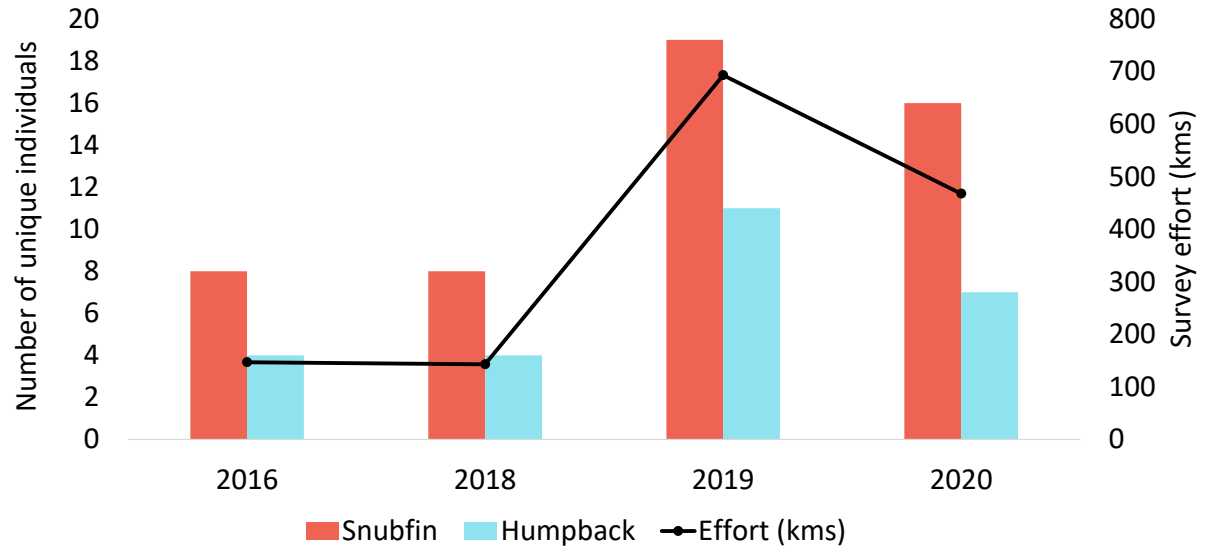


Figure 5 Number of individual dolphins that were identified from unique fin markings in the Prince Regent River and survey effort (kms) for each survey since 2016.

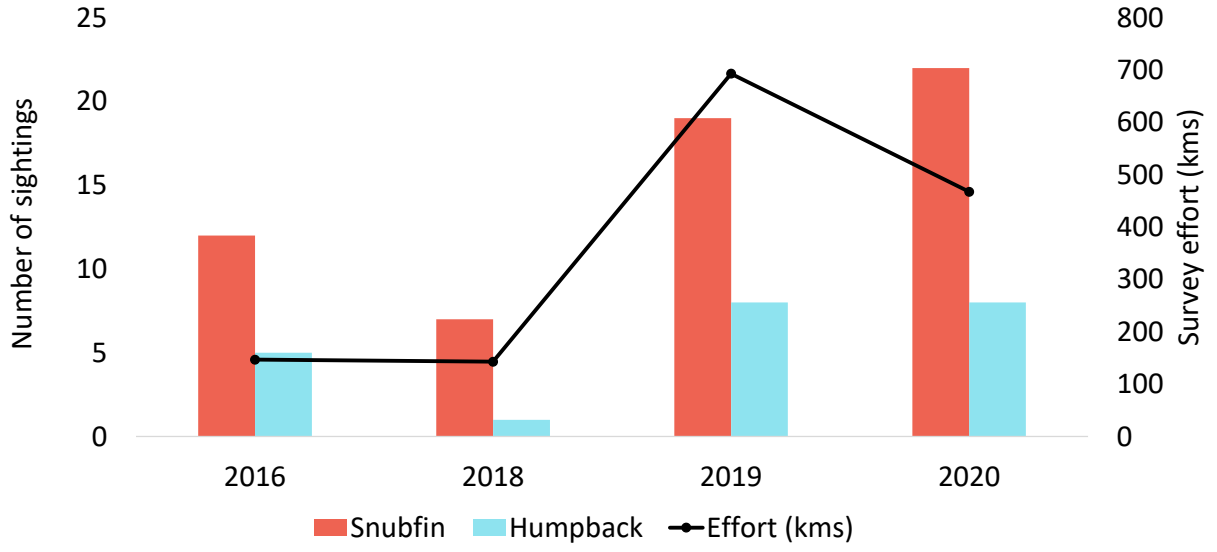
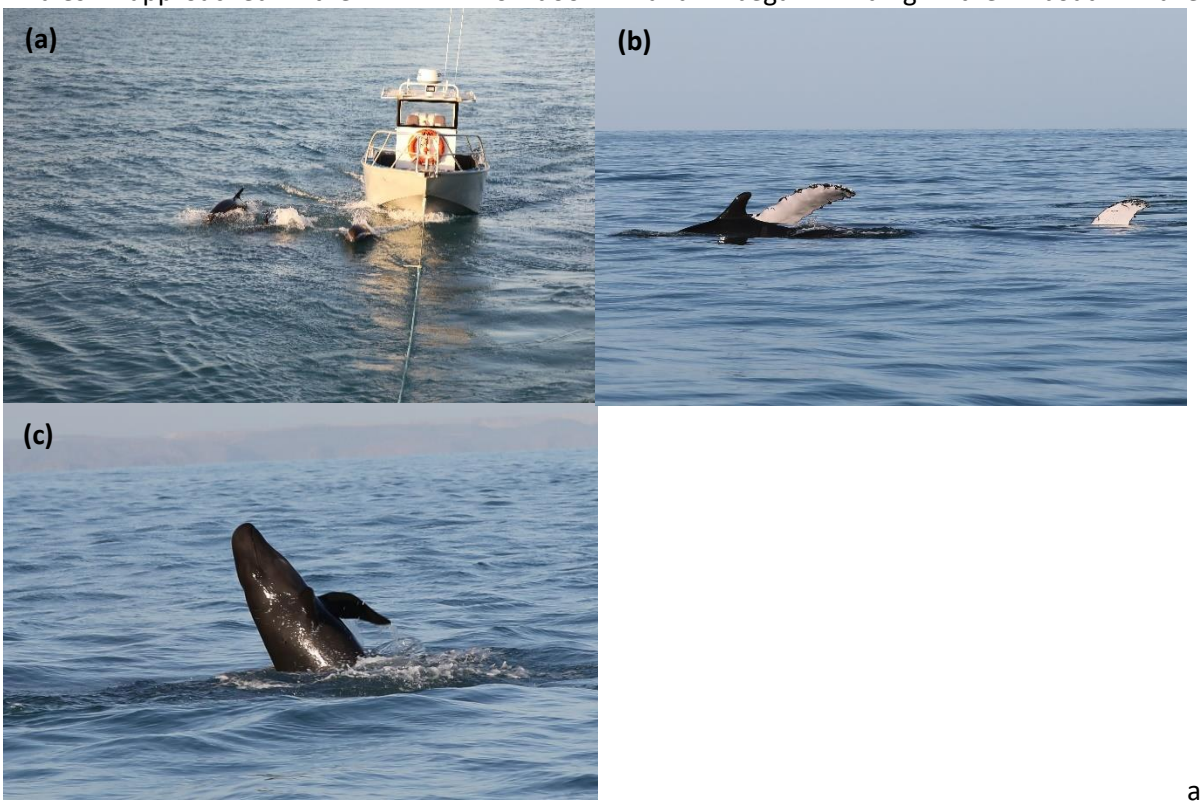


Figure 6 Number of dolphin group sightings in the Prince Regent River and survey effort (kms) for each survey since 2016. Note each group sighting includes from 1-8 individual dolphins.

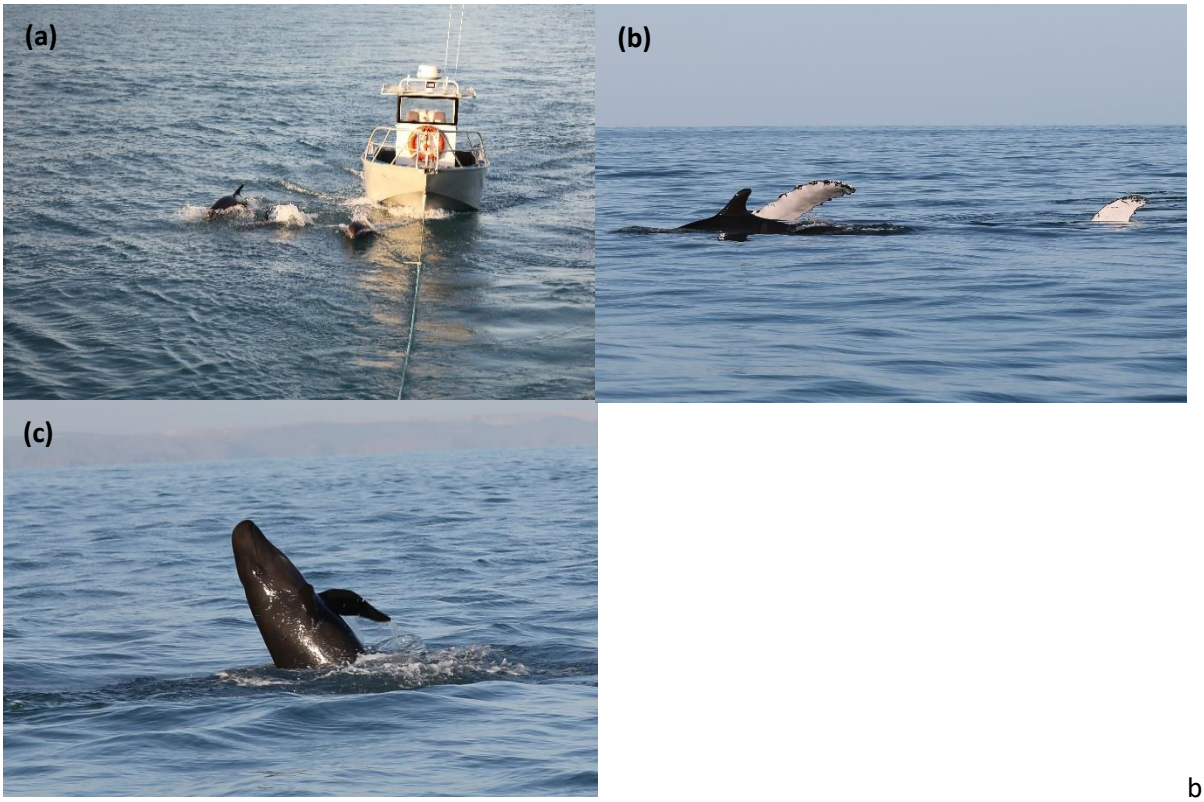
Other observations

On the 11th September while *PV Worndoom* was transiting to PRR, we encountered a group of 20 false killer whales (*Pseudorca crassidens*) northwest of Viney Island near Montgomery Reef. The false killer whales approached the PV Worndoom and began riding the boat wake (



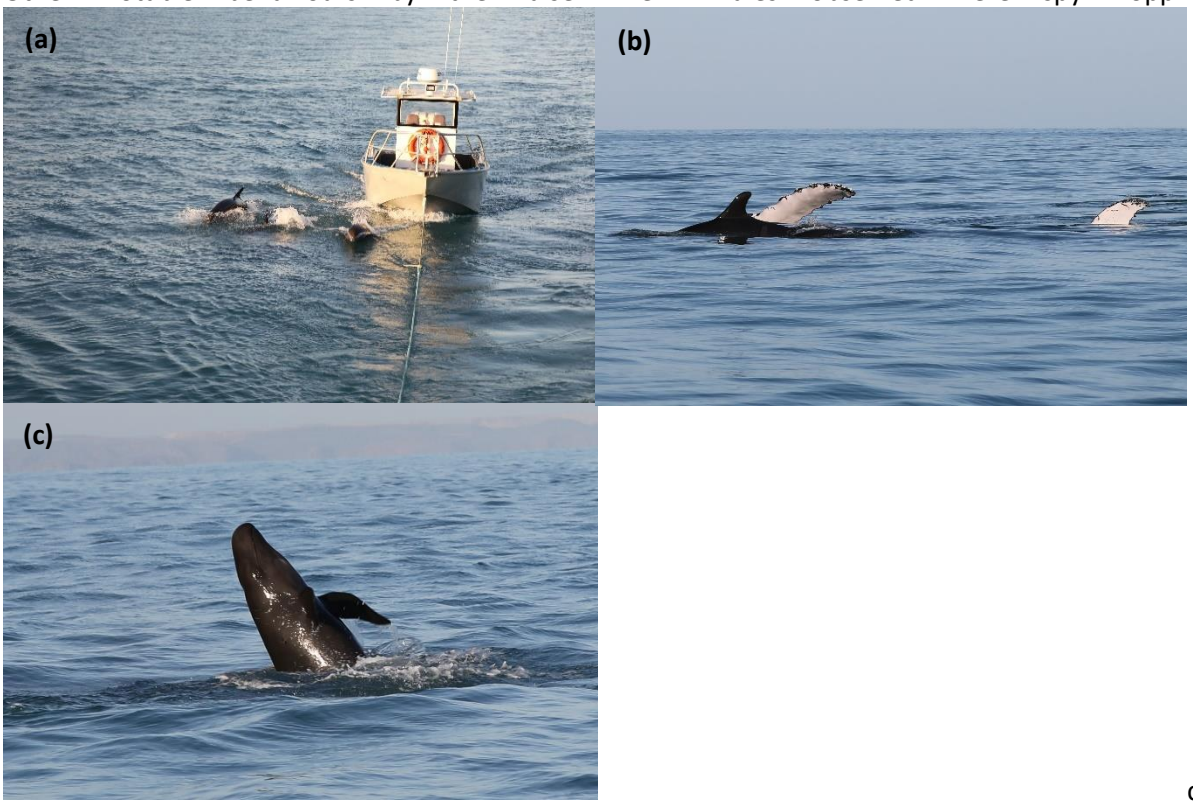
a).

We observed the group from *PV Worndoom* and commenced photographing dorsal fins. A team of four then boarded tender vessel *Pinyjiri* to get closer to the group for photographing. The false killer whales comprised two subgroups, one pod of approximately 8-10 presumably males (based on size and behaviour) that was stable and socialising with each other and another pod of 4-5 mother calf pairs that remained somewhat separate. Some animals from the male group did join occasionally with the mother calf group. There was also an interaction between a false killer whale mother calf pair and three humpback whales (two adults, one calf). It appeared affiliative between the humpback calf and mother calf false killer whales, while the adult humpbacks were quite vocal and chuffing loudly. The humpback calf went on its side with its ventral side toward the false killer whales (



b).

Other notable behaviours by the false killer whales observed were spy hopping (



c),

inversions and underwater vocalisations audible above water.

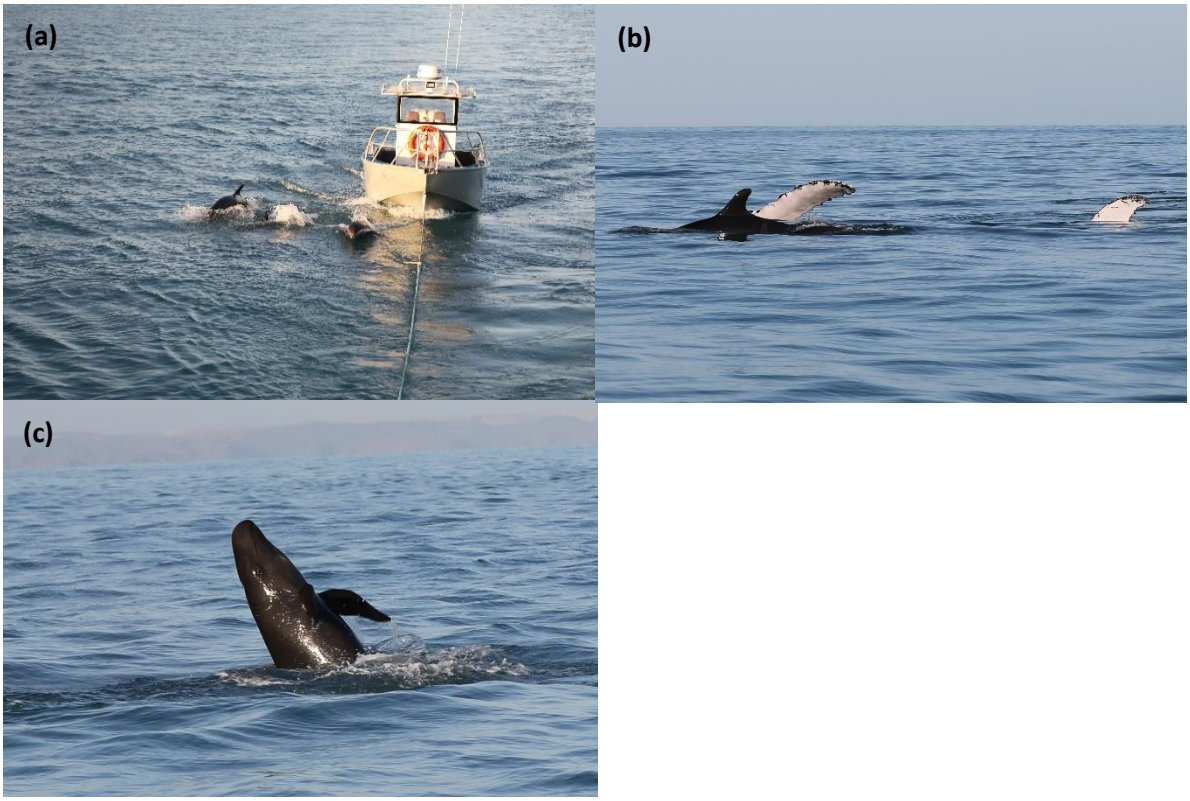


Figure 7 False killer whales (a) riding on the bow of tender Pinyjiri while being towed behind PV Worndoom (b) interacting with humpback whales and (c) spy hopping.

On four occasions during the survey snubfin dolphins were observed using spitting as a feeding technique. This unique behaviour has been observed in previous surveys of PRR (2018 & 2019) and in the Roebuck Bay population. On the 16th September one individual, OhLG04 'Moana', was observed spitting followed by a wolf herring (*Chirocentrus dorab*) jumping out of the water. Snubfin have previously been observed feeding on this species in PRR in 2019, confirming they are a prey item present in this area at this time of year. Snubfin OhLG06 was also observed spitting, although no fish were observed to be nearby (**Error! Reference source not found.**).

Figure 8 Snubfin dolphin (OhLG06) spitting large volume of water repeatedly.

Interestingly, the humpback dolphins were mostly sighted near the rocks or edge of the mangroves on the banks of the river rather than in the middle of the PRR. This is in contrast to the sightings of snubfin dolphins which were more common across the river. Similar observations were reported in previous years and may indicate habitat preference by the humpback dolphins for the near shore areas of the river, possibly segregation to avoid competition for food or agonistic social interactions.

Discussion

We now have three consecutive years of survey effort that suggest the area supports approximately 20 snubfin dolphins at any one time at this time of year. Eleven of the dolphins sighted this year were seen in previous years (2016, 2018 & 2019) which suggests that there is a high degree of site fidelity. However, surveys at different times of the year would be needed to confirm this. The small population of snubfins that use the PRR is reportedly locally important to Dambimangari (Department of Parks and Wildlife, 2016). Given their local value and conservation status (vulnerable globally on the IUCN Redlist, near threatened in Queensland, priority species that is data deficient precluding conservation assessment in Western Australia) this survey highlights the importance of such a small population using a marine park, where threats can be actively managed to benefit the conservation status and the persistence of the species. The survey design and methodology have proven effective in capturing how many dolphins are using the river at any one time. Using two vessels allowed a more intensive survey effort and demonstrates the availability and perception biases that are higher when using one vessel. That is, with two boats covering the same stretch of water (albeit on reciprocal transects), encounter rate differed as a result of dolphins being missed because they were submerged and unavailable, or observers were scanning a different area or were fatigued and missed them surfacing. Essentially two vessels on the water at the same time are more likely to sight all dolphins in the area through better spatial and temporal coverage.

Sea conditions were fair throughout the dedicated survey with consistently low or light winds in the morning and strong westerly winds setting in about midday, with the exception of the morning of the 15th where moderate easterly winds arrived mid-morning. This resulted in survey effort being concentrated in

the morning as afternoon conditions were unsuitable (BSS >2) for sighting, photographing and biopsying dolphins. This survey pattern of ceasing around the middle of the day may have been beneficial to the dolphins as it reduced the likelihood of multiple encounters in the same day with the same individuals and cumulative exposure to boat time. In 2019 it was noted that the behaviour of the dolphins became increasingly evasive throughout the course of the survey, with animals spending longer periods of time below the surface when re-encountered. This was not observed in the 2020 survey. However, there may be alternative explanations to this change in behaviour, for example king spring tides peaked at the end of the 2019 survey which may also influence dolphin foraging behaviour, making them appear more evasive.

Fewer humpback dolphins were sighted (7) and identified (3) compared to the 2019 survey (11). This may have been because observers were prioritising biopsy sampling snubfin and would spend longer with groups attempting darting and collecting samples rather than moving on to a humpback group to capture photos if a humpback dolphin group surfaced nearby during a snubfin dolphin encounter. On a few occasions a humpback was sighted near the mangroves or up against the rocks while observers were with a snubfin group, some photos would be taken from a distance to confirm species and potentially contribute to the overall count, but due to the distance the photos were taken from many were not clear enough to identify individuals.

If human pressures continue to increase in the PRR (e.g. increased boat activity) then monitoring through regular (annual) survey may be required to determine the impact these pressures are having on the local population over timeframes that allow for successful management intervention. This may include the need for additional surveys at different times of year (peak and off-peak seasons) to monitor the dolphin population as well as collection of data on numbers of boats present at any one time and across the season to monitor the pressure. The number of dolphins using the area and encounter rates can then be compared between years to detect changes that can be assessed relative to changes in the number of boats also using the area. Additional research questions may need to be explored, including activity budgets for the dolphins and habitat use to determine whether these factors change in the presence of increasing numbers of vessels. Together these data may provide a point of comparison to investigate whether dolphins are being displaced from the area or continue to use PRR regardless of boat activity. It should be noted that dolphins may continue to use an area, for example to forage, even if it is sub-optimal due to boat traffic which may impact their short-term activity budget. If exposure is continued and chronic it may result in a fitness cost to the population (Allen and Read, 2000).

4. Recommendations

Consideration should be given to the ongoing monitoring of the condition of dolphin populations in LGMP as a part of the joint management prioritisation process for monitoring effort that is jointly conducted by DBCA and the Dambimangari traditional owners. This should include due consideration of recent published research on snubfin dolphin abundance and distribution (Bouchet et al In press) across the Kimberley and on modelling of future scenarios (Boschetti et al 2020). If this value is considered a priority in relation to other values within the marine reserve and joint management or external research capacity allows then the dolphin survey program should continue. There are two options for how to continue this work into the future:

1. the program is incorporated into the existing joint management monitoring activities, run collaboratively through the West Kimberley District office, Marine Science Program and Dambimangari traditional owners.
2. there is an ongoing research question that is identified, and for which a Science Concept Plan and Science Project Plan should be developed by relevant parties and approved through the Departmental science protocol, that clearly identifies specific objectives, responsibilities and roles of all parties and staff.

Either option will need to be approved through the LGMP joint management board which will have taken into consideration the level of priority allocated to dolphins or the specific research question relative to other values or research questions in the reserve, as well as joint management capacity to conduct the work itself. If capacity is a limiting factor, effort should be made to direct external researchers or institutions to consider the recommendations made in this document.

Should the dolphin research program continue based on the current objectives, it is recommended that a survey be conducted in PRR following the same methodology and design at a minimum of every 2 years with 2-3 repetitions of the transects over a 3-7 day period. A minimum of one week should be allocated to the task, given unpredictable weather conditions. Surveys should be undertaken at the same time of year and should avoid spring tides. Where possible, two vessels should be used for the survey. These surveys should continue to record sightings of other marine mammals, particularly when in transit, to inform marine park targets on species diversity. This will allow for a quantitative assessment of dolphin abundance and distribution throughout the study area as well as the collection of important demographic information on site fidelity, reproduction and longevity. There would be limitations on answering some of these questions if surveys were conducted less frequently as dolphin dorsal fins can change rapidly, leading to mis-identification of individuals. Further, regular (biennial survey) will allow for detection of catastrophic events that may have an impact on the local dolphin population that can be addressed through management. Leaving a longer interval between surveys will mean that demographic information is lost and therefore limit the questions that can be answered on dolphin population health.

Additional research questions may also be addressed using these data over time, or an added focus can be added to the biennial survey. For example, to estimate home range, a minimum of 30 sightings, preferably ~100 sightings of each individual dolphin would be needed, requiring additional survey effort. A number of tissue samples from snubfin dolphins in PRR have been collected and this effort could continue should there be priority research questions on relatedness and connectivity within and between populations.

Finally, all staff will need to ensure that they are appropriately covered by DBCA scientific licence and Animal Ethics Approval for any future dolphin surveys and biopsy collection.

Acknowledgements

Dambimangari traditional owner Janet Oobagooma and Inga Pederson were generous in sharing their knowledge and sea country. Michael Hourn and Brett Francis's knowledge of the survey area maintained safe operation of *PV Worndoom* which was integral to the successful completion of the survey.

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OhLG01
Mum
OhLG05
Biopsy sampled
OhLG09
Resighted 16Sep2018
OhLG13
17Sep2018
OhLG02
Mum
OhLG06
16Sep2018
OhLG10
16Sep2018
OhLG14
OhLG03
Biopsy sampled
OhLG07
OhLG11
16Sep201
OhLG15
Mum
OhLG04
Resighted 17Sep2018
OhLG08
OhLG12
16Sep2018
OhLG23


OhLG24
OhLG25


SsLG01
SsLG05
SsLG09
SsLG13
Mum
SsLG02
Mum
SsLG06
SsLG10
SsLG24
15Sep2018
SsLG03
SsLG07
SsLG11
SsLG28
19Sep2018
SsLG04
SsLG08
SsLG12
SsLG29
28Sep2019


SsLG30 28Sep2019
SsLG34 30Sep2019
SsLG31 26Sep2019
SsLG35 30Sep2019
SsLG32 26Sep2019
SsLG36 30Sep2019
SsLG33 26Sep2019
SsLG37 14Sep2020


TaLG01
TaLG02
TaLG03
TaLG13 (Mum)
TaLG04
TaLG05
TaLG06
TaLG07
TaLG08
TaLG09
TaLG10
TaLG11
TaLG12