



Investigating Marine Mammal Occurrence and Conservation Status in Purari Delta, Gulf Province, Papua New Guinea

Survey Report
25 March 2024





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1 BACKGROUND

The Snubfin Dolphin Project (SDP) has been running an inshore dolphin research and conservation project in the Kikori Delta (Figure 2) since 2013 (Beasley *et al.* 2014; Beasley *et al.* 2015). Recently, the Secretariat of the Pacific Regional Environment Programme (SPREP) have been supporting research and outreach in the Kikori Delta on the impact of a swim bladder fishery on regionally significant populations of globally threatened IUCN Red listed dolphins, sawfish and river sharks (Beasley 2002; Beasley 2003).

The swim bladder fishery primarily uses gillnets to target barramundi (*Lates calcarifer*) and scaly stonefish (*Nibea squamosa*) for a highly valuable commodity, swim bladder (also known as fishmaw) (Grant *et al.* 2021a; Grant *et al.* 2021b). Shark fin is also retained as a supplementary product in this fishery. These products are exported to East Asian markets (through Indonesia and PNG) for food or medicine, with swim bladder having a disproportionately lucrative value (Sadovy de Mitcheson *et al.* 2019) (estimated local price fishers receive ranges from USD132-2,652/kg, with illegal market chains having higher value). At these prices, the fishery forms a very important income source for local communities (i.e. one kg of swim bladder can be equivalent to one year's salary), who are also reliant on fisheries resources for protein. However, there is presently no management plan in place for the swim bladder fishery, and there are serious concerns for the sustainability of target species. Perhaps more urgently, populations of threatened marine species including Australian snubfin dolphin, Australian humpback dolphin (Figure 1), and several species of shark and ray species (including many listed in Appendix I or II of the Convention on International Trade of Endangered Species of Flora and Fauna, CITES) are declining severely due to incidental capture in this fishery (Smith *et al.* 2023).

The Kikori Delta has been identified by IUCN Species Survival Commission as an Important Marine Mammal Area (IMMA) (Figure 3), and supports four marine mammal species, the Australian snubfin dolphin, Australian humpback dolphin (Figure 1), Indo-pacific bottlenose dolphin (*Tursiops sp.*) and Dugong (*Dugong dugon*) (Table 1) (IUCN Marine Mammal Protected Areas Task Force 2017).



Figure 1. Australian snubfin dolphin (left) and Australian humpback dolphin (right)



Figure 2. Location of the Kikori Delta

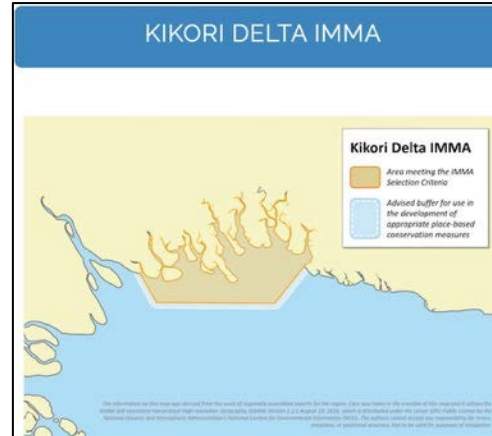


Figure 3. Kikori Delta IMMA

Table 1. Four marine mammal species confirmed to occur in the Kikori Delta

Species	IUCN Red List Status	CITES	CMS
Australian snubfin dolphin	Vulnerable	Appendix I	Appendix II
Australian humpback dolphin	Vulnerable	Appendix I	Appendix II
Indo-Pacific bottlenose dolphin	Data Deficient	Appendix II	Appendix II
Dugong	Vulnerable	Appendix I	Appendix II

Abundance estimates of the Australian snubfin dolphin and Australian humpback dolphin are difficult to obtain due to the dolphins being shy and cryptic to photo-identify. In 2015, estimates were roughly estimated at 200 snubfin and 100 humpback dolphins in the Kikori Delta area. From Morigo Island east to Baimurru. (Beasley et al. 2015).

Between November 2021 – March 2023 (duration of SPREP funded projects), 82 by-catch/stranding events were recorded by the community monitors, consisting of 99 dolphins.

From these 82 events, 99 dolphins were recovered, consisting of:

- 91 snubfin dolphins (67 by-catch and 24 unknown mortality),
- 6 humpback dolphins (3 by-catch and 3 unknown mortality)
- 2 pygmy sperm whales (2 by-catch) (Table 2).



Table 2. Pidua carcass recovery program summary (November 2021 – March 2023).

Species	100% By-catch	Released Alive	Unconfirmed	Total
Snubfin	67	2	24	91 (89 dead)
Humpback	3	0	3	6
Pygmy sperm	0	0	2	2
Total	70	2	29	99 (97 dead)

With the dolphin population levels likely to be extremely small already, this rate of by-catch is unsustainable for species that have very low reproductive rates. Both Australian snubfin and Australian humpback dolphins are now under threat of local extinction in the Kikori Delta, in a situation that mirrors that of the vaquita (*Phocoena sinus*), which is nearing extinction because of a similar fishery targeting totoaba (*Totoaba macdonaldi*) swim bladders (Rojas-Bracho and Reeves 2013; Rojas-Branch *et al.* 2006). Both the vaquita and totoaba are now listed as Critically Endangered on the IUCN Red List of Threatened Species (Beasley 2023).

Although Australian humpback and snubfin dolphins are known to occur in the Kikori Delta, their occurrence in other regions of southern PNG, and PNG, remains unknown (Beasley *et al.* 2016). Based on knowledge of large river systems in PNG, the only other location that inshore dolphins may be found is around the Madang Region, near the Sepik/Ramu Rivers (Figure 4). There are numerous large river systems in southern PNG along Western, Gulf and Central Provinces (Figure 5), so it is highly likely the inshore dolphins also occur outside the Kikori Delta. However, no sighting records have yet been obtained from other locations. There are fears that the humpback dolphin may already be close to extirpation from the Delta (Beasley 2022).

This situation is of very high conservation concern, as these dolphins are not known to occur anywhere else in PNG or other Pacific Islands (Beasley *et al.* 2016). The humpback dolphin is present in some areas of Indonesian Papua, and both species occur across northern Australia as they belong to the same populations (Beasley *et al.* in review). Based on genetic studies, the PNG snubfin and humpback dolphins are genetically the same as northern Australian populations, showing that there must be at least some migration between the two countries.

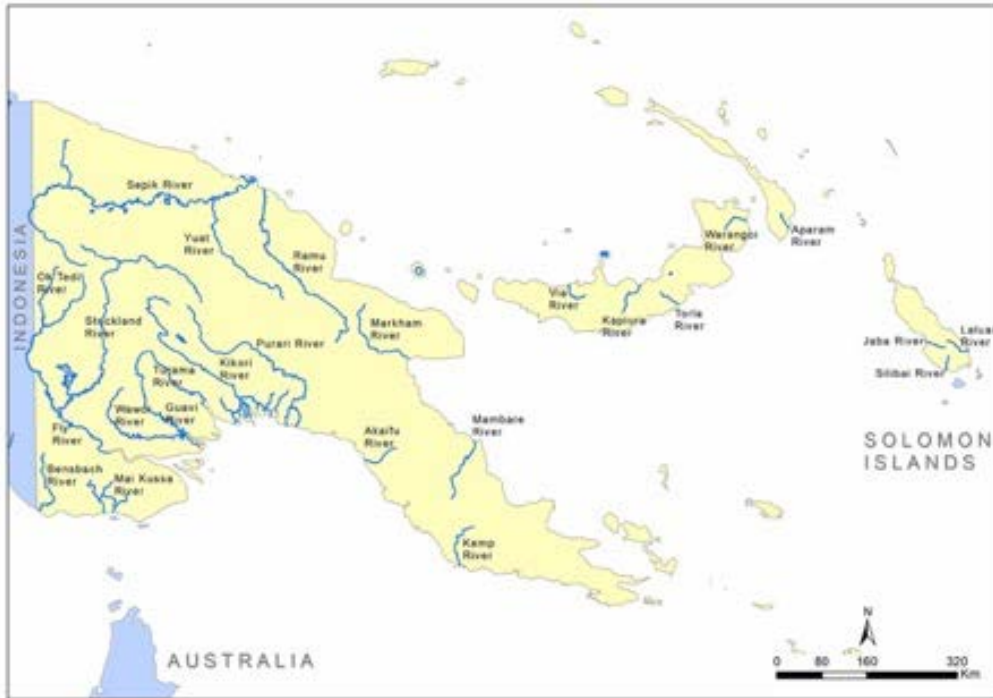


Figure 4. Major river systems of PNG

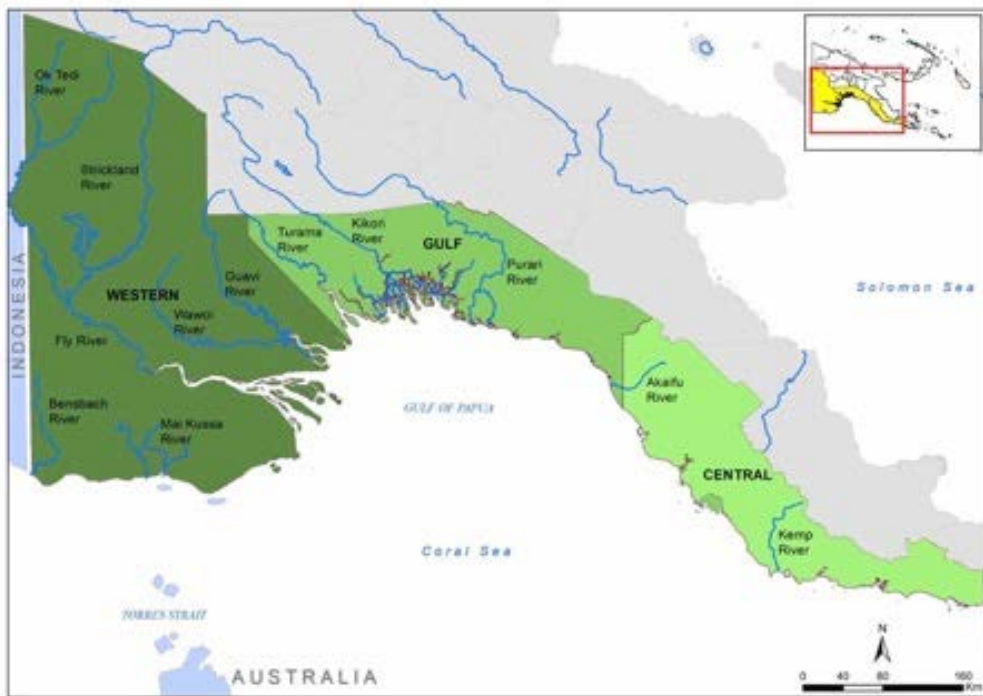


Figure 5. Major river systems Gulf Province



Further studies of inshore dolphins, and other marine mammals, east of Baimuru and west of Morigo Island are therefore urgently needed to assess inshore dolphin conservation status in PNG waters. This is particularly important if additional cumulative pressures will be present in the future, such as continued by-catch in gillnets, dredging or increased boat traffic.

A marine mammal field survey was undertaken in October 2023 throughout the Purari Delta, to determine if the two inshore dolphins are present in the Purari Delta and investigate how far their home range extends east of Kikori Delta. The outcome of this proposed project will contribute important information on the occurrence, distribution and potential hotspots for marine mammals in Gulf Province. The project consisted of two components:

Phase I – Community Meetings and Preliminary Boat-based Surveys

- Community meetings and discussions; and
- Preliminary boat-based surveys

This project was primarily funded by Total Energies Papua New Guinea Ltd. The SPREP funded project **AP2/17/3 - Kikori Delta Dolphin Surveys** assisted significantly to pay for Dr. Beasley's travel to PNG, accommodation while in PNG, and time to attend these surveys.

2 PHASE 1 – AIMS AND OBJECTIVES

The aims of Marine Mammal Surveys - Phase I (community meetings and preliminary boat-based surveys) are to:

- Inform local communities about the dolphin project activities and conservation status of inshore dolphins in Gulf Province; and
- Establish if inshore dolphins regularly occur in the Purari Delta.

The objectives of the Marine Mammal Surveys - Phase I are:

- Inform local communities about the project activities and conservation status of inshore dolphins in Gulf Province, and conduct community meetings and informal discussions with community members regarding marine mammal occurrence and diversity;
- Obtain opportunistic boat-based marine mammal sightings;
- Conduct preliminary boat-based surveys in Orokol Bay, Gulf Province;
- Identify key areas for marine mammals in the Purari Delta



3 **METHODS**

The Marine Mammal Surveys - Phase I methods consisted of:

- Community awareness raising about the project objectives and dates of project;
- Community meetings and discussions; and
- Preliminary boat-based surveys.

3.1 COMMUNITY MEETINGS AND DISCUSSIONS

During the project, villages in the project area were visited to discuss the marine mammal survey project and marine mammal sightings and strandings in their region. A village visit was required before any boat-based surveys were undertaken past the village.

Upon arrival to a village, the Community Liaison Officer (CLO) met with the VLO and community leaders, to inform them of our arrival and request for a community meeting. All community members were then invited to attend the meeting. The CLO would introduce the team to the community, then introduced the project and SDP. SDP Team Lead Dr. Beasley then provided some background to the project, and explained why inshore dolphin research and conservation in Gulf Province was important. Dr. Beasley also informed the community about the Pidua marine mammal project in the Kikori Delta, to raise awareness about marine mammals in the study area and the threats they are facing (i.e. primarily by-catch in gillnets). Providing this information hopefully provided a good introduction to the project team and raised the interest of the community to discuss further topics regarding marine mammal diversity and occurrence with team members.

If community members were interested to discuss additional topics with the SDP team, further one-on-one discussions were undertaken with community members. High priority were community members who had recently sighted dolphins in the Delta, with those that were expert fishers that fished regularly. Informal interview datasheets that had already been trialed and utilized in the Kikori Delta dolphin project were used to determine:

- Marine mammal species diversity and occurrence; and
- Mortality rates and causes.

Any community members that were interested to answer further questions about marine mammal diversity, occurrence and mortality rates and causes were asked to sign an associated consent form to confirm that they were happy to provide their answers to the survey team, and also happy for their image to be used in reports and publications, if required.

3.2 BOAT BASED SURVEYS

3.2.1 Vessels Used for Surveys

Two vessels were used for surveys. One is a 34m survey/accommodation vessel, the Silver Star (Figure 6). The associated tender is a 12m flat bottom vessel called Black Bass (Figure 7). Both vessels are operated by TWL Group (<https://www.twl.com.pg/marine.html>).



Figure 6. Silver Star



Figure 7. Black Bass



The larger vessel the Silver Star was primarily used to access/survey coastal waters of the Purari Delta, and provide accommodation for the survey team. It's height above sea level is 28m, therefore provides an excellent platform for observations. However, a major constraint is that its draft is 2.3m, so it is not able to access coastal waters from the river mouth out to approximately 5km from the coast because of the shallow Purari Delta coast-line. Once dolphins are sighted it is also less maneuverable than a smaller vessel, so it is harder to follow dolphin groups using Silver Star. A large vessel such as Silver Star is essential for coastal surveys because the tides are so strong a smaller vessel would have difficulty to make-way against the tide.

The Black Bass is a perfect survey vessel for riverine waters. Unfortunately, it is unallowed to transit into coastal waters for operations reasons, so it was not possible to use Black Bass for the coast to 5km section.

3.2.2 Transect Observation Methods

A minimum of three observers conduct observations during on-effort surveys. Two observers search along transects with binoculars (binoculars to be used intermittently) on either side of the bridge wings, while the other observer is 'recorder' and scanning primarily with naked eye at the centre of the flying bridge.

Scanning methods for all vessels follow standard protocols. The scanning pattern utilised is designed to maximise observers sighting dolphins close to the transect line, as well as further away from the vessel:

1. Each observer scanned for dolphins with binoculars from 90 degrees to their side of the boat to 10 degrees to the opposite side of the bow;
2. The recorder on Eclipse scanned 180 degrees in front of the boat, primarily with naked eye;
3. Observers scanned each field of view for 5 seconds and moved onto the next field of view until 90 degrees was reached. Approximately 2-3 minutes was then spent scanning with naked eye. This avoided eye fatigue and allowed observers the opportunity to spot marine wildlife in a broader field of view. This scanning protocol was repeated in a slow, gradual scan motion throughout each 30 min observer rotation.

Once a dolphin group was sighted, the boat collected the necessary location data, and then transited to the dolphin group to obtain additional data and photographs.

3.2.3 Vessel Speed

Following standard methodology, surveys are carried out at a consistent low speed (12-15km/hr, 6-8 knots) while on-transect. Previous experience by the SDP team has shown that if surveys are conducted at higher speeds fewer sightings will be observed, as there is less time for the dolphins to surface within the field of view of observers. It is therefore important that speed is kept constant when observers are 'on-effort'.



3.2.4 Data Collection

At the start of the day before the boat departs for surveys, observers complete the top section of the effort datasheet, which includes details about:

- Departure location;
- The area to be surveyed;
- Names of observers;
- Start time from the GPS;
- Start odometer km from the GPS (which is always to be reset to '0' before the survey begins).

The boat then travels to the location that surveys will begin for the day. The boat track is always recording automatically every 2 minutes using the GPS, and it is not turned off until the survey team has finished for the day.

The 'trip computer' on the GPS page displays all relevant information for the effort sheet, primarily time and odometer. The boat then travels to the location that surveys will begin for the day. The boat track is always recording automatically every 2 minutes using the GPS, and it is not turned off until the survey teams have finished surveys for the day. Information on tides and tide state is also collected, to determine whether tides have an influence on dolphin distribution within the study area.

3.2.5 Tides and Beaufort

The semi-diurnal range (the difference in height between high and low waters over about half a day) varies in a two-week cycle. Approximately twice a month, around new moon and full moon when the sun, moon, and earth form a line (a condition known as syzygy, the tidal force due to the sun reinforces that due to the Moon. The tide's range is then at its maximum; this is called the *spring tide*.

When the moon is at first quarter or third quarter, the sun and moon are separated by 90° when viewed from the Earth, and the solar tidal force partially cancels the Moon's. At these points in the lunar cycle, the tide's range is at its minimum; this is called the *neap tide*, or *neaps*.

Spring tides result in high waters that are higher than average, low waters that are lower than average, 'slack water' time that is shorter than average, and stronger tidal currents than average. Neaps result in less-extreme tidal conditions. There is about a seven-day interval between springs and neaps (<http://en.wikipedia.org/wiki/Tide>).

3.2.6 Data collection while 'on-transect'

Once the boat has arrived to the location that surveys begin, the boat stops and the second portion of the 'effort' data sheet is completed. This includes information on:

- Effort type (i.e. Begin Effort at the start of surveys, OC = Observer change, EC = Environmental change, PC = Position change and EE = End effort);



- Time;
- Transect/WPT number;
- Odometer;
- Beaufort/swell;
- Depth (from boats sounder);
- Temperature (from boats sounder).

Beaufort is one of the most important environmental variables to collect consistently during surveys, as the rougher the sea conditions the more difficult it is to observe marine mammals.

- **Beaufort/swell** - the Beaufort state and swell height, written as e.g. '2 / 0' for Beaufort / Swell respectively.
 - **Beaufort 0** = no ripples, flat calm.
 - **Beaufort 1** = corrugated iron-type ripples.
 - **Beaufort 2** = wavelets but no white-caps.
 - **Beaufort 3** = wavelets with white caps.
 - **Beaufort 4** = large waves, lots of white caps that are rolling, white bubbles.

Once a marine mammal sighting is observed, an entry will be made to end effort (with all other associated information), and the marine mammal group will be approached to complete the sighting sheet. All megafauna (i.e., sharks, turtles, sea snakes) were recorded on the 'megafauna data sheets', while the boat continues along the survey line.

3.2.7 Species identification and survey mode

'Closing mode' will be used for these surveys since:

1. Accurate species identification is required
2. Photo-ID will be conducted on individuals sighted, which requires the group to be approached.

After the dolphin group is approached, data on the groups' exact location, species identity, group size, group age composition and general behaviour was recorded. Photographs were taken during observations of the group. Environmental variables (depth, turbidity, temperature, salinity, Beaufort and tide state) will be recorded at the sighting location, once all information had been collected and the sighting was complete. The following provides more detail on the data to be collected (see below).

3.2.8 Environmental Data

Environmental parameters (depth, temperature, turbidity, salinity, pH, Beaufort, tide, tide-state and tide height) will be taken at the location of every dolphin sighting, and at the extremities of the survey region (i.e. the furthest points travelled upstream).

- Depth and tide height were taken from the vessels depth sounder.
- Temperature, turbidity, salinity, PH were taken from the Horiba water quality meter.
- Tide and tide state were taken from Austides 2013 (produced by the Australian Hydrographic Service).



These environmental data are essential when investigating habitat preferences and potential seasonality of sighting data of dolphins and dugongs.

3.2.9 Transect Protocols

Transect breaks will occur when:

1. dolphin groups were sighted,
2. weather deteriorates,
3. interviews were conducted.

Refreshment and toilet breaks will be scheduled for when observers are 'off-effort', so as not to interfere with survey progress and to maximise the distance covered each day.

Once a break was taken for a dolphin sighting, the boat will return to the transect line when observers were confident that all required data had been collected (including group size estimations) and photographs had been taken (taking into consideration the groups behaviour and the requirement to finish transect lines). The boat will return to the transect line at the closest location from the transect break point, taking into consideration the requirement to reduce double-counting by attempting to leave the sighted dolphin group behind. Studies have shown that sighting rates of a variety of marine wildlife decreases as weather deteriorates. Thus, all surveys were conducted in calm sea conditions (i.e. Beaufort Sea state ≤ 3 (no whitecaps) and swell $\leq 1\text{m}$, and no rain) to minimize variation in animal sightings and optimize use of resources available.

3.2.10 Additional Marine Megafauna Data to be Collected

During all surveys, any marine megafauna (i.e. dugongs, turtles, sawfish, crocodiles) birds, and other marine wildlife sighted were recorded with associated position and depth data. This sighting data is mapped, with associated mapping of the survey tracks travelled. Photographs were taken of additional marine megafauna whenever possible to enable confirmation of species identification, which is particularly important for turtles and sea snakes.

4 STUDY AREA

The study area is the Purari Delta of Gulf Province (Figures 8 and 9). Baimuru is the main town located in the north west of the study area.

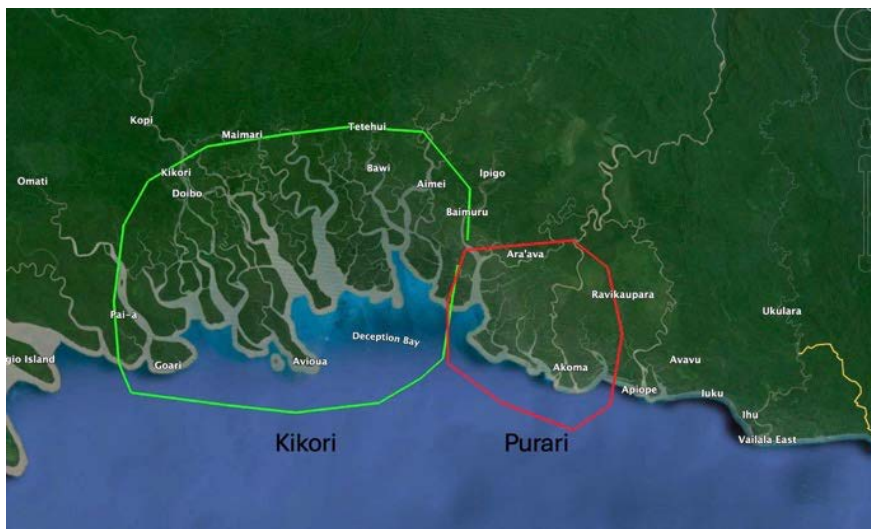


Figure 8. Purari Delta study area which is east of the Kikori Delta.



Figure 9. Purari Delta study area, showing the three main river channels (yellow highlight)

5 SURVEY TEAM

The marine mammal survey project is led by the Snubfin Dolphin Project (SDP) an Australian-based research and conservation NGO. SDP specializes in marine mammal research and conservation in PNG, with a particular emphasis on capacity building local students and researchers.

Project team members (Figure 10) were:

1. Dr. Isabel Beasley (SDP Lead)
2. John Ben (SDP Field Lead)
3. Tracey Boslogo (SDP Field Officer)
4. Ill Yamine Pilga (SDP Field Officer)
5. Captain Laka To-oro and Sioni (Black Bass crew)



Figure 10. Three team members interviewing an Aumu villager about dolphins in the area.



6 SCHEDULE

The Snubfin Dolphin Project (SDP) team mobilized to Port Moresby on Friday 13 October. The weekend was spent in training, with the official kick off meeting on 16 October. The SDP team boarded the survey vessel Silver Star on Thursday 19 October and departed that evening for the Purari River Delta. A summary of the project schedule and field activities is provided in Table 3.

Table 3. A summary of the daily activities

Day	Date	Activities	Region	Comment
1	Mon 16 th Oct	Kick-off meeting	POM	
2	Tue 17 th Oct	Preparation of documents and survey gear	POM	
3	Wed 18 th Oct	<ul style="list-style-type: none"> Silver Star loading and induction Departed to project area at 1700hrs 	POM to Apiope	Direct transit to Apiope with no formal operations
4	Thu 19 th Oct	<ul style="list-style-type: none"> POM to Apiope 	Arrived Apiope	No marine mammal sightings
5	Fri 20 th Oct	<ul style="list-style-type: none"> Boarded Black Bass at 10am to conduct marine mammal survey towards Purari River mouth Aumu community meeting 	Purari River	No marine mammal sightings
6	Sat 21 st Oct	<ul style="list-style-type: none"> Apiope community meeting 	Purari River	No marine mammal sightings
7	Sun 22 nd Oct	<ul style="list-style-type: none"> Dead dolphin recovery OHEI20231023_Apiope 	Orokolo Bay	Dead dolphin recovered
8	Mon 23 rd Oct	<ul style="list-style-type: none"> Community interviews at Apiope Village 	Coastal region	No marine mammal sightings
9	Tue 24 th oct	<ul style="list-style-type: none"> Community interviews at Kapai Village 	Coastal region	No marine mammal sightings
10	Wed 25 th Oct	<ul style="list-style-type: none"> Transit back to POM (TEP to assist with flood relief efforts) 	Purari River	Transit back to POM No marine mammal sightings
11	Thu 26 th Oct	<ul style="list-style-type: none"> Silver Star arrives to POM 6am SDP team (TB and JB) demobilise 	Arrive POM	
12	Fri 27 th Oct	<ul style="list-style-type: none"> IB demobilise to Hobart 	POM	



7 RESULTS - BOAT-BASED SURVEYS

7.1 EFFORT

Seven days were spent conducting dedicated boat-based surveys in the project area. A total of over 506.4 km was traveled over 46 hours and 4 minutes. Of this total, 253.2km (20 hours and seven minutes) were spent conducting on-effort observations dedicated to sighting marine mammals (Table 4). No marine mammals were sighted.

Table 4. Summary of boat-based survey effort

Day	Location	Boat Name	Total KM	Total Time	Total Time - On Effort	Total KM - On Effort	Sightings
19-Oct-23	POM to Apiope	Silver Star	44.7	04:07:00	4:07:00	44.7	0
20-Oct-23	Apiope and Aumu	Black Bass	21.0	02:26:00	2:25:00	21.0	0
21-Oct-23	Upstream Aumu	Black Bass	46.3	05:38:00	1:33:00	37.6	0
22-Oct-23	Apiope	Black Bass	43.3	07:07:00	0:00:00	0.0	0
23-Oct-23	Apiope	Black Bass	53.0	09:34:00	2:24:00	18.9	0
24-Oct-23	Silver Star to Kapai	Black Bass	24.1	02:00:00	0:00:00	0.0	0
24-Oct-23	Silver Star to Kapai	Black Bass	70.0	03:35:00	2:42:00	23.7	0
25-Oct-23	Apiope to POM	Silver Star	204.0	11:37:00	6:56:00	107.3	0
TOTAL			506.4	46 hrs 4 mins	20 hrs 7 mins	253.2	0

Survey sea conditions were quite average. River waters were reasonably calm but coastal waters were still rough with whitecaps and rough seas. The majority of boat-based surveys were conducted in Beaufort 3 conditions (133.8km), followed by Beaufort 2 conditions (73.0km) (Table 5).

Table 5. Summary of Beaufort conditions during boat-based surveys

Day	Location	Total KM - On Effort	B0	B1	B2	B3	B4	B5
19-Oct-23	POM to Apiope	44.7	0.0	0.0	40.6	4.0	0.0	0.0
20-Oct-23	Apiope and Aumu	21.0	0.0	10.7	10.3	0.0	0.0	0.0
21-Oct-23	Upstream Aumu	37.6	1.4	6.2	3.1	26.9	0.0	0.0
22-Oct-23	Apiope	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23-Oct-23	Apiope	18.9	0.0	4.1	2.7	11.6	0.5	0.0
24-Oct-23	Silver Star to Kapai	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24-Oct-23	Silver Star to Kapai	23.7	0.0	0.0	10.0	6.5	7.2	0.0
25-Oct-23	Apiope to POM	107.3	5.8	1.5	6.2	84.7	0.0	9.2
TOTAL		253.2	7.2	22.5	73.0	133.8	7.7	9.2

7.1.1 19 October 2023

On 19 October 2023, boat-based surveys were conducted onboard Silver Star as the vessel approached the Purari River Delta (Figure 11). Beaufort state ranged from 2 (little wavelets – no whitecaps) to 3 (small whitecaps). No marine mammals were sighted.

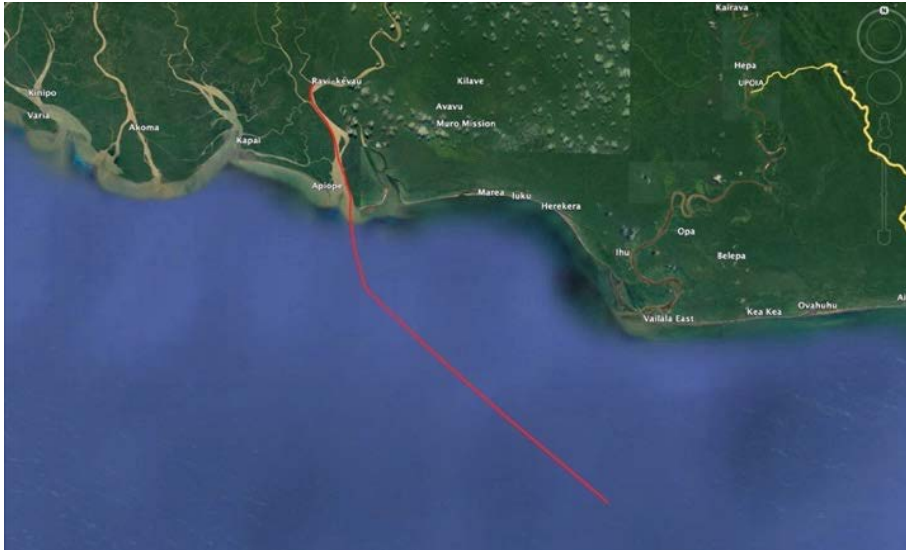


Figure 11. Survey track on 19 October 2023

7.1.2 20 October 2023

On 20 October 2023, boat based surveys were conducted from the Silver Star downstream to the river mouth near Apiope Village (Figure 12). Beaufort ranged from 1 (small ripples) to 2 (little wavelets – no whitecaps). No marine mammals were sighted

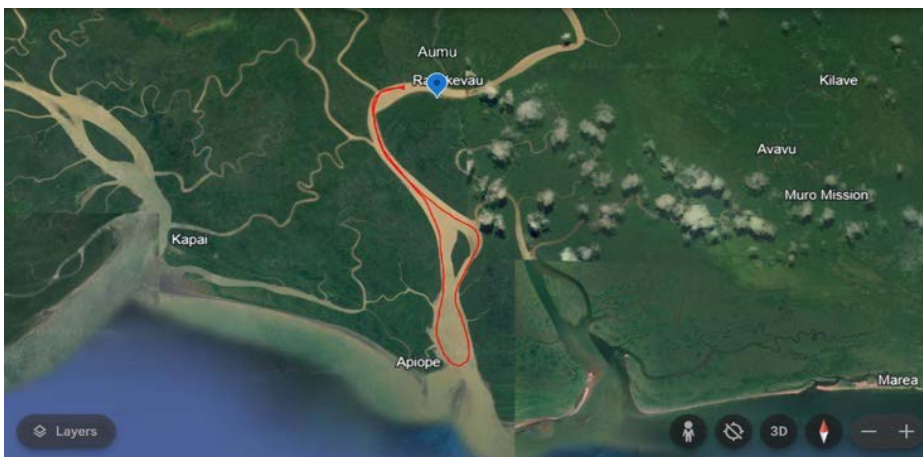


Figure 12. Survey track on 20 October 2023

7.1.3 21 October 2023

On 21 October 2023, rain and thunder delayed the start of surveys. Once the rain cleared, boat based surveys were conducted from the Silver Star upstream past Aumu approximately 10km (Figure 13). The team then traveled downstream to the river mouth. Beaufort ranged from 1 (small ripples) to 2 (little wavelets – no whitecaps). No marine mammals were sighted



Figure 13. Survey track on 21 October 2023

7.1.4 22 October 2023

On 22 October 2023, the day was spent retrieving the dead snubfin dolphin from near Apirope Village (Figure 14). Limited marine mammal observations were conducted as the day was spent transit to and from the stranding site. No live marine mammals were sighted.

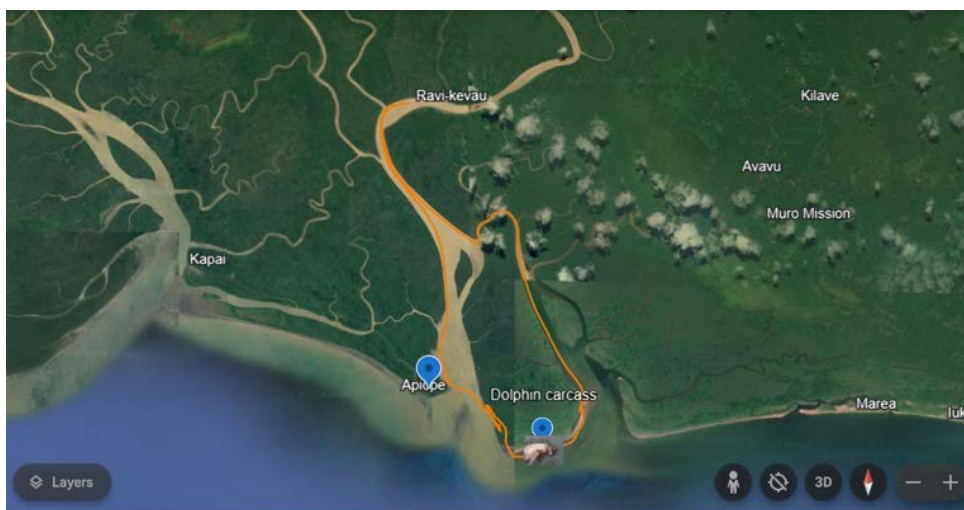


Figure 14. Survey track on 22 October 2023

7.1.5 23 October 2023

On 23 October 2023, the team surveyed downstream to the river mouth near Apiope Village, then out towards the eastern river mouth. (Figure 15). Beaufort ranged 1 (small ripples) to 4 (large whitecaps and rolling waves). No marine mammals were sighted.



Figure 15. Survey track on 23 October 2023

7.1.6 24 October 2023

On 24 October 2023, the team surveyed through an inland river channel towards Kapai Village. Some observations were undertaken around Kapai Village before returning back to the Apiope region. (Figure 16). This region appeared very suitable for inshore dolphins, with a number of river channels converging, mangrove habitat and a lot of bird feeding activity. Beaufort ranged 2 (little wavelets – no whitecaps) to 4 (large whitecaps and rolling waves). No marine mammals were sighted.



Figure 16. Survey track on 24 October 2023

7.1.7 25 October 2023

On 25 October 2023, the team transited back from the Purari River mouth to Port Moresby (Figure 17). The early morning survey conditions through the river mouth were excellent, however no marine mammals were sighted.

The sea conditions were quite rough on the transit back through the Gulf of Papua, ranging from Beaufort 3 (small whitecaps) to Beaufort 5 (very large white caps with rolling waves). Effort was concluded at sunset and the vessel continued its transit to Port Moresby. No marine mammals were sighted.

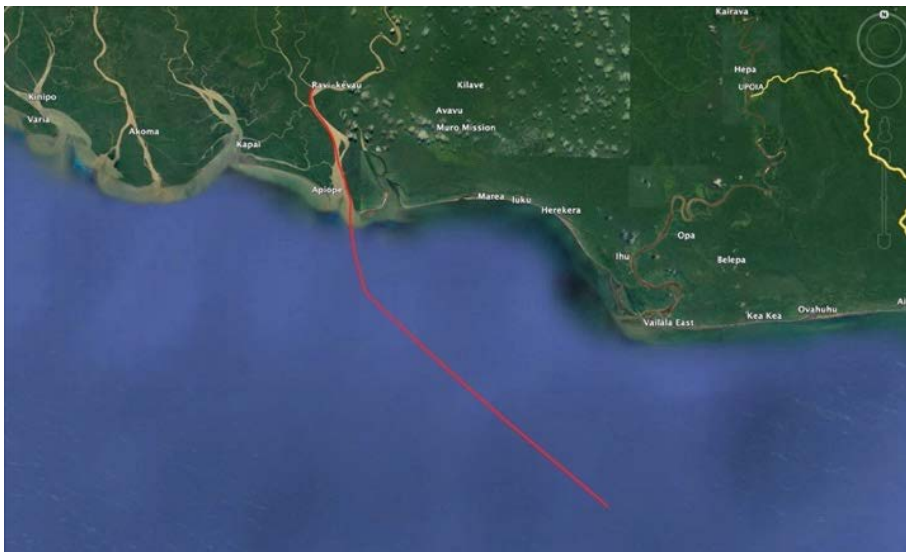


Figure 17. Survey track on 25 October 2023

7.2 MARINE MAMMAL SIGHTINGS

No live marine mammals were sighted during surveys. One dead snubfin dolphin was found near Apiope Village on 22 October 2023.

7.3 MARINE MEGAFUNA

One sea snake was sighted on 19 October 2023 on the transit towards the Purari River mouth (Figure 18). The species could not be determined.

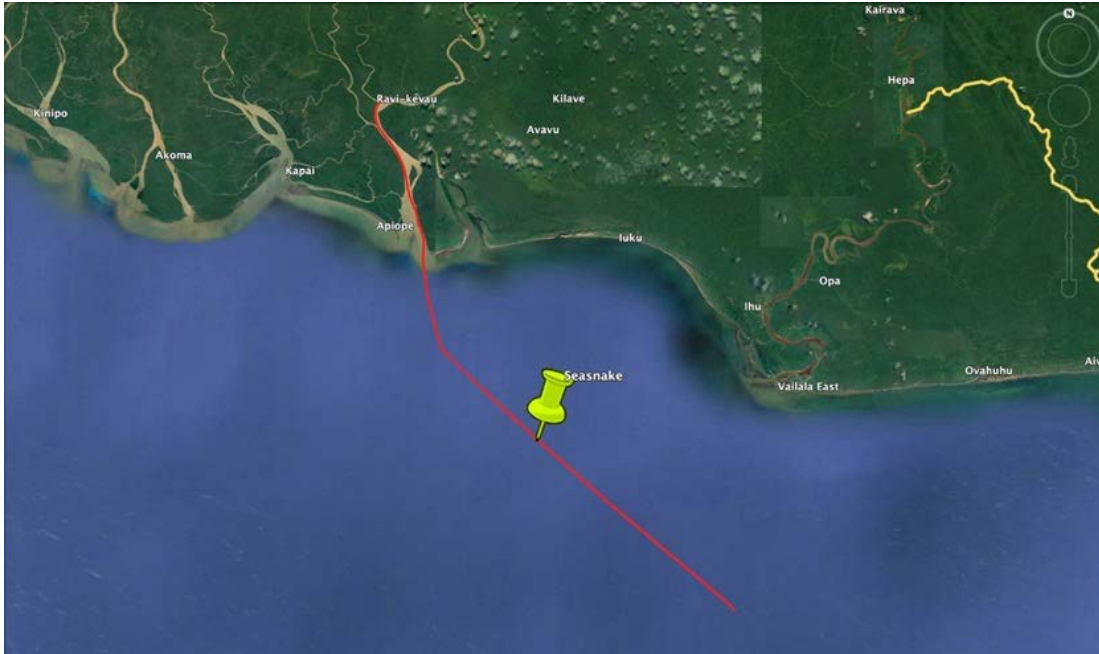


Figure 18. Seasnake sighted on 19 October 2023 during the transit towards the Purari River mouth

8 DOLPHIN STRANDINGS AND SKELETAL MATERIAL

8.1 SNUBFIN DOLPHIN – NEAR APIOPE VILLAGE

On 21 October 2023, after the Apiope community meeting, a young boy came up to inform the team that he had found a dead dolphin on the headland that morning. Village members and the team went to view the dolphin on 22 October 2023 (Figure 19-21).

- The dolphin was an adult female snubfin dolphin
- Specimen number: OHEI20231022_Apiope
- Location found: Apiope Headland. Lat: -7.86196, Long: 145.2025
- Total length: 217m
- Samples collected: Photographs, skull, teeth, skin, stomach
- Cause of death: Probably caught in a net – tail had been cut cleanly by a knife and there appeared to be net marks around the neck region



Figure 19. OHEI20231022 – Snubfin dolphin found on a headland near Apiope



Figure 20. OHEI20231022 – Snubfin dolphin found on a headland near Apiopie (right side)



Figure 21. OHEI20231022 – Snubfin dolphin found on a headland near Apiopie (left side)

Measurements were taken of the total length, flipper width and length, and dorsal fin length and height. The stomach was also taken, which was full indicating that it was a healthy dolphin that was actively feeding prior to death (Figures 22-23).



Figure 22. Stomach of OHEI20231022 filled with prey items



Figure 23. Fish, eels, prawns and shrimp found in stomach of OHEI20231022

8.2 RISSO'S DOLPHIN (SPECIES TO BE CONFIRMED) – KAPAI VILLAGE

After the community workshop at Kapai, a number of village members informed us about dead whales and skeletal material that has been sighted/recovered (Figure 24 and 25).

One boy showed us a skull that appears to be a Risso's dolphin (*Grampus griseus*). The skull is quite worn so this species identification will need to be confirmed using genetic testing of the bone samples.



Figure 24. Probable Risso's dolphin skull found at Kapai Village



Figure 25. Probable Risso's dolphin skull found at Kapai Village

8.3 LARGE UNKNOWN WHALE – KAPAI VILLAGE

Other village members showed us the vertebrae from a large whale that stranded on the other side of the river earlier in the year (Figure 26).



Figure 26. Rib bone (left) and vertebrae (right) of large whale stranded near Kapai Village

9 COMMUNITY MEETINGS

Community meetings were held at three communities: Aumu, Apiope and Kapai Villages (Figure 27). The main summaries from each community meeting are provided below, with a selection of meeting images in Appendix 1-3.

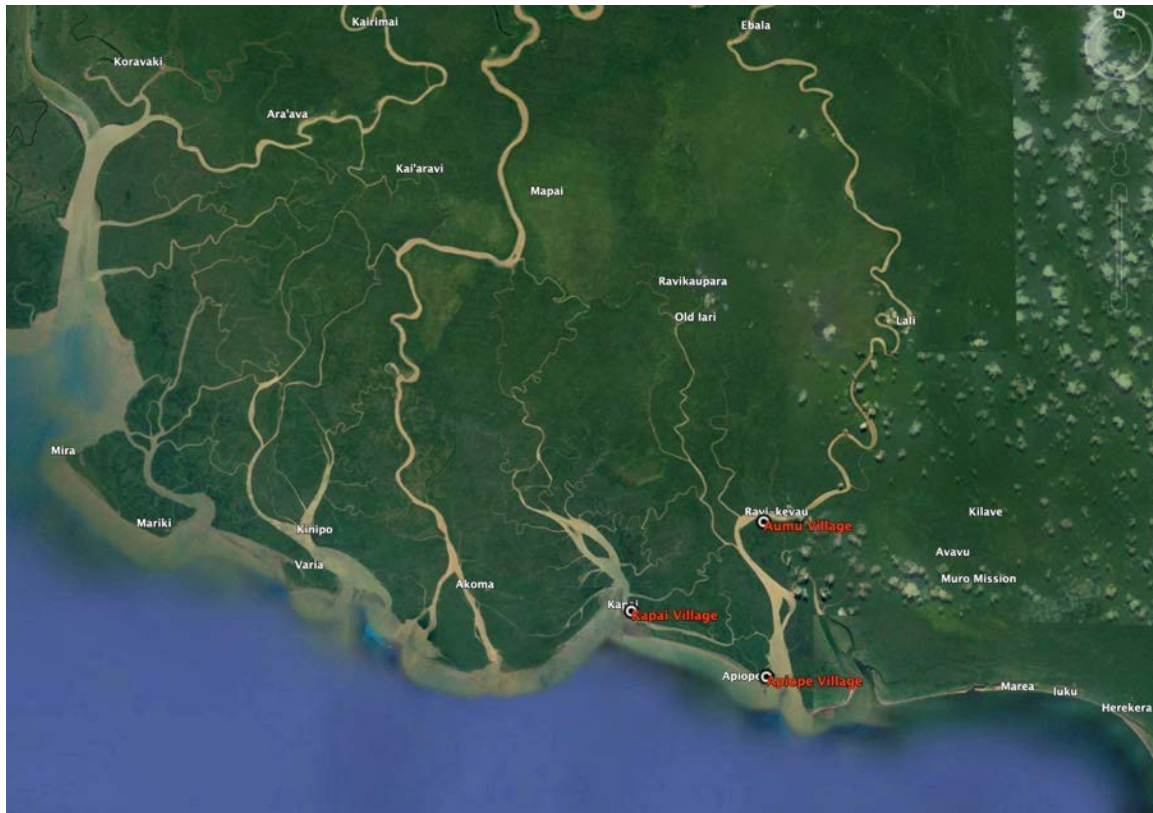


Figure 27. Location of community meetings at Aumu, Apiope and Kapai Villages

AUMU - Main Outcomes From Meeting

- Aumu Village is located approximately 15 km up the Purari River (Figure 28).
- Meeting attendance - 20 men, 35 woman and 11 children.
- Aumu Village leaders and elders were very vocal about their dissatisfaction with many the oil and gas companies that have operated upstream since 2007 (i.e. oil search and Total Energies), and also the logging company RH which operated prior to 2007.
- The village elders raised their concern about livelihood projects such as water and sanitation that were not attended to by companies using their river system to date. The main grievances that the community mentioned in the meeting were:
 - Lack of drinking water
 - Oil and gas and logging industries destroying the environment
 - Noise and increase in vessel traffic
- **No dolphin sightings in front of village since 2007.**
- Prior to 2007, the community said that they would often see dolphins in front of their village when the sea water came up with the tides.
- The lack of dolphin sightings seems to coincide with when the clear salt water stopped flowing upstream during high tide (no doubt resulting from sedimentation of the river mouth).
 - This leads on to questioning whether the proposed dredging project at the Purari River mouth may have at least one positive impact, in terms of opening the channel for sea water to travel upstream again
- After the meeting the community appeared happy to support any dolphin research or conservation efforts by SDP (Figure 27).
- One community member later provided one-on-one discussions to the SDP team (see Section 10 - Interview 1).



Figure 28. Aumu Village meeting

APIOPE - Main Outcomes From Meeting

- Apiope Village is located at the mouth of Purari River (Figure 26).
- Meeting attendance - 23 men and 11 male youths, 27 woman and 18 children.
- Village leaders were vocal about their concern about the effects of the dredging project on their environment and fisheries.
 - Village leaders expressed dissatisfaction with regards to how the community awareness are often carried out. The information about developmental impacts is often always on the positive side, no negatives for the community to consider.
- Village leaders are also very concerned about the continual erosion that is destroying their village.
- **It was unanimously agreed that both inshore dolphin species are commonly sighted around Apiope Village.**
- The community were very happy to help with further one-on-one discussions about dolphins in the area.
- The community were very happy to help us with information about the dead dolphin, and take us to it the next day.
- The VLO Moses Hapi seems very passionate about the environment and conservation of natural resources. He is well educated and explained our objectives very well to the community. He seems to be a key community member for future awareness and community outreach in Apiope Village (Figure 29).
- Three community members later provided one-on-one discussions to the SDP team (see Section 10 - Interviews 2-4).



Figure 29. Some of the participants from Apiope Village community meeting



KAPAI - Main Outcomes From Meeting

- Kapai Village is located near the Gulf of Papua coast, between the Purari and Ivo River mouths (Figure 30).
- Meeting attendance - 20 men and 8 youth boys, 12 women and 6 youth girls and 15 children
- Villager leaders and speakers rarely voiced concerns about Total Energies and previous oil and gas projects
 - Since the village does not experience shipping or other vessels transiting its waters, the villagers would not experience much disturbance from TEP project activities.
- **It was unanimously agreed that both inshore dolphin species are still commonly sighted around Kapai Village.**
 - The last time someone had sighted dolphins near the village was three days ago during a transit back to the village.
- The community were very happy to help with further one-on-one discussions about dolphins in the area and show the team fishing nets and skeletal specimens.
 - Three interesting interviews were conducted after the meeting, as well as three interviews regarding net types and uses.
- The first fisher to speak in the meeting – Tony Omae, was very honest right from the onset that he had previously accidentally caught three dolphins in this net (on three separate occasions a long time ago but he could not remember exact dates), and the village had eaten the dolphins. This honesty was unexpected but paved the way for other speakers to hopefully be honest about their interactions with dolphins.
- It was obvious that many people (if not all) are eating dolphins/whales, if they are caught in nets. Villagers will kill a dolphin if still alive to take back to the village to eat.
- Interestingly, no inshore dolphin skulls were available in the village
- A young boy brought a probable Risso's dolphin skull for us to view. Another couple of people brought the rib bones and vertebrae from a larger whale of unknown species. This region therefore appears to attract some oceanic species, probably strandings rather than resident populations.
- This was a very easy village to conduct the meeting and interviews. The presence of many high level officials likely assisted with the process (Figures 30 and 31).
- Three community members later provided one-on-one discussions to the SDP team (see Section 10 - Interviews 5-7).
- Quote from Solomon Lae, Kapai Village - **"We never treat these people (pointing and referring to the inshore dolphins on the information sheet) with respect. Now we know they suffer from our hands."**



Figure 30. Kapai meeting participants



Figure 31. Key participants from the Kapai Village meeting

10 COMMUNITY DISCUSSIONS/INTERVIEWS

Seven informal discussions/interviews were held with community members after the meetings. One from Aumu Village, two from Apiopie Village and four from Kapai Village (Figure 32).

Of primary interest was the last time community members has sighted dolphins in the area in front of their village. Responses were:

- Interview 1 - Aumu - Last saw before 1991 (<10 years ago)
- Interview 2 - Apiopie - Last saw May 2022 (1-5 years ago)
- Interview 3 - Apiopie - Last saw 3 months ago (1-6 months ago)
- Interview 4 - Kapai - Last saw 1-5 years ago (1-5 years ago)
- Interview 5 – Kapai – Last saw November 2022 (1-5 years ago)
- Interview 6 – Kapai - Last saw 1-6 months ago (1-6 months ago)
- **Interview 7 – Kapai - Last saw 3 days ago (within past week)**

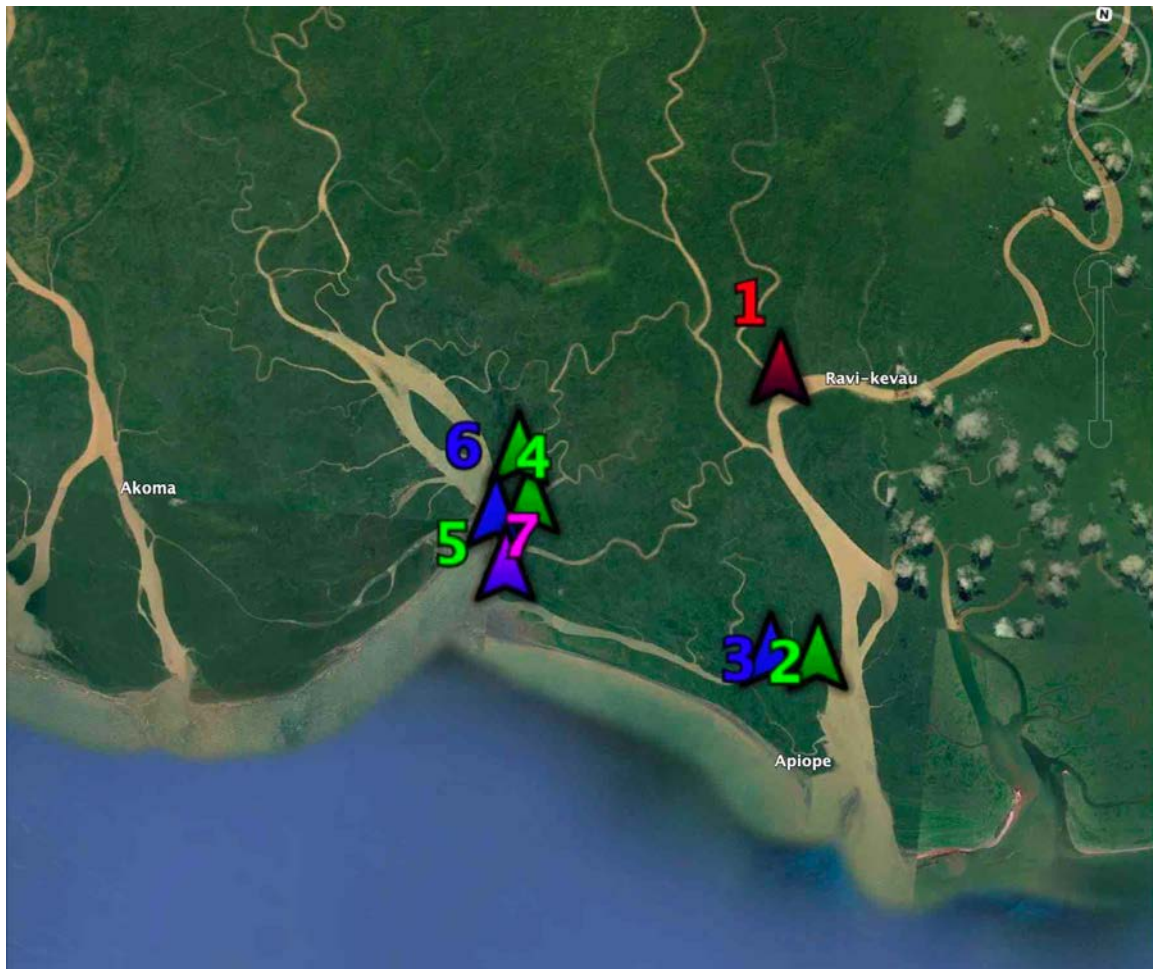


Figure 32. Location of seven interviews. Red icon = < 10 years, Green icon = 1-5 years, Blue icon = 1-6 months, Purple icon = past week.

10.1 AUMU VILLAGE – INTERVIEW ONE

The main findings from **interview one – Aumu village** (Figure 33) were:

- Even though he regularly fishes in the Aumu region, **he has not sighted dolphins since 1991.**
- He had seen both long and short nosed dolphins previously.
- He had not recently seen dolphins in any other parts of the Delta.
- Traditional name is 'Ai'i and Pinane respectively.
- He fishes uses 6-inch nets, primarily for large fish for the swim-bladder fishery.
- He has seen one dead dolphin previously. He cut off the fins and sold at the market at Port Moresby.
- He thinks dolphin numbers are decreasing because of boats traveling in and out of the river, dolphins caught in gillnets, and disturbances from upstream.



Figure 33. Interview one. Fishbladders from stonefish (approx. 5grams each worth PGK20)

10.2 APIOPE VILLAGE – INTERVIEW TWO

The main findings from **interview two – Apiope Village** (Figure 34) were:

- **He last saw dolphins in this area in 2022.**
- He had seen both long and short nosed dolphins previously, and also a medium sized dolphin.
- He had not recently seen dolphins in any other parts of the Delta.
- Traditional name is '*Dui*' for all dolphins.
- He does not use nets to fish, he uses bow and arrow fishing method.
- He has never previously caught a dolphin, but he has seen dead dolphins in other fishers nets in 2022.
- He does not know if dolphin numbers are increasing or decreasing.



Figure 34. Interview two. Traditional fishing methods still being used at Apiope Village

10.3 APIOPE VILLAGE – INTERVIEW THREE

The main findings from **interview three – Apiope Village** (Figure 35) were:

- **He last saw dolphins in this area 6 months ago (short nose).**
- He had seen both long and short nosed dolphins previously, and also a medium sized dolphin.
- He had not recently seen dolphins in any other parts of the Delta.
- Traditional name is 'Dui' for all dolphins.
- He uses 1-3 inch gillnets to fish for small and big fish. Big fish are sold for their swimbladders and small fish are eaten.
- He previously caught one dolphin in his net (caught by the tail), but it broke away.
- If he did previously catch a dolphin in his net he would have given it to people in the village that eat dolphins.
- He believes dolphin numbers are increasing because:
 - Village does not catch dolphins or target them and by-catch is rare



Figure 35. Interview three. Sighted short-nosed dolphin 3 months ago

10.4 KAPAI VILLAGE – INTERVIEW FOUR

The main findings from **interview four – Kapai village** (Figure 36) were:

- **He last saw dolphins 1-5 years ago.**
- He had seen only short nosed dolphins previously.
- He had not recently seen dolphins in any other parts of the Delta.
- Traditional name is 'Ere Morere'.
- He fishes uses ½ inch nylon, 7-inch guardline and woven net, primarily for baits, large fish for the swim-bladder fishery, and prawns/fish bait respectively.
- If he did catch a dolphin in his net, he would eat it.
- He thinks dolphin numbers are increasing because villagers haven't caught dolphins very often.



Figure 36. Interview four. Last saw dolphins 1-5 years ago

10.5 KAPAI VILLAGE – INTERVIEW FIVE

The main findings from **interview five – Kapai village** (Figure 37) were:

- This lady found a small whale in November 2022. It got caught on her fishing line and dragged her boat upstream. The whale was killed by locals and they ate it.
- It had a short nose. The skull is still kept at the village and is a probable Risso's dolphin.
- She has not seen dolphins in any other parts of the Delta.
- Traditional name is '*Ere Morere*'.
- She uses 20 to 40lb fishing line, primarily to catch fish for the swim-bladder fishery.
- If he did catch a dolphin in his net he would eat it.
- She thinks dolphin numbers are increasing because there are plenty of dolphins in the river and they do not kill them.



Figure 37. Interview five. Last saw a potential Risso's dolphin in November 2022

10.6 KAPAI VILLAGE – INTERVIEW SIX

The main findings from **interview six – Kapai village** (Figure 38) were:

- He has seen both long nose and short nose dolphins.
- **The last time that he saw dolphins was 1-6 months ago.**
- No local name mentioned.
- He primarily uses a 5-inch nylon net, primarily to catch large fish for the swimbladder fishery.
- He has not caught a dolphin previously in his net.
- He thinks dolphin numbers are increasing because they do not kill them.



Figure 38. Interview six. Last saw dolphins 1-6 months ago

10.7 KAPAI VILLAGE – INTERVIEW SEVEN

The main findings from **interview seven – Kapai village** (Figure 39) were:

- In the community meeting Tony was the first to honestly and openly admit that he had previously caught three dolphins in his net (over several years a long time ago, but he could not remember exact years) and that people in the village had eaten them. This honesty assisted others in the meeting to talk openly about dolphins that had seen, and also eaten.
- He has seen both long nose and short nose dolphins.
- Traditional name for both species is '*Ere Morere*'.
- The last time that he saw dolphins was within the past week (3 days ago).
 - He mentioned that the dolphins do not go much upstream. They are mainly seen around the river mouth and waters in front of the village.
- He fishes every day
- He primarily uses a 6-inch rope net, and 3-8 inch nylon/store brought net, primarily to catch large fish for the swimbladder fishery.
- He has previously caught three short-nose dolphins in his net. He gave to the people in his village to eat. He does not eat dolphin (the interviewee did not ask why he does not eat dolphin).
- He thinks dolphin numbers are increasing because they do not kill them.



Figure 39. Interview seven. Last saw dolphins 3 days ago



11 DISCUSSION

11.1 BOAT-BASED SURVEYS

The live-aboard vessel Silver Star and the associated tender Black Bass have been excellent accommodation/survey vessels for Phase I.

Unfavourable weather along the coastline that has prevented preliminary boat-based surveys using Silver Star. However, surveys have been conducted within the Purari River and river mouths near Apiope and Kapaï using Black Bass.

No live dolphins have been sighted.

There are **two main survey restrictions** that have affected dolphin sightings during surveys are:

- Tender vessels are currently unable to travel along the coast because of operational restrictions – the coastal transects within 1km from the shore have the highest probability of sighting dolphins in this region.
- Surveys have been unable to start early because of the 7am toolbox meeting that everyone must attend for OHS purposes. The survey team must also be back on the vessel by 5pm. The best times to sight dolphins are in the early morning and late afternoon/early evening, so these crucial times are not being surveyed.

Future boat-based surveys will require a large accommodation vessel, such as Silver Star, and an associated tender vessel that can access coastal and riverine waters. Within PNG, a company named TWL has numerous vessels available that would be suitable for future surveys.

Weather is the other major consideration when planning future surveys. There is only a very short weather-window to conduct boat-based surveys in Gulf Province, which is from December – March. January is the most predictably calm-weather month. Outside these months the seas are too rough to conduct surveys.

11.2 RECOVERY OF DEAD DOLPHINS AND SKELETAL MATERIAL

Recovery of dead dolphins and skeletal material is always an important component of any marine mammal research program. During Phase 1A, three marine mammal remains were recovered:

- Snubfin dolphin carcass from near Apiope Village
- Probable Risso's dolphin skull from Kapaï Village
- Unidentified large whale rib bone and vertebrae from Kapaï Village.

These samples will be stored at the Piku Biodiversity Network office until appropriate CEPA export permits can be obtained to send the samples for genetic analysis. Genetic analysis will assist to confirm species identification and gender.



The snubfin dolphin skull is currently buried at Apiope Village. It will eventually be taken back to the PNG National History Museum and Art Gallery, to be curated with the other inshore dolphin specimens.

The PNG National History Museum and Art Gallery has recently obtained a storage container to assist with storage of samples. This has helped to facilitate SDP continuing to collect inshore dolphin skeletal material.

11.3 COMMUNITY MEETINGS

The community meetings have been very informative and have provided a good opportunity to raise local awareness about the critical situation facing inshore dolphins in Gulf Province. The structure and format of the community meetings has worked very well, and the community eventually appear very interested to engage with the team, and later to be informally interviewed. It has been important to overcome the community's initial distrust of TotalEnergies, which was very evident at Aumu and Apiope Villages in particular.

There are no recommended changes to the format of the workshops, as they are running well and providing a good introduction to the team and project objectives for the villages. The primary recommendation is that as many villages as possible are covered during Phase 1, so that the majority of communities throughout the project area are aware of the project and its objectives.

11.4 COMMUNITY DISCUSSIONS

The community discussions after the meeting have provided very valuable information on dolphin occurrence and mortality rates and causes.

Based on the community responses there will be some minor changes made to the questionnaire to help to clarify some questions.

11.5 INSHORE DOLPHIN OCCURRENCE IN THE PURARI DELTA

Only one week of community meetings and discussions were undertaken, however, significant information was obtained regarding the occurrence and potential hotspots for marine mammals in the Purari Delta.

Unlike the Kikori Delta region, inshore dolphins do not appear to be traveling far upstream. In fact, in Aumu Village (which is only approximately 20km from the Purari River mouth), elders reported that they have not seen dolphins in front of the village since 2007. The timing when dolphins stopped coming upstream appears to be when the salt water stopped flowing up to the village at high tide. All community members agreed that the water in front of the village was previously salty during high tide, but now no saltwater reaches the village. Further community meetings and interviews will be a high priority at Evara, Mapalo and Kapuna Villages in the upper reaches of the Purari River.



The lack of dolphins upstream from Aumu is also likely related to the change in riverine habitat from mangrove to palms (Figure 40), which is subsequently related to a lack of salt water upstream and deeper waters caused by high water flow. The Purari River vegetation is in stark contrast to the mangrove lined riverine/delta environment of the Kikori Delta, where mangroves, small channels and islands are found many kilometres upstream.



Figure 40. Palms along the riverbank just upstream from Aumu Village

12 BOAT-BASED SURVEY STUDY DESIGN FOR GULF PROVINCE

The first inshore dolphin survey in Gulf Province, PNG was in 1999 in the Kikori Delta, conducted by WWF PNG program in collaboration with the PNG Museum and Art Gallery. Inshore dolphin studies in the Kikori Delta have been conducted opportunistically since 2011 by SDP. The last large-scale boat-based surveys to be undertaken in Kikori Delta was 2015. Significant dolphin mortalities have occurred since this time, as recorded through the 2022 and 2023 SPREP funded dolphin monitor project, so it is important to now conduct a recent population and conservation assessment of inshore dolphins in Gulf Province.

No studies had previously been conducted in the adjacent Purarai Delta. Total Energies initiated studies in October 2023 in collaboration with SDP (preliminary results included in this report) and supported by SPREP. These studies aimed to establish inshore dolphin species diversity, occurrence and potential hotspots in the Purari Delta.

Population assessments of snubfin and humpback dolphins in the Kikori/Purarai Delta regions are now urgently required to understand the size of remaining populations (Figure 41). The following is a proposed study design to assess population status using community meetings and boat-based surveys.

12.1 AIMS AND OBJECTIVES

The aims of the Gulf Inshore Dolphin Assessment (GIDA) are to identify current key hotspot areas for inshore dolphins in the Kikori/Purarai Delta regions and obtain estimates of relative abundance. Identification of hotspots for dolphins in areas where there is little or no swim bladder fishing may provide opportunities to develop marine mammal protected areas in consultation with community members.

The objectives are:

- **Phase 1:** Conduct community meetings with selected villages regarding marine mammal occurrence and diversity
- **Phase 2:** Conduct boat-based surveys throughout Kikori and Purari Delta riverine and coastal waters.



Figure 41. Humpback dolphins sighted in the Purari Delta

12.2 STUDY AREA

The two primary areas in Gulf Province where inshore dolphins are known to occur are the Kikori Delta and Purari Delta (Figures 42 and 43). In these maps, the green polygon shows the Kikori Delta region, and the red polygon shows the smaller Purari Delta region.

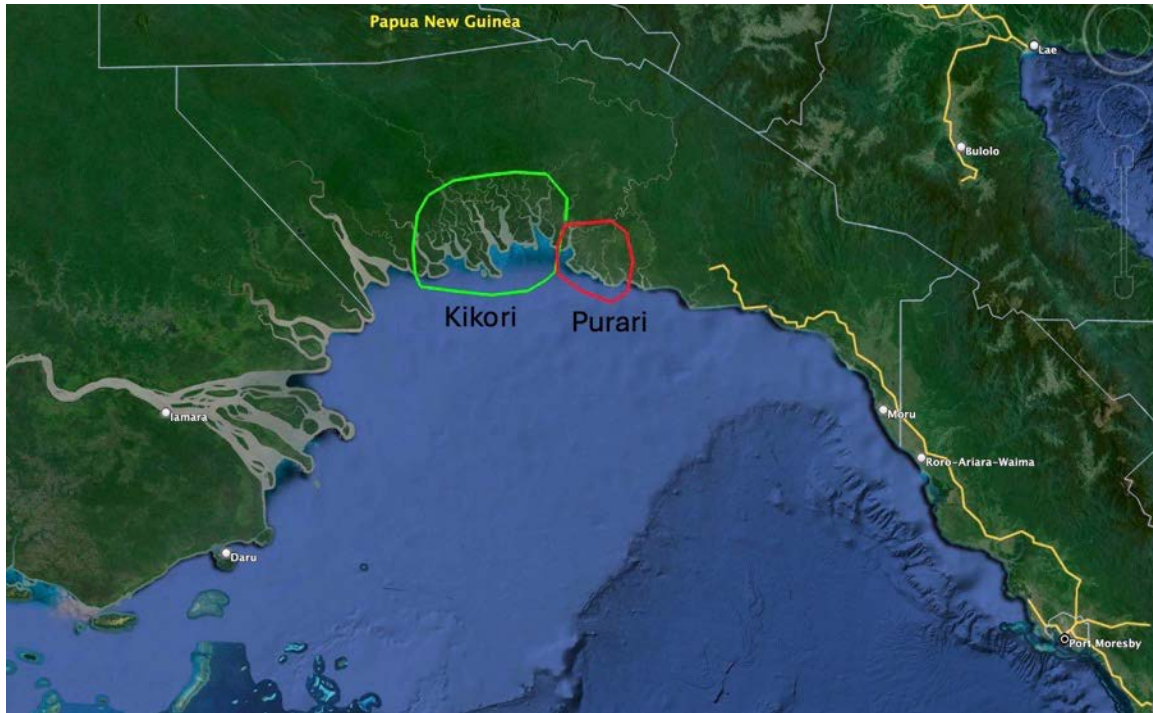


Figure 42. Location map of the Kikori and Purari Deltas, Gulf Province, Papua New Guinea

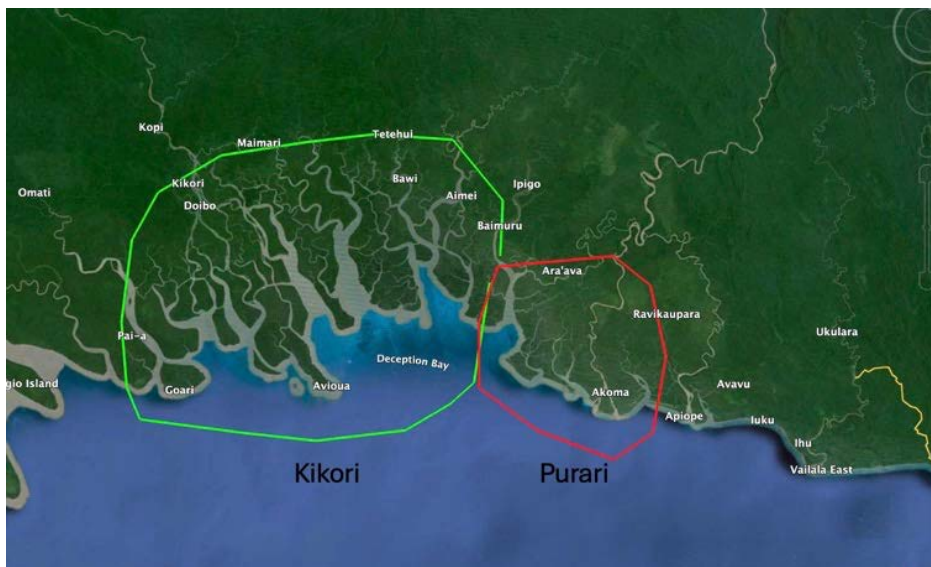


Figure 43. Close up view of the location of the Kikori and Purari Deltas, Gulf Province, Papua New Guinea



Although close in proximity, the habitats for the two regions are very different. In the Purarai Delta there is a very quick change in riverine habitat from mangrove to palms, after only 10-15km upstream. This is related to a lack of salt water upstream and deeper waters caused by high water flow. The Purari River vegetation is in stark contrast to the mangrove lined riverine/delta environment of the Kikori Delta, where mangroves, small channels and islands are found many kilometres upstream.

12.3 METHODS

Experiences gained through previous projects have assisted to develop the survey methodology proposed for this GIDA. As part of the project, it is essential that communities throughout the Delta are first notified of the proposed project, and their permission sought to undertake surveys throughout their waters. Village meetings associated with this objective also provide an opportunity to provide awareness materials to communities, and answer any questions they may have about the project.

Methods are therefore separated into two phases:

- **Phase 1:** Conduct community meetings with selected villages regarding marine mammal occurrence and diversity
- **Phase 2:** Conduct boat-based surveys throughout Kikori and Purari Delta riverine and coastal waters.

12.3.1 PHASE 1 - COMMUNITY MEETINGS

The methodology is based on the pilot study conducted and reported on in the first part of this report. The first phase of the project will be to conduct awareness and community meetings with villages throughout the Kikori/Purarai Deltas. This component is essential as a first step to ensure communities are aware of the project, and the boat-based surveys that will be conducted in Phase 2. All community meetings in the Kikori Delta will be held in partnership with the Piku Biodiversity Network. All community meetings in the Purari Delta will be held by SDP team, in partnership with existing community leaders.

- Key villages throughout the region will be pre-selected for community meetings;
- Village chiefs and ward councillors will be informed of the meetings through official invitation at least two weeks prior to the meeting being undertaken, and asked if they allow the SDP team to visit their village to hold the meeting;
- Meetings dates will need to be semi-flexible within 1-2 days to account for poor weather or other unforeseen circumstances;

During the meeting, the first priority for discussions will be to introduce the Pidu dolphin project and inform the community about the critical situation facing inshore dolphins in Gulf Province. This information will provide a good introduction to the project team and raise the interest of



the community to discuss further topics regarding marine mammal diversity and occurrence with team members.

If community members are interested to discuss further topics with the project team, existing datasheets that have already been trialled and utilized in the Kikori/Purari Delta dolphin project will be used to determine:

- Marine mammal species diversity and occurrence, and
- Mortality rates and causes

The interviews will also provide an opportunity for the community to share any local folklores about dolphins and dugongs, if they choose to do so. Traditional Ecological Knowledge experts will be consulted about how best to collect and store this information.

Any community members that are interested to answer further questions about marine mammal diversity, occurrence and mortality rates and causes will be asked to sign an associated consent form to confirm that they were happy to provide their answers to the project. Phase 1 must be undertaken prior to boat-based surveys, to ensure the

12.3.2 PHASE 2 - BOAT-BASED SURVEYS

Phase 2 will consist of dedicated boat-based surveys throughout the Kikori/Purari Delta regions. These surveys will follow standard transect protocols commonly used to study cetaceans. Investigating occurrence and key areas will be the primary focus of boat-based surveys, as well as obtain relative estimates of abundance (i.e. number of groups/individuals per kilometre surveyed).

It is recommended that two vessels are used for surveys; a larger live-aboard accommodation vessel and an associated tender that can access coastal waters (Figures 44 and 45).



Figure 44. Accommodation vessel the Silver Star



Figure 45. Black Bass

12.3.2.1 SURVEY METHODS

VESSEL OBSERVATIONS

A minimum of two observers will undertake observations from the live-aboard vessel while it is in transit. Observers will search 'on-effort' with binoculars (binoculars to be used intermittently) on either side of the bridge wings. One of these observers will also be 'recorder' and scanning primarily with naked eye at the centre of the flying bridge (only in good weather conditions). Observer positions will be rotated every 30 mins to reduce observer fatigue.

The scanning pattern utilised is designed to maximise observers sighting marine mammals close to the transect line, as well as further away from the vessel:

1. Each observer scans for dolphins with binoculars from 90 degrees to their side of the boat to 10 degrees to the opposite side of the bow.
2. The recorder also scans 180 degrees in front of the boat, primarily with naked eye.
3. Observers scan each field of view for 5 seconds and moved onto the next field of view until 90 degrees is reached. Approximately 2-3 minutes is then spent scanning with naked eye. This will help to avoid eye fatigue and will allow observers the opportunity to spot marine wildlife in a broader field of view. This scanning protocol will be repeated in a slow, gradual scan motion throughout each 30 min observer rotation.

Once a marine mammal group is sighted, the survey team will collect the necessary location data, and then transit to the marine mammal group to obtain additional data and photographs.

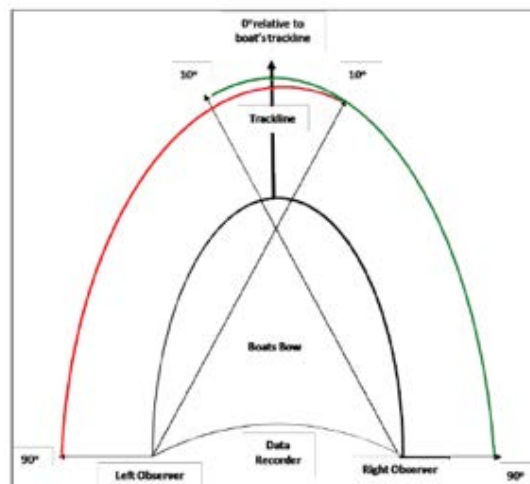


Figure 2: Suggested observer positions and area to be scanned.

VESSEL SPEED

Vessel surveys will be carried out at a consistent low speed (12-15 km/ h, 6-8 knots) while 'on-transect'. Previous experience has shown that if surveys are conducted at higher speeds fewer sightings will be observed, as there is considerably less time for animals to surface within the field of view of observers. Thus, it is important that speed is kept constant across all transect lines.



DATA COLLECTION

The 'effort' data sheet (data sheet that records time and number of kilometres surveyed throughout the day) is completed everyday day by the survey team (Appendix One).

Start of day

At the start of the day before the boat departs for surveys, observers complete the top section of the effort data sheet, which includes details about:

- departure location
- the area to be surveyed
- names of observers
- start time from the GPS
- start odometer km from the GPS (which is always reset to '0' before surveys begin).

The 'trip computer' on the GPS page displays all relevant information for the effort sheet, primarily time and odometer. The boat then travels to the location that surveys will begin for the day. The boat track is always recording automatically every 2 minutes using the GPS, and is not turned off until the survey teams have finished surveys for the day. Information on tides and tide state is also collected, to determine whether tides have an influence on dolphin distribution within the study area.

Tides and Beaufort

The semi-diurnal range (the difference in height between high and low waters over about half a day) varies in a two-week cycle. Approximately twice a month, around new moon and full moon when the sun, moon, and earth form a line (a condition known as syzygy, the tidal force due to the sun reinforces that due to the Moon. The tide's range is then at its maximum; this is called the *spring tide*.

When the moon is at first quarter or third quarter, the sun and moon are separated by 90° when viewed from the Earth, and the solar tidal force partially cancels the Moon's. At these points in the lunar cycle, the tide's range is at its minimum; this is called the *neap tide*, or *neaps*.

Spring tides result in high waters that are higher than average, low waters that are lower than average, 'slack water' time that is shorter than average, and stronger tidal currents than average. Neaps result in less-extreme tidal conditions. There is about a seven-day interval between springs and neaps (<http://en.wikipedia.org/wiki/Tide>).

Data collection while 'on-transect'

Once the boat has arrived to the location that surveys begin, the boat stops and the second portion of the 'effort' data sheet is completed. This includes information on:

- effort type (i.e. Begin Effort at the start of surveys, OC = Observer change, EC = Environmental change, PC = Position change and EE = End effort)
- time
- transect/WPT number
- odometer
- beaufort/swell
- depth (from boats sounder)



- temperature (from boats sounder)

Beaufort is one of the most important environmental variables to collect consistently during surveys, as the rougher the sea conditions the more difficult it is to observe marine mammals (Figure 21).

- **Beaufort/swell** - the Beaufort state and swell height, written as e.g. '2 / 0' for Beaufort / Swell respectively.
 - **Beaufort 0** = no ripples, flat calm.
 - **Beaufort 1** = corrugated iron-type ripples.
 - **Beaufort 2** = wavelets but no white-caps.
 - **Beaufort 3** = wavelets with white caps.
 - **Beaufort 4** = large waves, lots of white caps that are rolling, white bubbles.

Water temperature will be obtained from the survey vessel instruments.

DOLPHIN SIGHTING

Once a marine mammal sighting is observed, an entry will be made to end effort (with all other associated information), and the marine mammal group will be approached to complete the sighting sheet. All megafauna (i.e., sharks, turtles, sea snakes) were recorded on the 'megafauna data sheets', while to boat continues along the survey line.

Species identification and survey mode

'Closing mode' will be used for these surveys since:

3. Accurate species identification is required
4. Photo-ID will be conducted on individuals sighted, which requires the group to be approached.

After the dolphin group is approached, data on the groups' exact location, species identity, group size, group age composition and general behaviour was recorded. Photographs were taken during observations of the group. Environmental variables (depth, turbidity, temperature, salinity, beaufort and tide state) will be recorded at the sighting location, once all information had been collected and the sighting was complete. The following provides more detail on the data to be collected (see below).

ENVIRONMENTAL DATA

Environmental parameters (depth, temperature, turbidity, salinity, pH, beaufort, tide, tide-state and tide height) will be taken at the location of every dolphin sighting, and at the extremities of the survey region (i.e. the furthest points travelled upstream).

- Depth and tide height were taken from the vessels depth sounder.
- Temperature, turbidity, salinity, PH were taken from the Horiba water quality meter.
- Tide and tide state were taken from Austides 2013 (produced by the Australian Hydrographic Service).



These environmental data are essential when investigating habitat preferences and potential seasonality of sighting data of dolphins and dugongs.

TRANSECT PROTOCOLS

Transect breaks will occur when:

4. dolphin groups were sighted,
5. weather deteriorates,
6. interviews were conducted.

Refreshment and toilet breaks will be scheduled for when observers are 'off-effort', so as not to interfere with survey progress and to maximise the distance covered each day.

Once a break was taken for a dolphin sighting, the boat will return to the transect line when observers were confident that all required data had been collected (including group size estimations) and photographs had been taken (taking into consideration the groups behaviour and the requirement to finish transect lines). The boat will return to the transect line at the closest location from the transect break point, taking into consideration the requirement to reduce double-counting by attempting to leave the sighted dolphin group behind. Studies have shown that sighting rates of a variety of marine wildlife decreases as weather deteriorates. Thus, all surveys were conducted in calm sea conditions (i.e. Beaufort Sea state ≤ 3 (no whitecaps) and swell $\leq 1\text{m}$, and no rain) to minimize variation in animal sightings and optimize use of resources available.

MEGAFUNA DATA

During all surveys, any marine megafauna (i.e. dugongs, turtles, sawfish, crocodiles) birds, and other marine wildlife sighted were recorded with associated position and depth data. This sighting data is mapped, with associated mapping of the survey tracks travelled. Photographs were taken of additional marine megafauna whenever possible to enable confirmation of species identification, which is particularly important for turtles and sea snakes.



12.3.2.2 SURVEY EQUIPMENT

Table 2 provides a summary of the equipment required for the surveys

Item	Quantity	Source
Communications		
Phone	1 per person	Personal
Phone chargers	1 per person	Personal
Sat phone	1	SDP
Sat phone charges	1	SDP
Radios, charges and spare batteries	2	Vessel
Personal EPIRBs	2	SDP
Survey Equipment		
Handheld camera	2	SDP
Handheld camera spare battery	1	SDP
SD Cards	5	SDP
Handheld GPS	2	SDP
Survey camera with 300mm lens	2	SDP
Horiba water quality meter	1	SDP
Water quality meter chemicals	1	SDP
Personal laptops and charges	1 per person	Personal
Project laptop with charger	1	SDP
Portable hard drive	2	SDP
Samsung tablet with fulcrum app	2	SDP
Effort datasheet	30	SDP
Marine mammal sighting datasheet	60	SDP
Marine megafauna sighting datasheet	60	SDP
Community discussion datasheet	50	SDP
Folklore datasheet	20	SDP
Pencil case and stationery	Various	SDP
Sharpies	Various	SDP
Waterproof notepads	4	SDP
Clipboards	3	SDP
Marine mammal identification sheets	Various	SDP
Sample vials	50	SDP
Forms and Procedures		
COVID vaccination cards	1 per person	Personal



SDP travel forms	1 per person	SDP
JSA, Risk Assessment	1	SDP
HSES		
PPE (hats, sunglasses, boots, clothes, rain jackets, gaitors/gumboots)	1 per person	Personal
First aid kit	1	SDP
Medical assessments	1 per person	Personal
HSES documents and forms	Various	SDP
Hand sanitiser	Various	Personal
Sunscreen	Various	Personal
Insect repellent	Various	Personal

12.3.2.3 DATA MANAGEMENT

SURVEY DATA PROCEDURES

Excellent data management is essential to avoid data loss and minimising inefficiencies and errors in data analysis. It is crucial that data collected in the field is checked for quality assurance, compiled and stored appropriately to ensure data accuracy and avoid data loss.

The survey team will check the following prior to starting a day in the field:

- Datasheets and notes taken are legible and accurately represent the days capture data
- The spelling of species names are correct
- GPS waypoints have been recorded on the handheld GPS and GPS coordinates have been written down carefully.
- The required photos have been taken and camera and photo numbers have been recorded

The following will be undertaken at the end of each field day:

- The survey team will attend a meeting debrief on the day to identify any gaps/injuries/incidents/issues along with strategies to address these and communicate findings of significance.
- At the end of the day immediately after surveys are concluded, the survey team leader will carefully check each of the datasheets to ensure that the information is correct.
- The datasheets will be compared against the fulcrum app information, to ensure all data within the fulcrum app is correct.
- All hard copy survey tools and notes and collected and copied (i.e. photographed or scanned) and stored on the SDP project laptop. A backup is made on one of the portable hard drives.
- All photos are downloaded to the SDP laptop and labelled appropriately. A backup is made on one of the portable hard drives.
- GPS waypoints are downloaded to the SDP laptop and labelled appropriately. A backup is made on one of the portable hard drives.



- All cameras, radios and other electronic devices are charged, and additional memory/storage space is allocated as required. Note. Memory/storage space should not be cleaned in-field, sufficient spares will be available.

12.3.2.4 DATA STORAGE

The following protocol applies for data storage:

- As described above, all raw data will be downloaded or scanned to a laptop and copies of all data will also be backed up to portable hard drives
- All data will be backed up at the end of the day, and the hard drives stored in a safe location.
- SDP hard drives should not be inserted into non-SDP laptops or computers to minimize the risk of viruses and to maintain control over the data.
- As soon as possible, all copies of raw data should be uploaded to the SDP server. This is most likely to be when SDP personnel return to the office following the field trip.
- A photo log will be maintained by the survey leader that records date, locations/site, photo number and any notes associated with the photo.
- Raw data will be entered into the master spreadsheet daily and provided by email to the SDP survey manager by the field team for storage and the next step in the QA/QC process.

12.4 SURVEY DESIGN

12.4.1 Purari Delta Region

The Purari Delta region extends from the Vailala River mouth west to Port Romilly. A series of survey lines are suggested from Vailala River mouth west to Port Romilly. These lines will be 10km north/south and 5km east/west (Figure 44).



Figure 44. Purari Delta coastal survey lines.

Within the delta boat-based surveys will be conducted up to 10km from the river mouth (Figure 45). There are four important areas within the Purari Delta where surveys should be focused:

- Port Romilly,
- Kinipo,
- Akoma,
- Panarua Inlet and
- Apiope.



Figure 45. Purari Delta riverine survey lines.

12.4.2 Kikori Delta Region

The Kikori Delta region was previously surveyed in 2013 and 2015. Similar survey lines are recommended for the GIDA, since most of the Delta was covered during these surveys. The coastal survey lines will be the same format as the Purari Delta, being 10km north/south and 5km east/west (Figure 46).



Figure 46. Kikori Delta survey lines.



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