Review of **MARINE MAMMAL OCCURRENCE** in New Guinea and Cape York/Torres Strait Waters, with an Evaluation of the Kikori Delta Important Marine Mammal Area

SPREP
Secretariat of the Pacific Regional Environment Programme

ACP MEAs 3

Snubfin Dolphin Conservation Project

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PAPUA NEW GUINEA

SPREP Library Cataloguing-in-Publication Data

Review of the marine mammal occurrence in
New Guinea and Cape York/Torres Strait waters,
with an evaluation of the Kikori Delta Important
Marine Mammal Area. Apia, Samoa : SPREP, 2025.

54 p. 29 cm.

ISBN: 978-982-04-1498-3 (ecopy)

1. Marine mammals – Law and legislation – Papua
New Guinea. 2. Marine mammals – Research – Papua
New Guinea. 3. Marine mammals – Geographic

distribution – Papua New Guinea.
I. Beasley, Dr. Isabel. Pacific Regional Environment Programme (SPREP).
II. Title.

599.50954

Beasley (2023). Review of marine mammals in New Guinea and Cape York/Torres Strait Waters, with an evaluation of the Kikori Delta Important Marine Mammal Area. Unpublished report submitted to SPREP.

November 2023

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Inshore Dolphin Occurrence in New Guinea Waters

Although numerous records of occurrence exist for oceanic whales and dolphins inhabiting New Guinea waters, there is very little current information about inshore dolphins. Similarly there is very little current information on cetaceans from the Cape York/Torres Strait region of northern Australia (i.e. Princess Charlotte Bay north to Torres Strait and around Cape York to Arukun) (Figure 1).

Figure 1. Location of New Guinea (Papua New Guinea to the east and Indonesian Provinces of Papua/West Papua to the west) and Cape York/Torres Strait.

Recent studies have confirmed that two inshore dolphin species occur in the Kikori Delta of Gulf Province, Papua New Guinea (PNG) (Figure 2). The Australian humpback dolphin Sousa sahulensis and Australian snubfin dolphin Orcaella heinsohni are both listed as Vulnerable by the IUCN Red List, and occur in apparently small populations throughout the Kikori Delta from Morigo Island in the west to Port Romily in the east. These two inshore dolphin species have not been recorded in any other location in PNG or the Pacific Islands (excluding Australia). Beasley et al (2016) reviewed all available literature on marine mammal studies in the Pacific Islands and New Guinea, and found that in addition to the Kikori Delta, Australian humpback dolphins had been confirmed from Bintuni and Berau Bays, Arguni Bay, Triton Bay, Mayalibit Bay and Misool Island in West Papua. Snubfin dolphins had not been confirmed from any of these locations, or any other locations in West Papua or Papua (Beasley et al. 2016).

As a result of the importance of the Kikori Delta to Australian snubfin and humpback dolphins, the Delta was designated as an Important Marine Mammal Area (IMMA) in 2017 (Force. 2017) (Figure 3).

Figure 2. Location of the Kikori Delta.

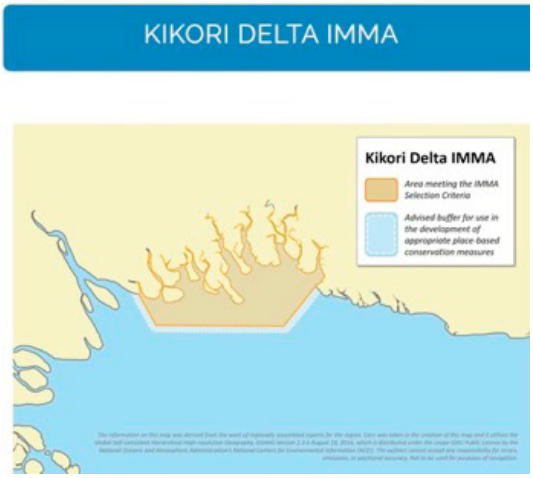

Figure 3. Location of the Kikori Delta IMMA

Kikori Delta Important Marine Mammal Area (IMMA)

The Important Marine Mammal Areas (IMMAs) initiative was launched by the Marine Mammal Protected Areas Taskforce of the International Union for the Conservation of Nature (IUCN) in 2016, as a response to a conservation crisis in the protection of marine mammals and wider global ocean biodiversity (Tetley et al. 2022). IMMAs identify discrete portions of habitat that are important for one or more marine mammal species and have the potential to be delineated and managed for conservation (Tetley et al. 2022). Between 2016 and 2021, eight expert workshops have resulted in the identification of 172 IMMAs located in 90 countries. Of these workshops, three have focused on the waters around New Guinea and Cape York/Torres Strait: Pacific Islands (PACISL) in 2016 (Force. 2017), North East Indian Ocean and South East Asian Seas (NIOSEA) in 2018 (Force. 2019) and Australia-New Zealand and South East Indian Ocean (ANSEIO) in 2020 (Force. 2020).

Throughout the waters of New Guinea and Cape York/Torres Strait there are currently seven Important Marine Mammal Areas (IMMAs), one candidate IMMAs and four Areas of Interest (Figure 4).

Pacific Islands

- Kikori Delta IMMA
- Bismarck Sea IMMA

North East Indian Ocean and South East Asian Seas

- Bintuni Bay, West Papua IMMA
- Kaimana, West Papua IMMA
- Raja Ampat and Dampier Strait cIMMA
- Cenderawasih Bay AoI
- North Papua to Papua New Guinea AoI
- New Britain Trench AoI

Australia-New Zealand and South East Indian Ocean

- Central and Western Torres Strait IMMA
- Mapoon to Auruken IMMA
- Northern Great Barrier Reef IMMA
- Torres Strait, Australia and Papua New Guinea AoI

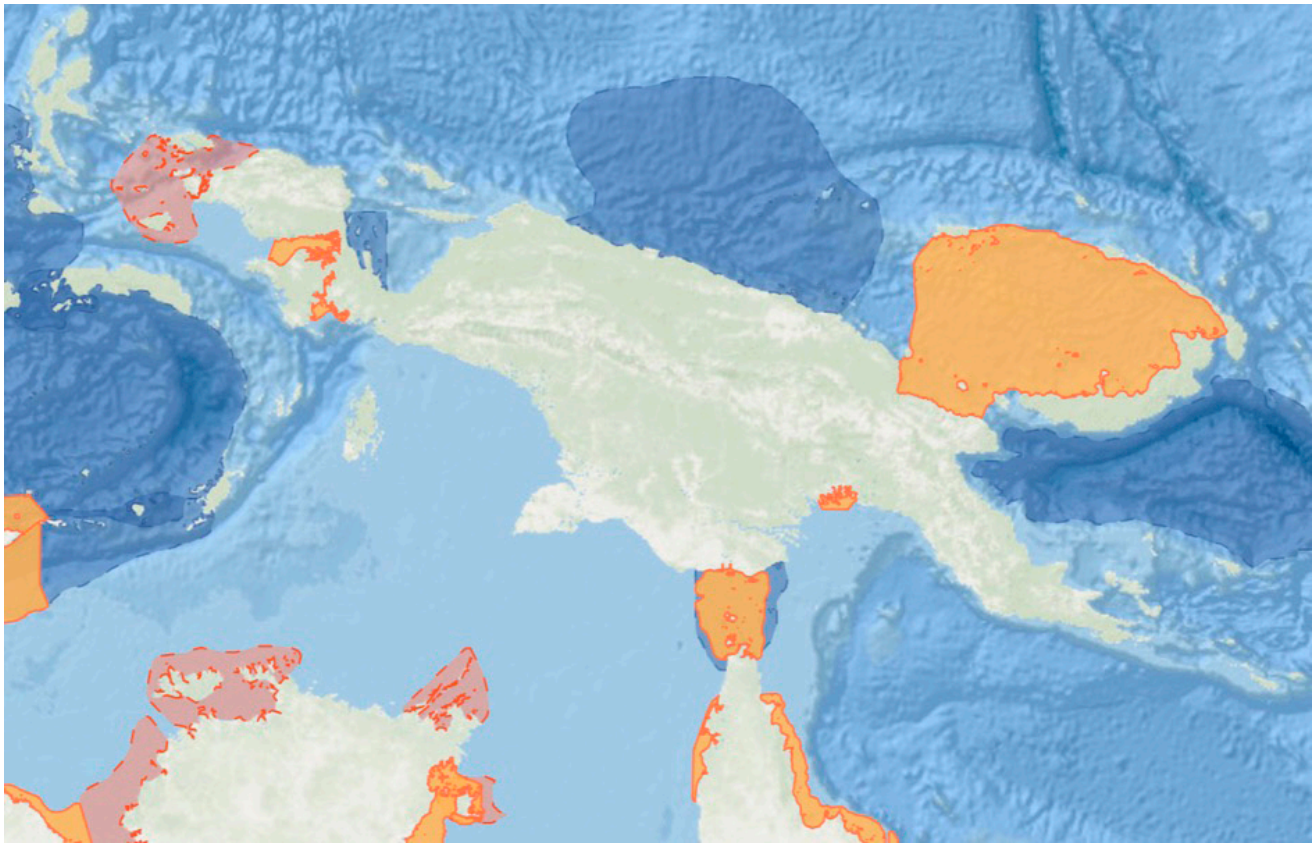

Figure 4. IMMAs in the New Guinea and northern Australia region.

IMMAs are not Marine Protected Areas and do not include specific measures for protection. They are intended as a tool to focus the conservation spotlight on the places that most matter to marine mammals and to broader marine biodiversity (Tetley et al. 2022). IMMAs are however supporting marine conservation through contributing to national coastal zoning and spatial planning processes, and supporting the refinement of national spatial planning and design of biodiversity denominations, such as Australia's Biologically Important Areas (Tetley et al. 2022).

In a rapidly changing ocean, it is essential that information about IMMAs reflects current conditions in order to be useful for supporting conservation management and providing a foundation for marine spatial planning, systematic conservation planning, and protected areas or special spatial regulations (Tetley et al. 2022). To address changing marine mammal distributions or decreasing populations, the devising of an 'early warning system' was proposed by Tetley et al (2022), based on a set of indicators to flag the need for management interventions (Agardy et al. 2019[Agardy, 2019 #454)]. Such information could include alerting information derived from visual or acoustic surveys, or unusual mortality events reported through stranding networks. Tetley et al. (2022) also proposed that adapting specific criteria from the UN World Heritage Sites which may be given 'in danger' status, could apply to IMMA's. Thus triggering efforts to mitigate or eliminate the threatening factors and to restore the area to its original condition (Brown et al. 2019).

Based on the recommendations by Tetley et al. (2022), it is important to determine if inshore dolphin status within the Kikori Delta IMMA has changed since 2017, and if the IMMA should be expanded to other areas of Gulf Province. To facilitate this objective, a comprehensive review of the occurrence and status of cetaceans in New Guinea and northern Cape York/Torres Strait waters has been conducted. Northern Cape York/Torres Strait has been included in this review because there appears to be at least some limited movement of both Australian snubfin and humpback dolphins between northern Australia and Papua New Guinea. There must therefore be some region of the Torres Strait that is being used by inshore dolphins, at least occasionally.

Cetacean Occurrence in Cape York/Torres Strait, Australia Waters

Although numerous marine mammal studies have been conducted in Australian waters, there are few studies from the Cape York/Torres Strait regions.

Torres Strait Waters

Reeves et al. (1999) mentioned that Peter Corkeron from James Cook University reported sighting humpback dolphins in Torres Strait during aerial surveys of dugongs (P Corkeron pers comm to Randall Reeves 1995). However, no further details of these sightings are available.

The recently designated Central and Western Torres Strait IMMA, was determined to be an IMMA primarily based on the region supporting the world's largest population of dugong, which is listed as Vulnerable by the IUCN. Bottlenose dolphins (species unconfirmed but likely T. aduncus), Australian humpback dolphins (Sobtzick et al. 2014) and Australian snubfin dolphins (inshore waters, anecdotal observations, Penrose et al. 2015) have apparently been observed in the area but have not been surveyed using established cetacean survey techniques. The cited references are unavailable for review.

Knowledge of inshore dolphin occurrence in the Torres Strait region, is important, to determine the amount of movement between PNG and northern Australia, if any. Recent genetic analysis of inshore dolphin samples from the Kikori Delta compared to Australian populations indicates no difference between the two populations. Therefore, some level of recent movement would assumedly exist between the two countries (Beasley et al. in prep).

A dolphin group from Torres Strait was painted by Alick Tipoti with the following description 'European explorers to the Torres Strait in the mid 18th century described the local people as dolphins because of their swimming and diving skills. The patterning in the print represents the waves of my culture. Bidul represents the description these strangers to our region gave to my forefathers (https://australianartnetwork.com.au/shop/region/torres-strait-islands/bidul-dolphins/) (Figure 5). No further records of cetaceans from the Torres Strait region are known.

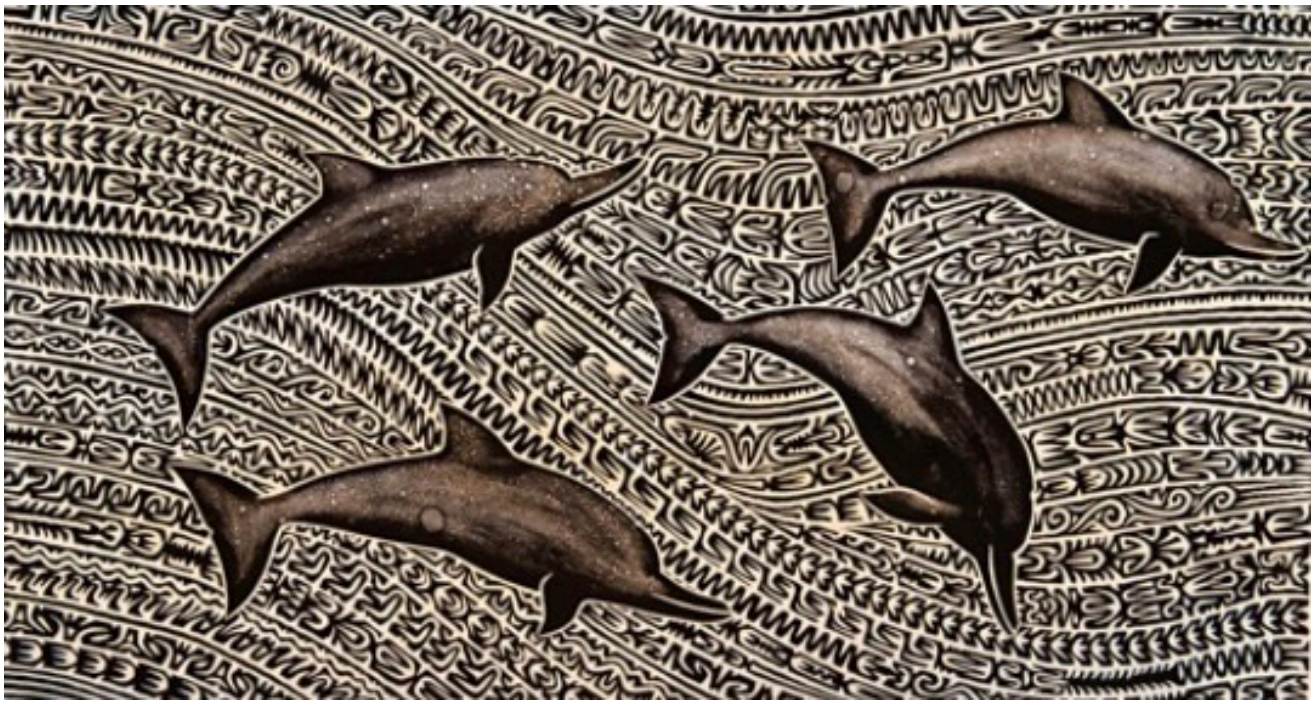

Figure 5. Bidul – Dolphins (painted by Alick Tipoti, Torres Strait)

Northern Cape York

One of the few dedicated studies on cetaceans in the Cape York region was conducted by Parra et al (2006). Boat-based transect surveys were conducted in three adjacent bays (Princess Charlotte, Bathurst and Ninian Bays). located in the far Northern Section of the Great Barrier Reef Marine Park, northeast Queensland. A total of 431km was surveyed, with 17 groups of snubfin dolphins and 7 humpback dolphin groups being sighted. Results showed that snubfin and humpback dolphins occurred closer to land than would be expected at random. Sunbfin dolphins were found closer to river mouths than humpback dolphins. Preference for nearshore, estuarine waters was likely related to the productivity of these tropical coastal areas.

The recently designated Mapoon to Aurukun IMMA, on the far western side of Cape York, Queensland, was determined to be an IMMA based on the occurrence of Australian snubfin and humpback dolphins. Other marine mammal species of importance in this region were Indo-Pacific bottlenose dolphins, false killer whales, killer whales and spinner dolphins (Force. 2020).

Detailed and comprehensive marine mammal surveys were undertaken by Blue Planet Marine along the western Cape York coast from Pine River in the north to Aurukun in the south from 2014-2019 (Marine. 2019). Over the five years, dolphin species included humpback dolphins (326 groups/1226 individuals), inshore bottlenose dolphins (113/735), offshore bottlenose dolphins (4/34), snubfin dolphins (30/166) and spinner dolphins (8/80). Estimated abundance of humpback dolphins in the study area (1,104km2) during each primary sample was 214 in 2014, 242 in 2016, 242 in 2017, 193 in 2018 and 245 in 2019. These abundance estimates represent some of the highest recorded anywhere in Australia for the species. Overall, the results showed that there is considerable interchange of individuals between the sample are and adjacent parts of western Cape York. A total of 44 snubfin dolphins were photographed from 2014-2018, but only 24 of these were captured with sufficient photo quality for reliable inter-year identification of individuals. Abundance estimates were not possible for this species for the years 2014-2018. A closed population model was possible for 36 individuals captured 58 times in 2019. Accounting for the marked proportion, the estimated total population size of snubfin dolphins using the study area in 2019 was 52 (SE=6.35, 95%CI+41-66). All spinner dolphin groups were identified as Gray's spinners (Dave Paton pers comm 2023) (Figures 6 and 7).

Meager (2018) photo-identified 37 Australian humpback dolphins and 12 Australian snubfin dolphins in the area from Pennyfather Creek to the Skardon River over 189km of boat-based transects over four days (Meager 2018). As described by IUCN (2020) historical records of dolphins in this region are sparse. A group of two snubfin dolphins was recorded in Port Musgrave in aerial surveys in 1997 (Marsh et al. 1998). All other reports from northern Cape York are unconfirmed and anecdotal.

No further records of cetaceans from the northern Cape York region are known.

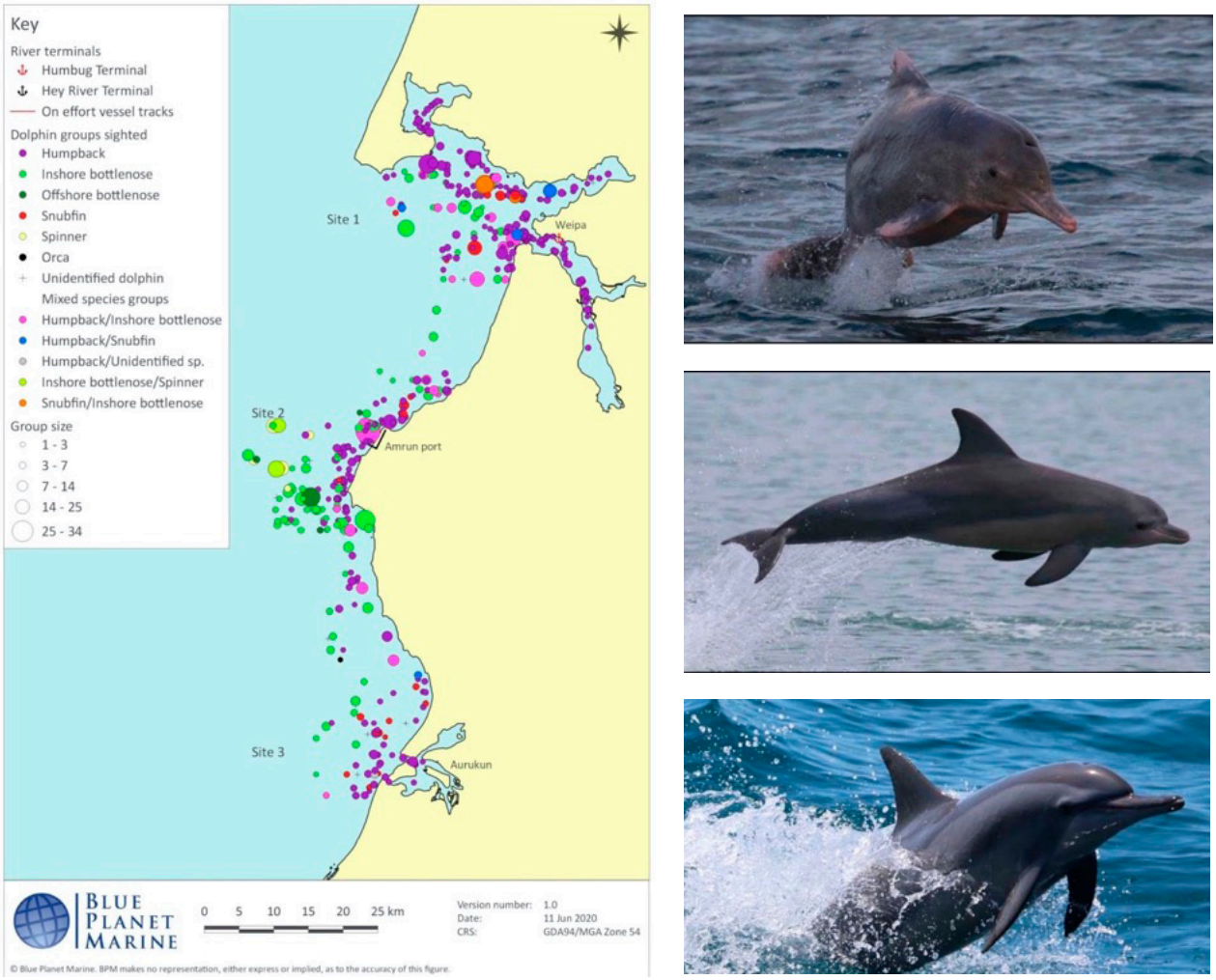

Figure 6. Map of cetacean sightings along western Cape York from 2014-2019. Dolphins sighted during 2014 baseline surveys included humpback dolphins (top image), common bottlenose dolphins (middle image) and Gray's spinner dolphins (bottom image).

Figure 7. A group of snubfin dolphins sighted during 2014 baseline surveys along western Cape York.

To date, six cetacean species have been recorded from northern Cape York/Torres Strait (Table 1).

Table 1. Records of cetaceans in northern Cape York/Torres Strait waters

SPECIES	REFERENCE
Balaenoptera borealis	
Sei whale	
Balaenoptera musculus	
Blue whale	
Balaenoptera edeni	
Bryde's-like whale	
Balaenoptera omurai	
Omura's whale	
Globicephala macrorhynchus	
Short-finned pilot whale	
Grampus griseus	
Risso's dolphin	
Lagenodelphis hosei	
Fraser's dolphin	
Orcaella heinsohni	
Australian snubfin dolphin	Parra et al. (2006), GHD (2014), Blue Planet Marine (2019)
Orcinus orca	
Killer whale	Blue Planet Marine (2019)
Peponocephala electra	
Melon-headed whale	
Pseudorca crassidens	
False killer whale	
Sousa sahulensis	
Australian humpback dolphin	Parra et al. (2006), GHD (2014), Blue Planet Marine (2019)
Stenella attenuata	
Pantropical spotted dolphin	
Stenella longirostris	
Spinner dolphin	GHD (2014), Blue Planet Marine (2019)
Tursiops aduncus	GHD (2014), Blue Planet Marine (2019)
Tursiops truncatus	GHD (2014), Blue Planet Marine (2019)
Kogia breviceps and sima	
Pygmy and dwarf sperm whale	
Physeter macrocephalus	
Sperm whale	
Ziphius cavirostris	
Cuviers beaked whale	
Balaenoptera acutorostrata	
Minke whale	
Feresa attenuata	
Pygmy killer whale	
Megaptera novaeangliae	
Humpback whale	
Mesoplodon densirostris	
Blainville's beaked whale	
Steno bredanensis	
Rough-toothed dolphin	

Cetacean Occurrence in Papua New Guinea Waters

There is very little known regarding marine mammals that occur in Papua New Guinea (PNG) waters. Many of the cetacean observations in PNG have been opportunistic, with very few dedicated research projects being conducted. One of the first reviews on marine mammals in the Pacific Islands was conducted by Reeves et al (1999), where 24 species were recorded including the Irrawaddy dolphin (Orcaella brevirostris) – now known as the Australian snubfin dolphin (Orcaella heinshoni) in PNG, and the Indo-Pacific humpback dolphin (Sousa chinensis) – now known as the Australian humpback dolphin (Sousa sahulensis) (Reeves 1999). Subsequently detailed reviews on Pacific Island cetaceans have been conducted by Miller (2007; 2021). Miller (2007) confirmed 15 cetacean species to occur in PNG waters, and Miller (2021) confirmed 18 species, Beasley et al. (2016) reviewed the occurrence and distribution of humpback dolphins in the Pacific Islands and New Guinea, which confirmed humpback dolphins in New Guinea waters were Australian humpback dolphins, rather than Indo-Pacific humpback dolphins which are found throughout Asia, including neighbouring Indonesia.

Dawbin (1972) was one of the first researchers to comprehensively document the occurrence of marine mammals in PNG. Dawbin (1972) documented spinner dolphins, spotted dolphins (Figure 8), bottlenose dolphins, Irrawaddy dolphins, false killer whale, killer whale, Risso's dolphin, pilot whale, pygmy sperm whale, sperm whale, unidentified beaked whales, and unconfirmed humpback whale.

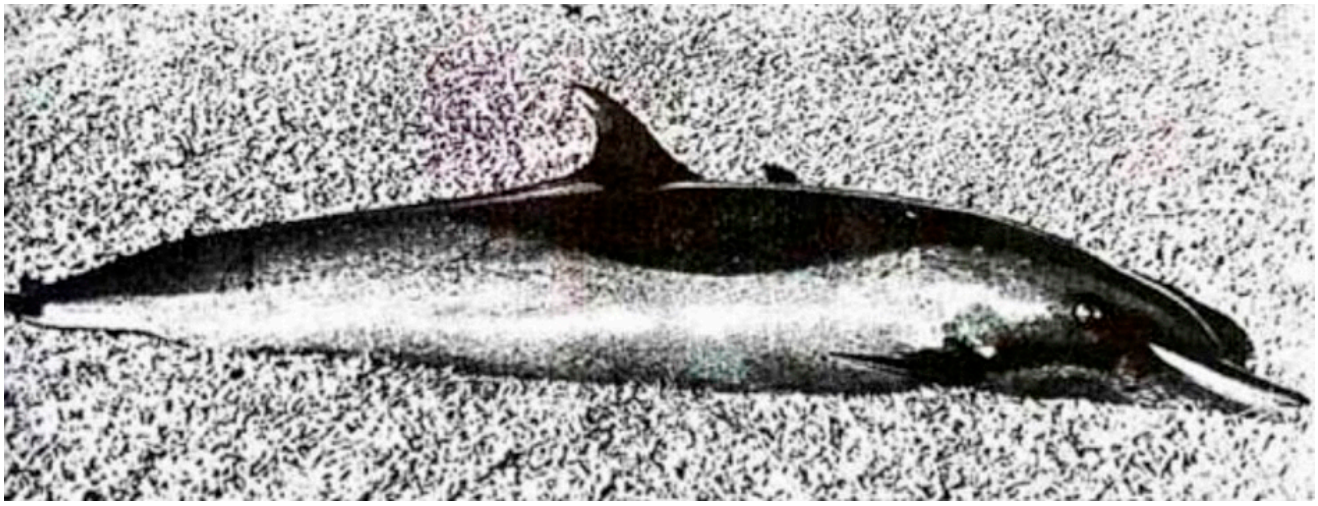

Figure 8. A spotted dolphin recovered from Rabul, as described in Dawbin (1972)

From 20 January to 19 March 1976, Miyazaki and Wada (1976) undertook a whale marking and sighting expedition in the western tropical Pacific, where some of the days were spent in northern PNG waters. During this trip 103 groups of 13 species were sighted, with 15 specimens captured for examination. In PNG waters, Miyazaki and Wada (1976) confirmed Bryde's whale, sperm whale, spinner dolphin, spotted dolphin, Tursiops sp. Fraser's dolphin, false killer whale, short-finned pilot whale, risso's dolphin and short-finned pilot whale.

Kimbe Bay in West New Britian Province has received the majority of marine mammal research in PNG. From 1989-1994, Munday (1994) recorded all species of marine mammal sighted in Kimbe Bay. The species included the humpback whale, sperm whale, short-finned pilot whale, killer whale, false killer whale, pygmy killer whale, melon-headed whale, spinner dolphin, bottlenose dolphin and dugong. Spinner and bottlenose dolphins were the most sighted, with short-finned pilot whales encountered regularly. Despite extensive marine mammal research being undertaken in Kimbe Bay since 1989, the two inshore dolphin species have not yet been sighted.

The first dedicated study of marine mammals in Gulf Province was conducted by Bonaccorso et al. (2000). Aerial and boat-based surveys were conducted between 10-17 December 1999 throughout the Kikori Delta from the mouth of the Omati River to the west and Iviri Inlet on the east (Bonaccorso et al. 2000b). Four species of marine mammals were observed during the surveys, dugongs, Indo-pacific bottlenose dolphins, Indo-Pacific humpback dolphins (now Australian humpback dolphins), and Irrawaddy dolphins (now Australian snubfin dolphins). The sightings of the latter two species represented the first records of these species in PNG, verified by professionally trained scientists (Bonaccorso et al. 2000b).

From March 2000 to August 2005, Ocean Alliance undertook a circumnavigation of the globe to document the health of the world's oceans and to provide data to reduce the flow of contaminants into the worlds oceans. The Voyage of the

Odyssey surveyed in PNG waters from 16 February 2001 to 8 August 2001. The Voyage subsequently provided confirmed sighting records of Sei whale, short-finned pilot whale, Risso's dolphin, Fraser's dolphin, false killer whale, pantropical spotted dolphin, spinner dolphin, common bottlenose dolphin and pygmy killer whale. The crew sighted 18 different groups of sperm whales and collected 110 tissue samples, and concluded that PNG is likely an important breeding and calving ground for sperm whales. The Voyage obtained the first records for Frasers dolphin and Sei whale in PNG waters. While researching in PNG, the Odyssey crew partnered with the PNG National Museum and Art Gallery to hold two Marine Mammal Forums. At the second meeting, the Prime Minister of PNG announced that PNG would designate its 200 mile-wide Exclusive Economic Zone as a marine mammal sanctuary (Alliance 2001; Bohannon 2004).

Several dedicated marine mammal surveys were conducted in Kimbe Bay by Visser (2002; 2003). Two surveys were conducted in April and July 2002 (Visser 2002a; Visser 2002b). A second marine mammal rapid ecological assessment was conducted over two periods: 3-4 April and 6-15 April 2003. Research methods included boat-based surveys, behavioural observations, photoidentification of individuals and hydrophone recordings. Twelve days were spent on the water, with cetaceans being sighted every day. A total of 59 encounters were recorded. Seven species were positively identified: pygmy sperm whale, Cuvier's beaked whale, common bottlenose dolphin, Indo-Pacific bottlenose dolphin, pantropical spotted dolphin, spinner dolphin and Risso's dolphins. The Blainville's beaked whale (Mesoplodon densirostris) was tentatively identified but remained unconfirmed (Visser 2003).

In January 2009, Exon Mobil PNG Limited released the PNG LNG Environmental Impact Statement (EIS) which was completed prior to construction (Exxon Mobil PNG Ltd 2009). Numerous studies were conducted as part of this EIS, some in the Gulf of Papua for the offshore pipeline. In 2008, Coffey Natural Systems assessed the offshore section of the LNG Project Gas Pipeline (Coffey 2008). Although it is mentioned within the report that 'several dolphins, including a pod of 12 long-beaked bottlenose dolphins were observed from the vessel', unfortunately no summary of sightings is presented in the EIS report. The only two images of cetaceans within the report are an adult humpback dolphin (Plate 3.6) 'observed from a prawn trawler (note that land is present in the background so the dolphin group was sighted close to shore), and 'dolphins observed during the marine pipeline survey', which are the group of 12 Indo-Pacific bottlenose dolphins earlier mentioned (Figure 9).

Plate 3.6 Indo–Pacific hump backed dolphin observed from a prawn trawler

Plate 3.7 Dolphins observed during the marine pipeline survey

Figure 9. Two cetacean groups documented by Coffey Natural Systems. An adult humpback dolphin (left image) and group of Indo-Pacific bottlenose dolphins (right image).

In November 2010 and 2013, boat-based surveys were undertaken throughout the Admiralty Island group in the Bismarck Sea, covering approximately 2,100km2, including 18 islands (Miller and Rei 2021). When conditions permitted, acoustic recordings were also taken. More than 1000 cetaceans were sighted, the most common being spinner dolphins, pantropical spotted dolphins, short-finned pilot whales and sperm whales. Large aggregations of spinner dolphins, including calves, suggest that the northern Bismarck Sea provides critical habitat for this species (Miller and Rei 2021). As a result of these surveys, and other surveys in Kimbe Bay and other regions of the Bismarck Sea, the Bismarck Sea region was designated as an Important Marine Mammal Area (IMMA) in 2018.

In March 2018, an Australian naturalist was voyaging along the southern coast of Gulf Province. From 4-8 March 2018 he was able to sight and photograph humpback and snubfin dolphins from the mouth of Pueraria Delta east to Ivo River mouth (Rich Twist pers comm 2018). Photographs of both species were sent to Isabel Beasley for identification. These sightings represent the first confirmed records of inshore dolphins to the east of the Kikori Delta in Gulf Province.

In 2020, Mavea et al. (2021) conducted a survey of inshore and pelagic waters along the south coast of New Britain Island (New Britian Trench), in association with research into a Critically Endangered seabird, Beck's petrel (Pseudobulweria becki). During 8 days (11-18 March 2020), 30 groups of cetaceans were sighted (397 cetaceans encountered), attributed to at least six species, with spinner (10 groups) and pantropical spotted dolphins (6 groups) being the most frequently sighted and abundant species. Other cetacean sighted during this survey were common bottlenose dolphin, (4 groups), short-finned pilot whale (3 groups), Cuvier's beaked whale (1 group), and dwarf sperm whale (1 group). All species encountered had been previously recorded in PNG waters (Miller 2007) (Figures 10 and 11).

The Western and Central Pacific Fisheries Commission compiled two reviews on data available on cetacean interactions in the WCPFC longline and purse-seine fisheries (Williams et al 2020; 2021). Species confirmed to occur in PNG waters through this program were Sei whale, Bryde's whale, short-finned pilot whale, melon-headed whale, false killer whale and bottlenose dolphin (Williams et al. 2020; Williams et al. 2021).

Figure 10. Cetaceans sighted during the New Britian Trench surveys. Short-finned pilot whale (top left), dwarf sperm whale (top right), Cuvier's beaked whale (middle left), spinner dolphin (middle right), pantropical spotted dolphins (bottom).

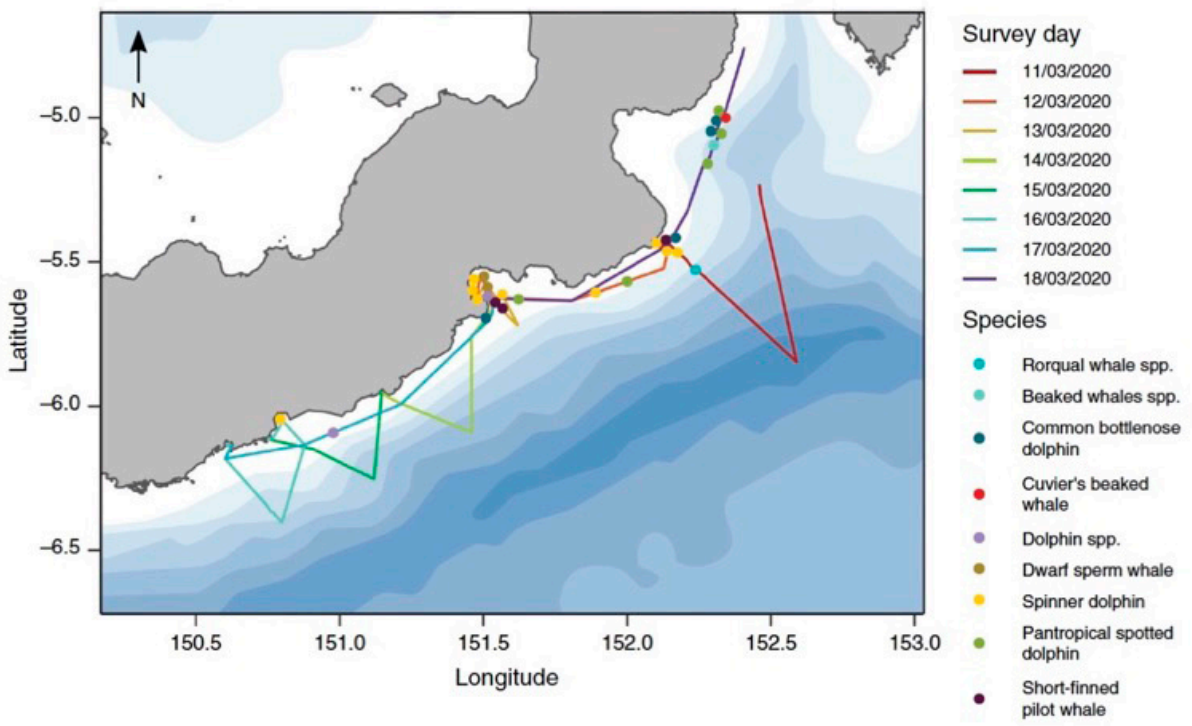

Figure 11. Survey lines conducted throughout the New Britian Trench in 2020 (Mavea et al (2021).

A global assessment of silver pollution using sperm whales as an indicator species was conducted by Savery et al. (2013), where 23 biopsy samples from sperm whales in PNG were collected during the voyage of the research vessel, Odyssey between 2000 and 2005, and used in the analysis. The analysis showed that there may be an increase in Ag levels in the Pacific, or perhaps regional hotspots within the Pacific (Savery et al. 2013).

From 2011-2023, The Snubfin Dolphin Project (SDP) has been running an inshore dolphin research and conservation project in the Kikori Delta, Gulf Province, PNG. Boat-based surveys were conducted in 2011, 2013 and 2015, which community discussions were the focus for 1999 and 2020 activities. From 2021-2023, the Secretariat of the Pacific Regional Environment Programme (SPREP) supported SDP to work in partnership with the Piku Biodiversity Network (PBN) to conduct research on inshore dolphins and provide awareness and outreach to communities in the Kikori Delta. A focus for this project has been on the impact of a swimbladder fishery on regionally significant populations of globally threatened IUCN Red listed dolphins, sawfish and river sharks. This SPREP funded project primarily focused on establishing a carcass recovery network, particularly for inshore dolphins by-caught in gillnets. As a result of this program, by-catch and some sighting information is available for this review.

In addition to dedicated and opportunistic at-sea observations, one relatively recent report of dolphin hunting is known from Kontu and Tembin Villages on southern New Ireland Province (Figures 12-14). On September 2022, a journalist was in the area to do a story on the shark callers. It just happened that on the day he arrived a dolphin hunt was underway. His account of events is as follows 'there were 3 villages spaced out along a very long bay: Kontu, Tembin and one other…and for this hunt to happen the dolphins would have to come from the north swimming along the edge of the reef... they would be spotted and an alarm would go up (blowing conch shells) so that by the time the dolphins arrived alongside the last village along the bay the fishermen of that village would be out in their canoes waiting for them... young boys (children) would jump in the water and banging rocks together they would "herd" the dolphins through a gap in the reef into a lagoon… once all in they would drop a gate in the opening effectively trapping the dolphins making it easier to hunt them... spearing them as they would come up for air. On this day I think they took around 40 dolphins which were shared out between the 3 villages. This is apparently a rare event, only being conducted once or twice a year when dolphins would swim close to the village, usually chasing tuna. Apparently nothing of the dolphin was wasted, and even the teeth were used in making necklaces which would be used as a bride-price'.

Figure 12. Dolphins killed during a drive hunt in New Ireland Province in 2002. Photographs provided courtesy of George Blonsky

Figure 13. Dolphins killed during a drive hunt in New Ireland Province in 2002. Top image – unknown species, middle left – spinner dolphin, middle right – spinner dolphin, bottom left – people cutting up dolphin on shoreline, bottom right – spinner dolphin. Photographs provided courtesy of George Blonsky

Figure 14. Dolphins killed during a drive hunt in New Ireland Province in 2002. Left image – unknown species, Right image – spinner dolphin. Photographs provided courtesy of George Blonsky

To date, 20 cetacean species have been recorded from PNG waters (Miller 2021 and this review) (Table 2).

Table 2. Records of cetaceans in PNG waters

RECORDS OF CETACEANS IN PAPUA NEW GUINEA WATERS		
SPECIES	CONFIRMED FOR GULF PROVINCE	REFERENCE
Balaenoptera borealis Sei whale		Ocean Alliance 2001, Williams et al. 2020
Balaenoptera musculus Blue whale		Frank and Ferris 2011
Balaenoptera edeni Bryde's-like whale		Miyazaki and Wada 1978, Ohsumi 1978, Williams et al. 2020
Balaenoptera omurai Omura's whale		R. Constantine pers comm. 2022
Globicephala macrorhynchus Short-finned pilot whale		Munday 1994, Williams et al. 2020, Mavea et al. 2021, Miller and Rei 2021
Grampus griseus Risso's dolphin		Ocean Alliance 2001, Visser 2003
Lagenodelphis hosei Fraser's dolphin		Miyazaki and Wada 1978, Ocean Alliance 2001
Orcaella heinsohni Australian snubfin dolphin	Confirmed for Kikori Delta (Beasley et al 2014 and 2015: unpublished) (Figure 3)	Beasley et al. 2016
Orcinus orca Killer whale		Munday 1994, Visser and Bonoccorso 2003
Peponocephala electra Melon-headed whale		Miyazaki and Wada 1978, Munday 1994, Reeves et al. 1999, Williams et al. 2020

RECORDS OF CETACEANS IN PAPUA NEW GUINEA WATERS		
SPECIES	CONFIRMED FOR GULF PROVINCE	REFERENCE
Pseudorca crassidens False killer whale		Munday 1994, Ocean Alliance 2001, Williams et al 2020
Sousa sahulensis Australian humpback dolphin	Confirmed for Kikori Delta and West Papua (Beasley et al. 2016)	Beasley et al. 2016
Stenella attenuata Pantropical spotted dolphin		Visser 2003, Mavea et al. 2021, Miller and Rei 2021
Stenella longirostris Spinner dolphin		Munday 1994, Ocean Alliance 2001, Visser 2003, Mavea et al. 2021, Miller and Rei 2021
Tursiops aduncus	Tursiops aduncus confirmed from coastal waters near Daru (Beasley et al 2014; unpublished) (Figure 15)	Beasley et al 2014 unpublished
Tursiops truncatus		Munday 1994, Visser 2003, Williams et al 2020, Mavea et al 2021
Kogia breviceps Pygmy sperm whale	Pygmy sperm whale confirmed from Kikori Delta (Beasley 2023: unpublished)	Beasley et al 2023, Visser 2003
Kogia sima Dwarf sperm whale		Mavea et al. 2021
Physeter macrocephalus Sperm whale		Lever 1964, Berzin 1972, Dawbin 1972, Munday 1994, Ocean Alliance 2001, Savery et al 2013, Miller and Rei 2021
Ziphius cavirostris Cuviers beaked whale		Visser 2003, Mavea et al. 2021
Unconfirmed Species		
Balaenoptera acutorostrata Minke whale		Mavea 2017
Feresa attenuata Pygmy killer whale		Munday 1994
Megaptera novaeangliae Humpback whale		Munday 1994
Mesoplodon densirostris Blainville's beaked whale		Visser 2003
Steno bredanensis Rough-toothed dolphin		Visser 2003

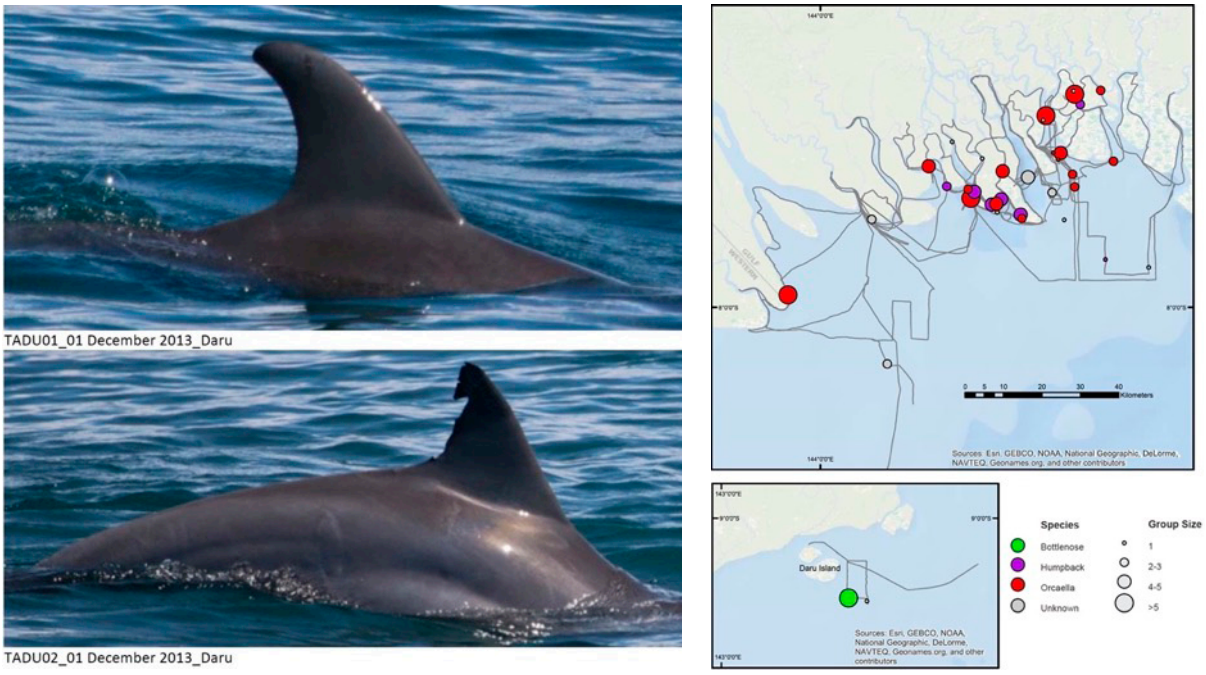

Figure 15. Indo-Pacific bottlenose dolphins photo-identified near Daru during transit to the Kikori Delta (left image), Cetacean sightings during the 2013 Kikori surveys, with the location of the bottlenose dolphin group shown by the green circle in the bottom map (Beasley et al 2014).

Cetacean Occurrence in Papua and West Papua Waters, New Guinea

A number of dedicated marine mammal surveys have been conducted in West Papua (Figure 16), and no recent studies are known for Papua. Although these studies have already been reviewed by Beasley et al (2016) to document Australian humpback dolphins, a further review here is justified and important to determine if Australian snubfin dolphins have been sighted in these regions.

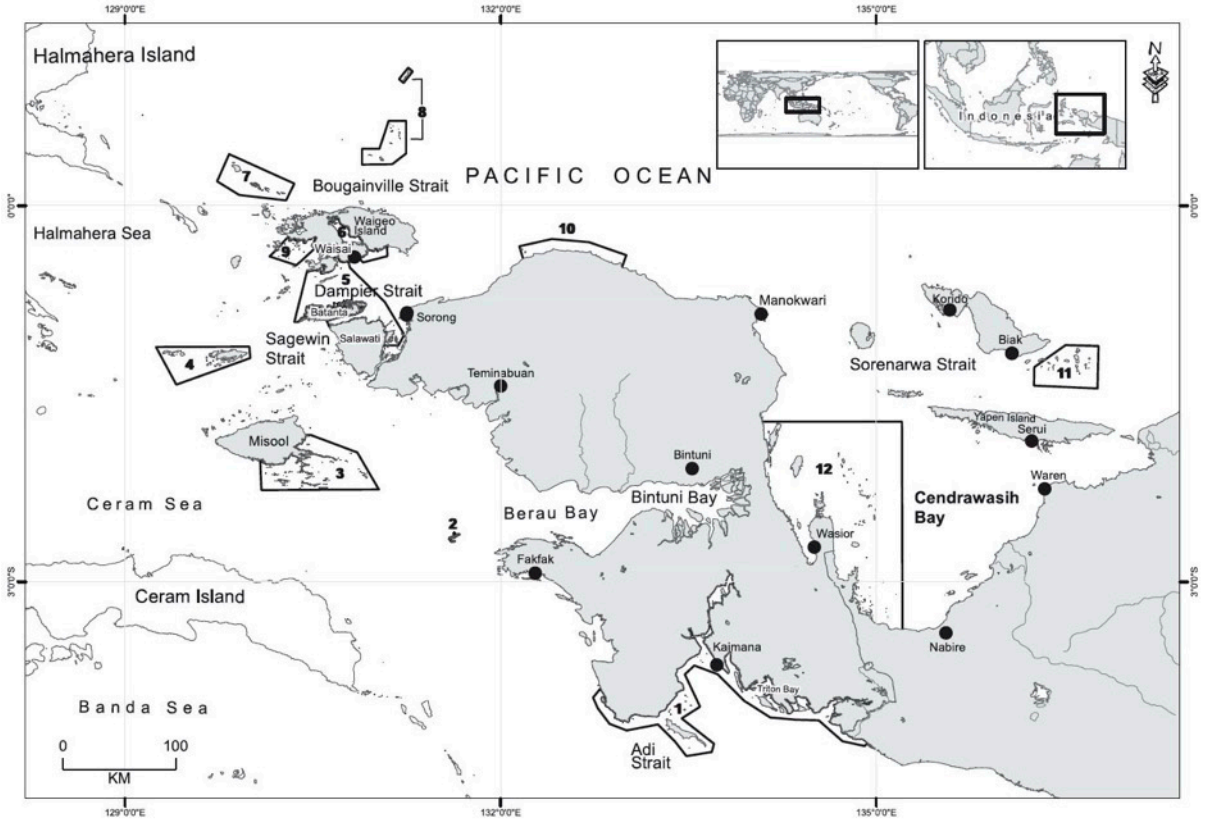

Figure 16. Map of the Bird's Head Seascape showing the location of major towns, islands and Marine Protected Area (MPA) boundaries. MPA's shown are: 1=Kaimana, 2=Sabuda Tataruga, 3=Southeast Misool, 4=Kofiau and Boo Islands, 5=Dampier Strait, 6=Mayalibit Bay, 7=Kawe, 8=Ayau-Asia Islands, 9=Panjang Islands, 10=Abun, 11=Padaido, 12=Cendrawasih Bay (Mangubhai et al. 2012).

The Bintuni-Berau Bay Rapid Ecological Assessment was conducted during 15 days in two periods, from 17-20 September and 22 October-1 November 2005. Cetaceans were sighted on 62 separate encounters, consisting of 364 individuals belonging to five species including Indo-Pacific humpback dolphin (now Australian snubfin dolphin), spinner dolphin, Indo-Pacific bottlenose dolphin, common bottlenose dolphin and a single Bryde's whale (Kahn et al. 2006). Cetacean sightings were dominated by Australian humpback dolphins. No dugongs or Australian snubfin/Irrawaddy dolphins were sighted.

The Raja Ampat Marine Mammal Assessment was conducted over 11 days from 26 October – 5 November 2006 (Kahn 2007). Boat-based surveys covered 1315km, with ten cetacean species being confirmed. No dugongs were sighted during these surveys. The cetacean species encountered were common bottlenose dolphin, spinner dolphin, Indo-Pacific bottlenose dolphin, Risso's dolphin, sperm whale, pantropical spotted dolphin, false killer whale, dwarf sperm whale, Bryde's whale and 'pygmy' Bryde's whale (Kahn 2007). No Australian snubfin/Irrawaddy dolphins were sighted during these surveys.

Triton Bay is located near the township of Kaimana on the west coast of the Indonesian Province of West Papua. It is part of the Bird's Head Seascape and situated within the epicentre of the 'Coral Triangle'. Triton Bay contains most, if not all, of the habitat types for both coastal and oceanic species of cetaceans inhabiting the Indonesian Seas. Kahn (2009) conducted boat-based surveys over nine field days from 13-21 February 2008. Five cetacean species and the dugong were confirmed for Triton Bay, including Indo-Pacific bottlenose dolphin, spinner dolphin, Bryde's whale, Indo-Pacific humpback dolphin (now Australian snubfin dolphin) and pantropical spotted dolphin. The most sighted cetacean

species were the Indo-Pacific bottlenose dolphin (18 sightings), spinner dolphin (14 sightings) and Bryde's whale (12 sightings) (Kahn 2009). No Australian snubfin/Irrawaddy dolphins were sighted during these surveys.

Boat-based transects conducted by Borsa and Nugroho (2010), surveyed the seas around Raja Ampat (West Papua) in November and December 2007. A total of 1561 km were surveyed, with six cetacean species identified, comprising spinner dolphins, short-finned pilot whale, Risso's dolphin, bottlenose dolphin (Tursiops sp.), false killer whale and sperm whale. The most commonly encountered cetacean was the spinner dolphin, which was considered to be the pelagic form S. l. longirostris (Borsa and Nugroho 2010). No Australian snubfin dolphins/Irrawaddy dolphins or Australian humpback dolphins were sighted during these surveys.

Incidental sightings from aerial surveys and boat-based surveys were conducted from 2006-2011 (over 417 days) in Raja Ampat in the Bird's Head Seascape, West Papua (Ender et al. 2014). The majority of sightings (300) were dolphins, comprising 3391 individuals. A total of 514 individual whales were encountered during 51 sightings. Seven species of dolphins were sighted during surveys (Spinner dolphin, common bottlenose dolphin, Fraser's dolphin, Indo-Pacific bottlenose dolphin, Risso's dolphin, Pantropical spotted dolphin, Indo-Pacific humpback dolphins - now Australian humpback dolphin). Six cetacean species were observed in the Kofiau Marine Protected Area (MPA) or Misool MPA, while Australian humpback dolphins, were sighted north of Misool Island. Six species of whales were recorded during boat-based surveys including, short-finned pilot whales, Bryde's whale, sperm whale, pygmy killer whale, false killer whale and killer whale (Ender et al. 2014). No Australian snubfin dolphins/Irrawaddy dolphins were sighted during these surveys.

Arguni Bay is located north of Kaimana, West Papua. Ninety days of visual observations in the Bay were conducted by Wijaya (2015) from 21 January to 11 April 2015. Observations were conducted from a land-based site, as well as opportunistic boat-based surveys. During these surveys, 64 Australian humpback dolphin groups and 40 bottlenose dolphins (Tursiops sp.) groups were sighted. No Australian snubfin dolphins/Irrawaddy dolphins were sighted during these surveys.

To date, 19 cetacean species have been recorded from Papua and West Papua waters (Table 3).

Table 3. Cetacean species recorded from Papua and West Papua, Indonesia

SPECIES	REFERENCE
Balaenoptera borealis Sei whale	
Balaenoptera musculus Blue whale	
Balaenoptera edeni Bryde's-like whale (including pygmy Bryde's whale described by Kahn (2007)	Kahn et al. (2006), Kahn (2007), Kahn (2009), Ender et al. (2014)
Balaenoptera omurai Omura's whale	
Feresa attenuata Pygmy killer whale	Ender et al. (2014)
Globicephala macrorhynchus Short-finned pilot whale	Rudolph et al. (2007), Borsa and Nugroho (2010), Ender et al. (2014)
Grampus griseus Risso's dolphin	Kahn (2007), Borsa and Nugroho (2010), Ender et al (2014)
Lagenodelphis hosei Fraser's dolphin	Ender et al (2014)
Orcaella heinsohni Australian snubfin dolphin	
Orcinus orca Killer whale	Ender et al. (2014)

SPECIES	REFERENCE
Peponocephala electra Melon-headed whale	Rudolph et al. (2007)
Pseudorca crassidens False killer whale	Kahn (2007), Borsa and Nugroho (2010), Ender et al. (2014)
Sousa sahulensis Australian humpback dolphin	Kahn et al. (2006), Kahn (2009), Wijaya (2015), Ender et al. (2014)
Stenella attenuata Pantropical spotted dolphin	Kahn (2007), Ender et al. (2014), Kahn (2009)
Stenella longirostris Spinner dolphin	Kahn et al. (2006), Kahn (2007), Rudolph et al. (2007), Kahn (2009), Borsa and Nugroho (2010), Ender et al (2014)
Tursiops sp.	Borsa and Nugroho (2010), Wijaya (2015)
Tursiops aduncus	Kahn et al. (2006), Kahn (2007), Kahn (2009), Ender et al (2014)
Tursiops truncatus	Kahn et al. (2006), Kahn (2007), Ender et al (2014)
Kogia breviceps Pygmy sperm whale	Rudolph et al. (2007)
Kogia sima Dwarf sperm whale	Kahn (2007)
Physeter macrocephalus Sperm whale	Kahn (2007), Borsa and Nugroho (2010), Ender et al. (2014)
Ziphius cavirostris Cuviers beaked whale	Rudolph et al. (2007)
Balaenoptera acutorostrata Minke whale	
Feresa attenuata Pygmy killer whale	Ender et al. (2014)
Megaptera novaeangliae Humpback whale	
Mesoplodon densirostris Blainville's beaked whale	
Steno bredanensis Rough-toothed dolphin	

Species Accounts
Confirmed Records

Balaenoptera

Blue Whale Balenoptera musculus

Papua New Guinea

- There are no confirmed sightings of blue whales in PNG waters. However, during the Woodlark Basin seismic experiment in eastern PNG (1999-2000), an ocean-bottom seismic array recorded marine mammal vocalisations along with target earthquake signals. On 21 December 1999, clear recordings of a blue whale song were obtained composed of a three-unit phrase. That song does not match the vocalisation characteristics of other known Pacific blue whale sub-populations and may represent a previously undocumented blue whale song (Frank and Ferris 2011). Based on these recordings, the blue whale was confirmed to occur in PNG by Miller 2021.

Indonesia Provinces of Papua and West Papua

- No known records

Sei whale Balaenoptera borealis

Papua New Guinea

- A single individual was observed in the Solomon Sea, east of New Ireland Province on 23 February 2001 by researchers onboard the research vessel 'Odyssey'. The whale swam alongside the vessel for approximately two hours and skin samples were taken for genetic analysis which confirmed species identification (Odyssey web logbook; Miller 2007).
- Sei whales have been reported as a cetacean species that interacts with the WCPFC longline and purse seine fishery in PNG waters (Williams et al. 2020; Williams et al. 2021)

Indonesia Provinces of Papua and West Papua

- No known records

Omura's Whale Balaenoptera omurai (Wada et al. 2003)

Papua New Guinea

- In 2021, a large whale was stranded on the northern coast of PNG. A skin sample was collected and sent to Auckland University for genetic analysis. This whale was confirmed to be an Omura's whale (R. Constantine pers comm 2022), which is the first confirmed record for PNG waters.

Indonesia Provinces of Papua and West Papua

- No known records

Bryde's Whale Balaenoptera edeni (Ohsumi 1978)

Papua New Guinea

- Miyazaki and Wada (1978) were very confident with their identifications of Bryde's whales in northern PNG waters, saying 'the research vessel could always approach the whales, so it is easy for us to identify species, particularly based on the three ridges on the snout'. In PNG, Bryde's whales were mainly sighted around Manus Islands and Nauru Island.
- In another tagging study, several individuals marked with discovery tags north of New Guinea and in the general vicinity of Nauru Island, were later killed on the pelagic whaling grounds east of southern Japan (Ohsumi 1978).
- Bryde's whales have been reported as a cetacean species that interacts with the WCPFC longline and purse seine fishery in PNG waters (Williams et al. 2020; Williams et al. 2021).

Indonesia Provinces of Papua and West Papua

- Fifteen days of boat-based surveys were conducted in Bintuni-Berau Bays from 17-20 September and 22 October-1 November 2005. One solitary Bryde's whale was sighted (Kahn et al. 2006).
- Eleven days of boat-based surveys were conducted in Raja Ampat, West Papua from 26 October – 5 November 2006. One Bryde's whale and one 'pygmy'

Bryde's whale were sighted (Kahn 2007).

- Nine days of boat-based surveys were conducted throughout Triton Bay, West Papua from 13-21 February 2008. Twelve groups of Bryde's whales were sighted, where the high frequency of sightings was considered particularly important for the region. This study combined with additional sightings in Bintuni Bay and Raja Ampat indicate that the waters of the Birds Head Peninsula are an important habitat for Bryde's whale, with Triton Bay considered a 'hotspot' for Indonesia (Kahn 2009).
- Boat-based surveys were conducted from 2006-2011 in Raja Ampat, West Papua by Ender et al (2014). Four group of Bryde's whales were sighted (Ender et al. 2014).

Common Minke Whale Balaenoptera aucutorostrata

Papua New Guinea

- There are no confirmed records of minke whales in PNG waters, however Reeves et al (1999) describe confirmed records of the dwarf minke whale from New Caledonia and Marion Reef in the Coral Sea.
- Frank Bonaccorso from the PNG Museum and Art Gallery confirmed a skull found in PNG to be a minke whale. The skull is currently housed at the PNG museum. A bone sample will be taken for future genetic analysis to confirm species identification.

Indonesia Provinces of Papua and West Papua

- No known records

Beaked Whales

Cuvier's beaked whale Ziphius cavirostris

Papua New Guinea

- Sightings of Cuviers beaked whales have been reported near Manus Islands by Miyazaki and Wada (1978), who noted the difficulty of making positive identifications because of these whales' cryptic behaviour.
- A single individual was observed between Cape Hoskins and May Reef in Kimbe Bay on 14 April 2003 (Visser 2003).
- Mavea et al. 2021 confirmed Cuvier's beaked whales during surveys of the New Britian Trench in 2021. One group was sighted of two adults breathing at the surface before diving. Water depth was @2600m. Identified from other beaked whales based on the relatively small size (5-7m), overall colouration with distinctly paler head, short, sloped rather than bulbous head and rostrum.

Indonesia Provinces of Papua and West Papua

- Rudolph et al (1997) note that Steve Leatherwood reported three sightings of Cuvier's beaked whales in Indonesian waters: one group of ten, a single animal north-west of West Papua on 6 June 1990, and three animals north of Doberai Peninsula, Werst Papua on 29 August 1991 (Rudolph et al. 1997).

Ginko-toothed beaked whale Mesoplodon ginkodens

Papua New Guinea

- There are no confirmed sighting records of ginko-toothed beaked whales from PNG waters. However, this is not surprising given that beaked whales are extremely difficult to sight at sea, and few dedicated surveys have been conducted in PNG waters. There are two skulls kept at the PNG Natural History Museum, identified as gingo-toothed beaked whale by Frank Bonaccorso. A bone sample will be taken from each skull for future genetic analysis to confirm species identification.

Indonesia Provinces of Papua and West Papua

- No known records

Sperm Whales

Sperm Whale Physeter macrocephaus

Papua New Guinea

- Lever (1964) identified the Bismarck Sea of Papua New Guinea and one of the important sperm whale whaling grounds, although the whaling season was restricted from October to March based on sperm whale occurrence (Lever 1964)
- Munday (1994) referred to sperm whales as being 'uncommon' in Kimbe Bay, with two verified sightings in January 1995. A single sperm whale was also reported to have beached on Talasea Peninsula in the 1970's, the bones of which were used by people from the Kombi region for small carvings (Munday 1994).
- Miller and Rei (2021) sighted 3 groups of sperm whales (10 individuals), during surveys throughout the northern Bismarck Sea. This study provided important information on sperm whales in the region given the Vulnerable conservation status of the species and relatively high pollutant loads of lead in this species sampled in PNG waters (Savery et al. 2014b).

Indonesia Provinces of Papua and West Papua

- Eleven days of boat-based surveys were conducted in Raja Ampat, West Papua from 26 October – 5 November 2006. Two groups of sperm whales were sighted (Kahn 2007).
- Five sperm whales were encountered at the western extremity of the deeper part of Dampier Strait, Raja Ampat, on 22 November 2007. They were solitary, or large size and appeared to be in foraging mode (Borsa and Nugroho 2010).
- Boat-based surveys were conducted from 2006-2011 in Raja Ampat, West Papua by Ender et al (2014). Two stranded sperm whales were documented in this study (Ender et al. 2014).

Pygmy Sperm Whale Kogia breviceps

Papua New Guinea

- Visser (2003) confirmed pygmy sperm whales in Kimbe Bay on 3 and 4 April 2003, north of Walindi Planation Resort. Apparently one group was photo-identified.
- Two pygmy sperm whales were by-caught in large mesh gillnets in the Kikori Delta during 2022 and 2023 (Beasley 2023). Both skulls were collected and are now deposited at the PNG Natural History Museum and Art Gallery (Figure 17). An initial species identification for both skulls was provided by international cetacean expert Dr. Thomas Jefferson. Bone samples will be taken from both skulls for genetic analysis to confirm species identification.

Indonesia Provinces of Papua and West Papua

- Rudolph et al. (1997) reported that Steve Leatherwood saw three pygmy sperm whales north of Doberai Peninsula, West Papua on 29 August 1991.

Dwarf Sperm Whale Kogia sima

Papua New Guinea

- Mavea et al. (2021) confirmed dwarf sperm whales during surveys of the New Britian Trench in 2021. Two sightings were observed on consecutive days in the late afternoon and early morning close to the same location in Jacquinot Bay. The first was one adult traveling quickly away from the transect line, the second was two adults logging at the surface before diving. The observations were in 720 and 650m water depth. These were identified from breviceps based upon a relatively large, upright dorsal fin set forward on the back.

Indonesia Provinces of Papua and West Papua

- Eleven days of boat-based surveys were conducted in Raja Ampat, West Papua from 26 October – 5 November 2006. One group of dwarf sperm whales were sighted (Kahn 2007).

Figure 17. One of the two pygmy sperm whale skulls recovered from Kikori Delta. The skull is now stored at the PNG Natural History Museum and Art Gallery.

Blackfish

Killer Whale Orcinus orca

Papua New Guinea

- The earliest reference to killer whales in PNG is from 1956 (Iwashita et al. 1963), who reported the widespread and year-round presence of killer whale pods in Pacific equatorial waters. However, Reeves et al. (1999) considered that these reports were not sufficiently well documented to be confirmed.
- Dawbin (1972) stated 'In PNG waters the most frequent sightings (of killer whales) are those from off the coast of northwest New Guinea'.
- Small groups of killer whales, including mother-calf pairs and an adult male were sighted in May, July and August 1994 in Kimbe Bay (Anonymous 1995) The whales were observed feeding on hammerhead sharks and tuna (Reeves et al. 1999).
- Munday (1994) considered killer whales 'uncommon' in Kimbe Bay, with individuals or small pods (<4) occasionally sighted, with confirmed sightings on three occasions in 1994.
- This is a well-documented cetacean in PNG waters, thanks to Visser and Bonaccorso (2003) who compiled a total of 94 killer whale sightings from PNG waters. Thirty-seven sightings from April 1987 to July 2002 were recorded with exact date and location information, A further 57 sightings were of unknown date or location. Twenty-seven of the records had either photographs or video to confirm identification (Visser and Bonoccorso 2003).

Indonesia Provinces of Papua and West Papua

- Boat-based surveys were conducted from 2006-2011 in Raja Ampat, West Papua by Ender et al (2014). Six groups of killer whales were sighted (Ender et al. 2014).

Short-finned pilot whale Globicephala macrorhynchus

Papua New Guinea

- The short-finned pilot whale is regularly sighted in deep waters of PNG. Munday (1994) referred to the species as 'regularly seen' in schools of 10-50 in Kimbe Bay. Often resting on the surface in calm water and remaining in the bay for a number of days.
- Mavea et al. (2021) confirmed short-finned pilot whale during surveys of the New Britian Trench in 2021. Three groups were sighted during surveys, totalling 54 individuals. Mean group size was 18 with a minimum 12 and maximum 30. These groups were identified as G. macrorhynchus based on known distribution, saddle colouration, dorsal fin and pectoral fin length and shape.
- Miller and Rei (2021) sighted one group of short-finned pilot whales (seven individuals) during surveys throughout the northern Bismarck Sea.
- Short-finned pilot whales have been reported as a cetacean species that interacts with the WCPFC longline and purse seine fishery in PNG waters (Williams et al. 2020; Williams et al. 2021).

Indonesia Provinces of Papua and West Papua

- Around 8 individuals were sighted north of the Vogelkop on 8 August 1983, around 30 individuals near Adi Island on 18 February 1985 and 2 sightings involving five individuals each near Adi Island on 23 February 1989, around 120 individuals north of the Vogelkop on 29 August 1991 (Rudolph et al. 1997).
- A single pod of >18 short-finned pilot whales was observed swimming parallel to a group of spinner dolphins in the deep waters (820m) of the Dampier Strait on 22 November 2007 by Borsa and Nugroho (2010).
- Boat-based surveys were conducted from 2006-2011 in Raja Ampat, West Papua by Ender et al (2014). Seven groups of short-finned pilot whales were sighted, and were the most commonly sighted whale species often seen in groups of around 20 individuals (Ender et al. 2014).

False Killer whale Pseudorca crassidens (Owen 1846)

Papua New Guinea

- Munday (1994) considered false killer whales to be 'rare' in Kimbe Bay, where a single school of approximately 20 individuals was observed directly off Walindi in January 1994. False killer whales have been reported as a cetacean species that interacts with the WCPFC longline and purse seine fishery in PNG waters (Williams et al. 2020; Williams et al. 2021)

Indonesia Provinces of Papua and West Papua

- Eleven days of boat-based surveys were conducted in Raja Ampat, West Papua from 26 October – 5 November 2006. One group of false killer whales were sighted (Kahn 2007).
- Around the Raja Ampat region, false killer whales were sighted twice, each time a pod of 5-6 individuals in relatively shallow (100-190m deep) waters at the western side of Dampier Strait at the entrance of the Halmahera Sea (23 November 2007), and off Salawati Island (4 December 2007) (Borsa and Nugroho 2010).
- Boat-based surveys were conducted from 2006-2011 in Raja Ampat, West Papua by Ender et al (2014). Two groups of killer whales were sighted (Ender et al. 2014).

Risso's dolphin Grampus griseus

Papua New Guinea

- Visser (2003) sighted three groups of Risso's dolphin during surveys in Kimbe Bay in April 2003. Photographs were taken of two of the three groups. A group of approximately 40 Risso's dolphins were sighted south of Kimbe Bay on 7 April 2003, a group of 6-8 individuals were sighted north of Kimbe Bay on 10 April 2003, and a single individual was sighted North of Cape Huessener on 13 April 2003.
- Miyazaki and Wada (1978) reported six sightings of small groups (usually <10 individuals), mainly in equatorial waters north of New Guinea.
- The findings of Risso's dolphin remains in archaeological material at Motupore Island, Bootless Inlet, south-eastern New Guinea, were discovered by Pernetta and Hill (1981), however it was unknown whether this represents a stranded specimen or is indicative of more persistent opportunistic hunting (Pernetta and Hill 1981).

Indonesia Provinces of Papua and West Papua

- Eleven days of boat-based surveys were conducted in Raja Ampat, West Papua from 26 October – 5 November 2006. Three groups of Risso's dolphins were sighted (Kahn 2007).
- Two small, separate groups of Risso's dolphins totalling 15 individuals were sighted in the deep waters (484-513m) immediately north-west of Sorong on 22 November 2007 (Borsa and Nugroho 2010).
- Boat-based surveys were conducted from 2006-2011 in Raja Ampat, West Papua by Ender et al (2014). One group of Risso's dolphins were sighted (Ender et al. 2014).

Melon-headed whale Peponocepha electra

Papua New Guinea

- Munday (1994) reported melon-headed whales as 'uncommon' in Kimbe Bay, although pods of 10-20 individuals were seen by Munday (1994) on several occasions between 1989-1991. There were no sightings since 1991.
- Reeves et al (1999) note that 'specimens from the Bismarck Archipeligo, Papua New Guinea were in the Zoological Museum, Germany but were destroyed during the Second World War (J.G. Mead pers comm. to Reeves et al 1999). A small pod apparently spent several weeks during September-October 1994 near Restorf Island in Kimbe Bay, PNG, although the identification is not confirmed).
- One immature female from a herd of about 20 animals, including several calves, was collected north of Nauru on 20 February 1976 (Miyazaki and Wada 1978). This group of melon-headed whales was swimming with a herd of 400-500 Frasers dolphins (Miyazaki and Wada 1978).
- Melon-headed whales have been reported as a cetacean species that interacts with the WCPFC longline and purse seine fishery in PNG waters (Williams et al. 2020; Williams et al. 2021).

Indonesia Provinces of Papua and West Papua

- Around 40 individuals were observed north of the Vogelkop on 29 August 1991 (Rudolph et al. 1997).

Pygmy Killer whale Feresa attenuata (Gray 1874)

Papua New Guinea

- Dawbin (1974) sighted a stranding record from Bogia, situated on the northwest coast of Madang Province, but no further details were available to confirm species.
- Miyazaki and Wada (1978) reported a sighting of 150-200 pygmy sperm whales on 6 March 1976, northeast of New Ireland Province. The group was confirmed as pygmy killer whales based on 1). body size of all animals was 2.5-3.5m, 2). the animals were of slender bodies with rounded head and no beak, and 3). their dorsal fins lead edge-slopes backwards, the rear margin is slightly concave, and the tip is pointed (Miyazaki and Wada 1978).
- Munday (1994) considered pygmy killer whales 'rare', with an unconfirmed report near Garua complex in 1994 (Burden pers comm in Munday 1994).
- No observations of pygmy killer whales were made by Visser during her research in Kimbe Bay (2002, 2003).
- Miller (2007, 2021) reported pygmy killer whales as being unconfirmed in PNG waters, however, the confirmed sighted by Miyazaki and Wada (1978) confirms the species occurrence, at least based on their identification.

Indonesia Provinces of Papua and West Papua

- Boat-based surveys were conducted from 2006-2011 in Raja Ampat, West Papua by Ender et al (2014). One group of 50 pygmy killer whales was sighted (Ender et al. 2014).

Delphinids

Fraser Dolphin Lagenodelphis hose

Papua New Guinea

- On 20 February 1976, a group of 400-500 Frasers dolphins was sighted swimming with a small group of around 20 melon-headed whales between New Guinea and Micronesia (Miyazaki and Wada 1978).
- Small numbers were sighted off New Britian in March 2001 by researchers on-board the research vessel Odyssey (Alliance 2001).
- There are no documented records from Kimbe Bay (Visser 2002, 2003).

Indonesia Provinces of Papua and West Papua

- Boat-based surveys were conducted from 2006-2011 in Raja Ampat, West Papua by Ender et al (2014). One group of Fraser's dolphins were sighted, which was the first confirmed sighting of the species for West Papua (Ender et al. 2014).

Spinner dolphin Stenella longirostris

The spinner dolphin is one of the most abundant cetaceans in Papuan water; with the two subspecies identified as present being Gray's spinner dolphin S. l. longirostris (Gray, 1828) as well as Dwarf spinner dolphin S. l. roseiventris (Wagner, 1846). The distribution patterns of S. l. longirostris/ S. l. roseiventris in Papuan waters is in need of further research in order to satisfactorily establish the distribution boundaries between these two. According to some researchers S. l. roseiventris is distributed in shallow waters of inner South-east Asia, including the Gulf of Thailand, the Timor and Arafura Seas off northern Australia, and other similar shallow waters off Indonesia and Malaysia. It is replaced in deeper and outer waters by the larger pelagic subspecies S. l. longirostris (Perrin et

al. 1999, 2002a, 2007). The Dwarf spinner dolphin S. l. roseiventris was re-described by Perrin et al. (1999) based on a large number of specimens including 37 specimens from a former Taiwanese shark gillnet fishery in the Arafura Sea off northern Australia; predicting that this form is at least present in the shallow waters off south-western New Guinea (including the Raja Ampat). The identity of many Spinner dolphin populations in Papuan waters remains unknown and identification may prove very difficult, especially true in the Raja Ampat Archipelago where despite a number of recent marine mammal surveys the racial identity of the S. longirostris present remains unknown.

Papua New Guinea

- Spinner dolphins were the most numerous cetacean species sighted in Kimbe Bay during 2003 surveys (Visser 2003).
- Spinner dolphins were described as especially abundant, observed in herds of hundreds and sometimes thousands, along the north coast of New Guinea, including Manus and New Britain (Dawbin 1972).
- Munday (1994) reported the spinner dolphin to be 'common' in Kimbe Bay, where the species is regularly seen in small pods of up to 10 individuals.
- Mavea et al. 2021 described the spinner dolphin as one of the most frequently sighted and abundant species during surveys of the New Britian Trench in 2021. Ten groups were sighted during surveys, totalling 150 individuals, typically relatively close to shore. Mean group size was 15 with a minimum 5 and maximum 50.
- Miller and Rei (2021) sighted 30 groups of spinner dolphins, totalling 1025 individuals. An additional 2 groups (40 individuals in total) were sighted in 2013 in association with pantropical spotted dolphins. The spinner dolphins sighted during these surveys were most likely Gray's spinner dolphins (S. longirostris longirostris), as evidenced by the slender beak, triangular and falcate dorsal fin, and colour patter on the body along with typical observations of spinning behaviour (Miller and Rei 2021).

Indonesia Provinces of Papua and West Papua

- Around 10-15 individuals were observed in the eastern Banda Sea on 23 January 1985, some tens in the Eastern Banda Sea on 2 February 1985, north of the Vogelkop in 1990, two groups south-east of Misool on 21 August 1991 and ca. 20 off Waigeo on 22 August 1991 (Rudolph et al. 1997).
- Fifteen days of boat-based surveys were conducted in Bintuni-Berau Bays from 17-20 September and 22 October-1 November 2005. Five groups of spinner dolphins were sighted (Kahn et al. 2006).
- Eleven days of boat-based surveys were conducted in Raja Ampat, West Papua from 26 October – 5 November 2006. Seven spinner dolphin groups were sighted (Kahn 2007).
- Extensive boat-based surveys around the seas of Raja Ampat in November and December 2007 determined that spinner dolphins were the most commonly

encountered cetacean (Borsa and Nugroho 2010). Spinner dolphins occurred in compact pods of eight to over 50 individuals, generally of 15-20 individuals. Based on body length and relative sizes of appendages, Borsa and Nugroho (2010) concluded that these were the pelagic form, rather than dwarf spinner dolphin.

- Nine days of boat-based surveys were conducted throughout Triton Bay, West Papua from 13-21 February 2008. Fourteen groups of spinner dolphins were sighted, the second-most commonly sighted cetacean species following Indo-pacific bottlenose dolphins (Kahn 2009).
- Boat-based surveys were conducted from 2006-2011 in Raja Ampat, West Papua by Ender et al (2014). Spinner dolphins were the second most frequently sighted cetacean (56 groups and 37% of all sightings). Spinner dolphins were primarily found in areas of deep water (>500m) in the strait between Kofiau and Boo Island, south of Boo island and also south of Kofiau Island (Ender et al. 2014).

Pantropical spotted dolphin Stenella attenuata

Papua New Guinea

- Visser (2003) sighted three groups of pantropical spotted dolphins in Kimbe Bay on 11 April and 14-15 April 2003). Photographs were taken of two of the three groups.
- Mavea et al. (2021) described the pantropical spotted dolphin as one of the most frequently sighted and abundant species during surveys of the New Britian Trench in 2021. Six groups were sighted during surveys, totalling 125 individuals, typically in deeper water further from shore than spinner dolphins. Mean group size was 21 with a minimum 10 and maximum 35. Miller and Rei (2021) sighted 3 groups of pantropical spotted dolphins (70 individuals) during surveys throughout the northern Bismarck Sea. An additional 2 groups (40 individuals in total) were sighted in 2013 in association with spinner dolphins.

Indonesia Provinces of Papua and West Papua

- Eleven days of boat-based surveys were conducted in Raja Ampat, West Papua from 26 October – 5 November 2006. Two groups of pantropical spotted dolphins were sighted (Kahn 2007).
- Nine days of boat-based surveys were conducted throughout Triton Bay, West Papua from 13-21 February 2008. One group of pantropical spotted dolphins were sighted (Kahn 2009).
- Boat-based surveys were conducted from 2006-2011 in Raja Ampat, West Papua by Ender et al (2014). One group of Pantropical spotted dolphins were sighted (Ender et al. 2014).

Common Bottlenose dolphin Turisiops truncatus

Papua New Guinea

- Munday (1994) reported the common bottlenose dolphin to be 'common' in Kimbe Bay, where the species is regularly observed throughout the bay in small pods.
- Mavea et al. (2021) confirmed common bottlenose dolphins during surveys of the New Britian Trench in 2021. Four groups were sighted during surveys, totalling 45 individuals. Mean group size was 11 with a minimum 4 and maximum 30. Photographs were obtained of two of the four groups. These groups were identified as truncatus based on a lack of spotting in mature individuals, body structure and rostrum length.
- Visser (2003) sighted T. truncatus on four days in Kimbe Bay (4 April and 13-15 April 2003). Miyazaki and Wada (1978a) observed bottlenose dolphins around New Ireland Province, and they collected a lactating female off the northwest corner of New Ireland.
- Bottlenose dolphins have been reported as a cetacean species that interacts with the WCPFC longline and purse seine fishery in PNG waters (Williams et al. 2020; Williams et al. 2021).

Indonesia Provinces of Papua and West Papua

- Fifteen days of boat-based surveys were conducted in Bintuni-Berau Bays from 17-20 September and 22 October-1 November 2005. One common bottlenose groups was sighted (Kahn et al. 2006).
- Eleven days of boat-based surveys were conducted in Raja Ampat, West Papua from 26 October – 5 November 2006. Eight groups of common bottlenose dolphins were sighted in the shallow waters off the southern and western coastlines of Waigeo, Western Dampier Strait, between northern Batanta and southern Waigeo, Sorong Bay, as well as off the southern coastline of Misool (Kahn 2007).
- Boat-based surveys were conducted from 2006-2011 in Raja Ampat, West Papua by Ender et al (2014). Common bottlenose dolphins were the most frequently sighted cetacean (50 groups and 51.5% of all sightings) (Ender et al. 2014).

Indo Pacific Bottlenose dolphin Turisiops aduncus

Papua New Guinea

- Visser (2003) sighted Indo-Pacific bottlenose dolphins on 10 of the 12 survey days in Kimbe Bay. This was the second most sighted cetacean species during surveys, with spinner dolphins being the most common.
- Four separate observations of solitary Indo-Pacific bottlenose dolphins were made during surveys of the Kikori Delta in 1999. This species was distinguished based on the dark grey colouration, large falcate dorsal fin and presence of a short but distinct beak (Bonaccorso et al. 2000a).
- In 2008, (Coffey 2008) photographed a group of Indo-Pacific bottlenose dolphins in the Gulf of Papua, in association with the LNG Project Gas Pipeline. This photograph is shown in Figure 9.

Indonesia Provinces of Papua and West Papua

- Fifteen days of boat-based surveys were conducted in Bintuni-Berau Bays from 17-20 September and 22 October-1 November 2005. Eight groups of Indo-Pacific bottle dolphins were sighted (Kahn et al. 2006).
- Eleven days of boat-based surveys were conducted in Raja Ampat, West Papua from 26 October – 5 November 2006. Six groups of Indo-Pacific bottlenose dolphins were sighted (Kahn 2007).
- During surveys in Arguni Bay, West Papua from 21 January to 11 April 2015, Wijaya (2015) sighted 40 bottlenose dolphin groups. These were likely Indo-pacific bottlenose dolphins based on their resident inshore distribution.
- Nine days of boat-based surveys were conducted throughout Triton Bay, West Papua from 13-21 February 2008. Eighteen groups of Indo-Pacific bottlenose dolphins were sighted, the most sighted cetacean species in the Bay (Kahn 2009).
- Boat-based surveys were conducted from 2006-2011 in Raja Ampat, West Papua by Ender et al (2014). Two groups of Indo-Pacific bottlenose dolphins were sighted (Ender et al. 2014).

Unconfirmed Records

Blainville's beaked whale Mesoplodon densirostris

Papua New Guinea

A tentative sighting of a Blainville's beaked whale was made by Visser (2003) in Kimbe Bay on 13 April 2003, between the resort and WPR. No photographs were obtained. Miller (2007; 2021) listed this sighting as unconfirmed for PNG waters.

Indonesia Provinces of Papua and West Papua

No known records

Humpback Whale Megaptera novaeangilae

Papua New Guinea

Dawbin (1972) stated that before they were severely depleted, humpback whales would occasionally visit the Gulf of Papua and reached the vicinity of New Britian, however, he had no evidence of their presence along the coast of New Guinea. Anecdotal reports of humpback whales in Kimbe whale were documented by Munday (1994), where he reported an unconfirmed report of a large pod north of Kimbe Island prior to 1985 (Benjamin pers comm in Munday (1994).

Indonesia Provinces of Papua and West Papua

No known records

Rough toothed dolphin Steno bredanensis

Papua New Guinea

A tentative identification of a group of rough-toothed dolphins was made by Visser 2003 in Kimbe Bay. This sighting remained unconfirmed by Miller (2007; 2021).

Indonesia Provinces of Papua and West Papua

No known records

Inshore Dolphins

Australian Humpback dolphin Sousa sahulensis

Beasley et al (2016) provides a comprehensive review on observations of Australian humpback dolphins in the waters of the Pacific Islands and New Guinea. Humpback dolphins have been confirmed to occur in the Kikori Delta of PNG, and Bintuni and Berau Bays (Kahn et al 2006), Mayalibit Bay (Kahan 2006), Triton Bay (Kahn 2009) and Arguni Bay, Kaimana (Wikaya 2015).

The humpback dolphin is not currently found in any other location of the Pacific Islands (Beasley et al 2016). Despite the large number of coastal surveys where Australian humpback dolphins have been sighted, no Australian snubfin dolphins have been sighted during these surveys.

As part of this review, two additional records were found of Australian humpback dolphins in PNG waters since Beasley et al. (2016). No additional records were found on humpbacks in Papua or West Papua.

Papua New Guinea

- In 2008, (Coffey 2008) photographed a lone adult Australian humpback dolphin in the Gulf of Papua, sighted from a prawn trawler. This photograph is shown in Figure 9. This photograph may indicate that inshore dolphins are feeding around prawn trawlers (Gulf of Papua Prawn Fishery) when the vessels are close to the shore.

- During a trip along the southern New Guinea coast, a naturalist Rick Twist sighted 26 groups of humpback and snubfin dolphins (11 and 15 groups respectively). The first group of 5-7 humpback dolphins was sighted on 4 March at the mouth of the Purari River, Gulf Province. This group had at least one newborn calf swimming with the adults. Other humpback dolphin groups were sighted in this area from 4-6 March, probably with some groups/individuals being resighted throughout the days (Figures 18 and 19).

Figure 18. Humpback dolphins sighted near the Puarai River mouth by Rick Twist on 4 March 2018.

Figure 19. Humpback dolphins sighted near the Puarai River mouth by Rick Twist on 4 March 2018, which includes a newborn humpback dolphin.

On 7 March the vessel moved west to the Ivo River, and a group of humpback dolphins was sighted in the morning, followed by a mixed group of snubfin and humpback dolphins (Figure 20). Snubfin dolphins were then sighted on 7 and 8 March 2018.

Figure 20. Humpback dolphins sightings (red pointers) from 4-7 March 2018. A mixed group of humpback and snubfin dolphins were sighted on 7 March 2018 at the mouth of the Ivo River, Gulf Province (purple pointer). Snubfin dolphins were also observed at the mouth of the Ivo River (green pointers)

Indonesia Provinces of Papua and West Papua

No additional records found since Beasley et al (2016).

Australian Snubfin Orcaella heinsohni

Papua New Guinea

- Dawbin (1972) reported that Irrawaddy dolphins were accidentally taken in fishing nets in the Gulf of Papua, but he did not have any direct evidence for this statement (Dawbin 1972).
- Pernetta and Hill (1981) indicate that Australian snubfin dolphins were known to be utilised for food in the Purari Delta of Gulf Province (Liem 1983). No further details are provided, however Liem (1983) lists Australian snubfin dolphins among the species used for food, in the context of both the subsistence and cash economies of the Purarai Delta.
- A single skull originating from Daru Island, Western Province is held in the Australian Museum (Beasley et al 2002; 2005).
- Australian snubfin dolphins were the most numerous cetacean seen during surveys of the Kikori Delta in 1999 (Bonaccorso et al. 2000b). Fourteen individuals representing six separate groups were observed on 15 and 16 December near Verabari Island.
- Research on inshore dolphins in the Kikori Delta, Gulf Province, PNG began in 2011, by Isabel Beasley from James Cook University. The primary aim of the 2011 trip was to determine which species of inshore dolphins occurred in the Delta. During the 2011 trip, one group of six Australian snubfin dolphins were sighted in Pai'ia Inlet, and two marine mammal skeletal remains were found; one partial dolphin skull of a juvenile bottlenose or humpback dolphin, and one lower mandible of a Risso's dolphin (Beasley 2012). The lack of sightings was primarily due to very poor weather conditions. However, as a result of this work, further funding was obtained from Exxon Mobil PNG Ltd (then PNG LNG), to continue research in Kikori.
- A large-scale boat-based survey was conducted throughout the Kikori Delta during 16 days from 1-16 December 2013. Australian snubfin dolphins were the most frequently sighted cetacean. A total of 16 groups were sighted, with a total group size of 63 animals. Group composition consisted of 60 adults and three juveniles; no calves were sighted. Groups were extremely shy and evasive and difficult to photo-identify. Only four individuals were photo-identified (Beasley et al 2014).
- Another large-scale boat-based survey was conducted throughout the Kikori Delta during 11 days from 20 February to 3 March 2013. A total of 1701km of survey was conducted over 156 hours. Australian snubfin dolphins were again the most frequently sighted cetacean. A total of 20 groups were sighted, with a total group size of 81 animals. Group composition consisted of 80 adults and one juvenile; no calves were sighted. Groups were again extremely shy and evasive and difficult to photo-identify. Eighteen individuals were photo-identified (Beasley et al 2015).
- During an exploration trip along the southern New Guinea coast in March 2018, a naturalist Rick Twist sighted 26 groups of humpback and snubfin dolphins (11 and 15 groups respectively). Australian snubfin dolphins were primarily sighted in front of the Ivo River mouth. Australian snubfin dolphins were sighted on 7 and 8 March 2018. A group of snubfin dolphins were sighted during the afternoon of 7 March (Figure 21). Interestingly, the dolphin photographed appears to have a dorsal groove along its back, which is characteristic of Irrawaddy dolphins rather than Australian snubfin dolphins.

Figure 21. Australian snubfin dolphin sighted at the mouth of the Ivo River on 7 March 2018 bottom image): this group was swimming together with Australian humpback dolphins. A snubfin dolphin sighted during the afternoon of 7 March 2018. Interestingly, this dolphin appears to have a dorsal groove along its back, which is characteristic of Irrawaddy dolphins rather than Australian snubfin dolphins (bottom image)

Indonesia Provinces of Papua and West Papua

- Morzer Bruyns (1966) reported Irrawaddy dolphins (now Australian snubfin dolphins) to occur in Irian Jaya (now West Papua) near Biak Island and in the mouths of muddy rivers on the southwest coast. Further details of these sightings could not be found (Rudolph et al 2007). These are currently the only known reports of Australian snubfin dolphins occurring in Papua or West Papua.

Evaluation of Inshore Dolphin Conservation Status in the Kikori Delta and the Kikori Delta IMMA

Evaluation Summary

In addition to this review, the following section provides further detailed information on the conservation status of inshore dolphins in Gulf Province and an evaluation of the Kikori Delta IMMA.

With regards to the Kikori Delta IMMA, recommendations from this review are:

- Conservation status of inshore dolphins in the Kikori Delta is now critical, with unsustainable by-catch in gillnet fisheries threatening local extinction of Australian snubfin and humpback dolphins in PNG waters. Development of community-based solutions to mitigate by-catch are urgently required;
- Recent sightings in 2018 (described in this report) have confirmed that Australian snubfin and humpback dolphins occur near the Purari River Delta region of Gulf Province. Future boat-based surveys in this region for Total Energies PNG will provide essential information on the current-day occurrence and potential hotspots of inshore dolphins outside the Kikori Delta;
- If future sightings are confirmed east of the Kikori Delta, it is recommended that the Kikori Delta IMMA is expanded to include coastal waters east of Kikori to Kerema;
- Based on Tetley et al. (2002) proposal to devise an 'early warning system', for IMMA's it is proposed that based on the unsustainable number of confirmed inshore dolphin mortalities from 2021-2023, the Kikori Delta IMMA is potentially designated as 'in danger' (or similar) status. This designation may help to direct international and national expert advice and assistance to mitigate by-catch.

Background

Research on inshore dolphins in the Kikori Delta, Gulf Province, PNG began in 2011, by Isabel Beasley from James Cook University. The primary aim of the 2011 trip was to determine which species of inshore dolphins occurred in the Delta. Initial research in 1999 by WWF-PNG and PNG Museum and Art Gallery (Bonaccorso et al 2000), recorded dugong (Dugong dugon), Indo-Pacific bottlenose dolphins (Tursiops aduncus), Indo-Pacific humpback dolphins (Sousa chinensis) and Irrawaddy dolphins (Orcaella heinsohni), based on aerial and vessel-based surveys conducted in December 1999. However, new taxonomic research conducted on the genus Orcaella in 2005 (Beasley et al. 2005), indicated Australian snubfin dolphins (Orcaella heinsohni) (hereafter snubfin dolphin) would occur in PNG, rather than Irrawaddy dolphins.

During the 2011 trip, one group of six Australian snubfin dolphins were sighted in Pai'ia Inlet, and two marine mammal skeletal remains were found; one partial dolphin skull of a juvenile bottlenose or humpback dolphin, and one lower mandible of a Risso's dolphin (Beasley 2012). The lack of sightings was primarily due to very poor weather conditions. However, as a result of this work, further funding was obtained from Exxon Mobil PNG Ltd (then PNG LNG), to continue research in Kikori.

Further dedicated field-trips to Kikori were undertaken in 2013 and 2015, which aimed to determine taxonomic status of inshore dolphins in Kikori, and obtain abundance estimates (Beasley et al 2013; 2015). During these trips, the main results were:

- Australian snubfin dolphins and Australian humpback dolphins were confirmed to occur in the Delta (Beasley et al. In review; Beasley et al 2016);
- No abundance estimates could be obtained of either species using traditional mark-recapture techniques, because of the dolphins extremely shy, cryptic surfacing nature and difficulty to sight and follow for photo-identification;
- The high number of snubfin dolphins sighted during surveys indicated that the Kikori Delta is an important regional hotspot for the species, and internationally important

- The primary threat to marine mammals in the Delta is accidental entanglement in fishing gear, where the mortality was considered unsustainable;
- At least two individuals (one snubfin and one humpback dolphin) were sighted with a pox-like lesion on their bodies, which could indicate a further threat that needed to be investigated.

These research trips highlighted the complexities and difficulties of a foreigner (i.e. Dr. Beasley) trying to conduct research and conservation work in PNG, such as language difficulties with many different languages being spoken in the Delta, striong landowner tenue and knowledge requirement of how these tenue systems operate and function, and cultural sensitivites. Therefore, from 2016-2021, the Pidu project focused on initiating and implementing a scholarship program in partnership with James Cook University and University of Papua New Guinea (UPNG), with funding from Exon Mobil PNG Ltd. From 2016-2018 the scholarship program supported three students to undertake their postgraduate studies; Wilma Mavea and Monika Kolkia who undertook Postgraduate Diploma in Science at UPNG, and Elizah Nagombi who undertook his Masters by Coursework and then Graduate Certificate in Research Methods at James Cook University. In 2020, Jacinta Jonathan and Lythia Mizigi began their Postgraduate Diploma in Science at UPNG. Wilma and Elizah graduated in 2018, and Jacinta completed her thesis program in June 2022, with additional financial support from the Marine Conservation Action Fund (MCAF). More detail on these students and their projects can be found at: https://pngdolphinproject.org/pidu-scholarship-program/.

As a result of the students research in Kikori during 2020-2021, it became clear that the by-catch of inshore dolphins had increased significantly since 2013. Between 2013-2020, a total of 38 snubfin and 6 humpback carcass/skeletal specimens were recovered by the Pidu team (Table 4).

Table 4. Confirmed inshore dolphin mortalities in the Kikori Delta, PNG from 2013-2020

YEAR	SNUBFIN	HUMPBACK
2013 and 2015	14 (incl. 6 fresh snubfin carcasses)	2
2019	11	2
2020	13	2
Total	**38 snubfin dolphins**	**6 humpback dolphins**

Swimbladder (fishmaw) Fishery in Gulf Province Threatening Inshore Dolphins

The majority of the by-catch resulted from a new fishing industry that had developed since 2016, targeting large fish swim bladders.The swim bladder fishery primarily uses gillnets to target barramundi (Lates calcarifer) and scaly stonefish (Nibea squamosa) for a highly valuable commodity, dried swim bladder (also known as fishmaw). 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 (estimated local price fishers receive ranges from 500–10,000 PGK kg-1, 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. 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 snubfin dolphin, humpback dolphin, and several species 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 (Grant et al. 2021). Ben-Hasan et al (2021), review available information on China's fish maw demand and implications for fisheries in source countries, where they concluded that 'the demand for maw is likely intensifying in countries already supplying it, shifting or explaning to new species, and emerging in new regions; most fish maw supplying species are under high fish pressure, poorly or not protected; and while management interventions are needed to sustain fishery resources and capture economic benefits, their effectuveness will be challenged by the high value of maw'. Grant et al. (2021) observed elasmobranch catches in small-scale fisheries in Gulf Province of PNG from 2017-2020, and identified the primary threat to river shark and sawfish populations is their capture by small-scale fisheries targeting teleosts from swim bladder. Interviews with fishers during 2018-2019 also confirmed a growing and ongoing threat from this fishery (Grant et al. 2020).

With the dolphin population levels likely to be extremely small already, this high rate of by-catch is unsustainable for species that have very low reproductive rates, such as inshore dolphins. This is of very high conservation concern as snubfin and humpback dolphins do not occur anywhere else in PNG or other Pacific Islands. 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 2016).

Both snubfin and humpback dolphins (Figure 22) 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. Both the vaquita and totoaba are now listed as Critically Endangered on the IUCN Red List of Threatened Species (Rojas-Bracho and Taylor 2017, Cisneros-Mata et al. 2021). The snubfin and Australian humpback dolphin are both listed as Vulnerable by the IUCN Red List (Parra et al. 2017a; b). Although it has not been possible to obtain abundance estimates for snubfin and humpback dolphins in the Kikori Delta, based on similar studies in northern Australia it is likely that inshore populations are small (<200 individuals) and localised (Brooks 2017, Parra and Cagnazzi 2016; Cagnazzi 2013).

Figure 22. Australian snubfin dolphin (left) and Australian humpback dolphin (right)

Recognising the need for urgent research, conservation and management action in Kikori to assess the status of the swim bladder fishery and its effects on endangered species, the Secretariat of the Pacific Regional Environment Programme (SPREP) commissioned two research tenders through the By-catch and Integrated Ecosystem Management Initiative (BIEM) Initiative; one for inshore dolphins (awarded to the Piku Biodiversity Network (PBN), PNG) and one for sharks and rays (awarded to Michael Grant from James Cook University. The inshore dolphin tender required research to continue to investigate mortality rates and causes, and to initiate outreach to the local community on the issue, including undertaking fisher surveys and conducting workshops and discussions on mitigation options. This research is being conducted in collaboration with the Snubfin Dolphin Conservation Project and partnership with the Conservation and Environment Protection Authority (CEPA), PNG.

SPREP Consultancy to Lead Dolphin By-catch Data Collection and Community Engagement in Kikori Delta, Papua New Guinea

In October 2021, the Piku Biodiversity Network in partnership with the SDP and CEPA was awarded a consultancy to 'lead dolphin by-catch data collection and community engagement in Kikori Delta, Papua New Guinea' (PNG). This consultancy is funded by the Secretariat of the Pacific Regional Environment Program (SPREP) through the Pacific- European Union Marine Partnership Program (PEUMP) which is funded by the European Union and the Government of Sweden.

The projects aimed to:

- Provide data on dolphin by-catch in gillnet fisheries in the Kikori River Delta, Gulf Province, Papua New Guinea, and investigate potential community conscious options to mitigate dolphin by-catch.
- Raise local and national awareness on the IUCN designated Kikori Delta Important Marine Mammal Area (IMMA), and work with community and all stakeholders/ government departments to develop a community-led management plan for this IMMA.

Study Site

The study site in the Kikori Delta, located in Gulf Province, southern Papua New Guinea (PNG) (Figures 23 and 24).

Figure 23. Location map of Papua New Guinea showing the Kikori Delta region in green highlight.

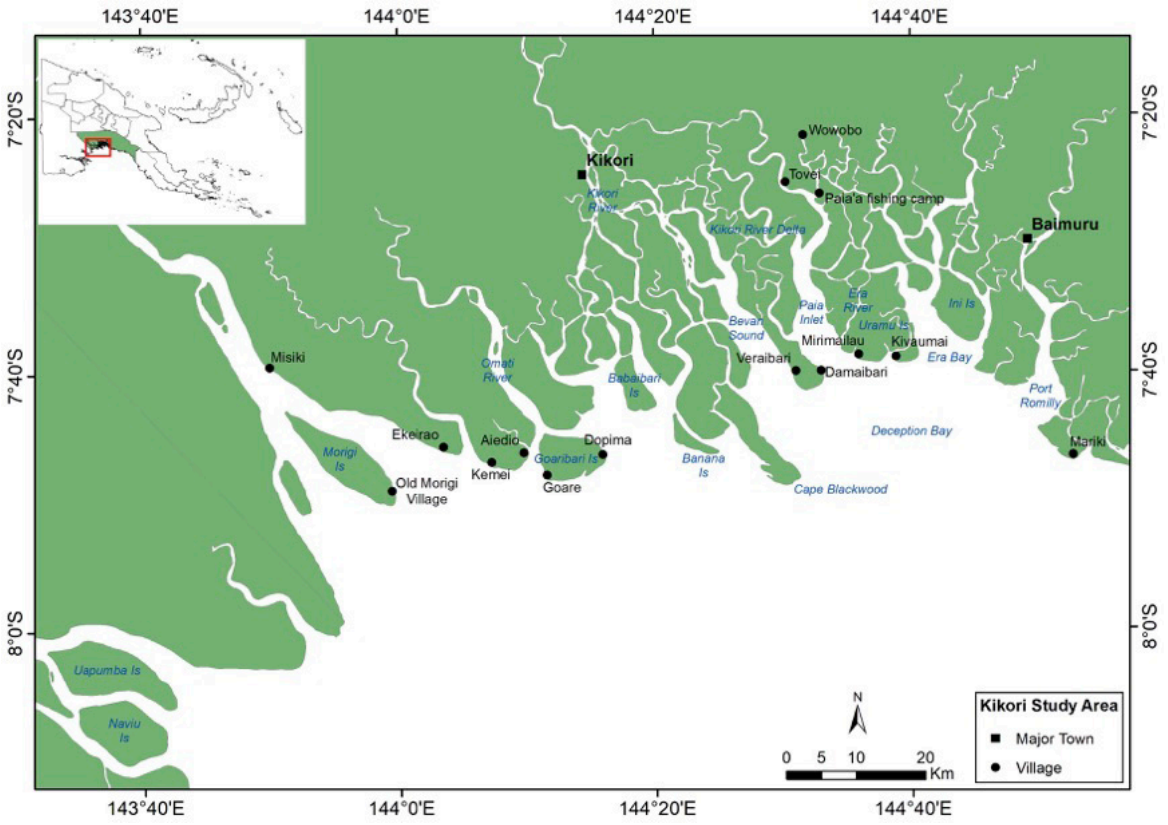

Figure 24. Close up map of the Kikori Delta region

Carcass Recovery Program (November 2021 – 31 May 2022)

Between 18 November 2021 – 31 May 2022, a total of 74 dolphins have been reported to the Pidu carcass recovery program, from 59 events. These reports consisted of 72 mortalities and 2 snubfin dolphins released alive from a 5-inch gillnet (Table 5). These 72 mortality reports consisted of 69 snubfin dolphins (Figure 25), 1 humpback dolphin, 1 probable humpback dolphin, and one pygmy sperm whale. Fifty-eight individuals were confirmed by-catch (2 snubfin dolphins were released alive) (Figure 26), and 16 were unknown cause of death.

Table 5. Pidu carcass recovery program summary (18 November 2021 – 31 May 2022)

SPECIES	100% BY-CATCH	RELEASED ALIVE	UNCONFIRMED	TOTAL
Snubfin	57	2	14	71 (69 deceased)
Humpback	1	0	0	1
Humpback?	0	0	1	1
Pygmy Sperm	0	0	1	1
Total	**58**	**2**	**16**	**74**

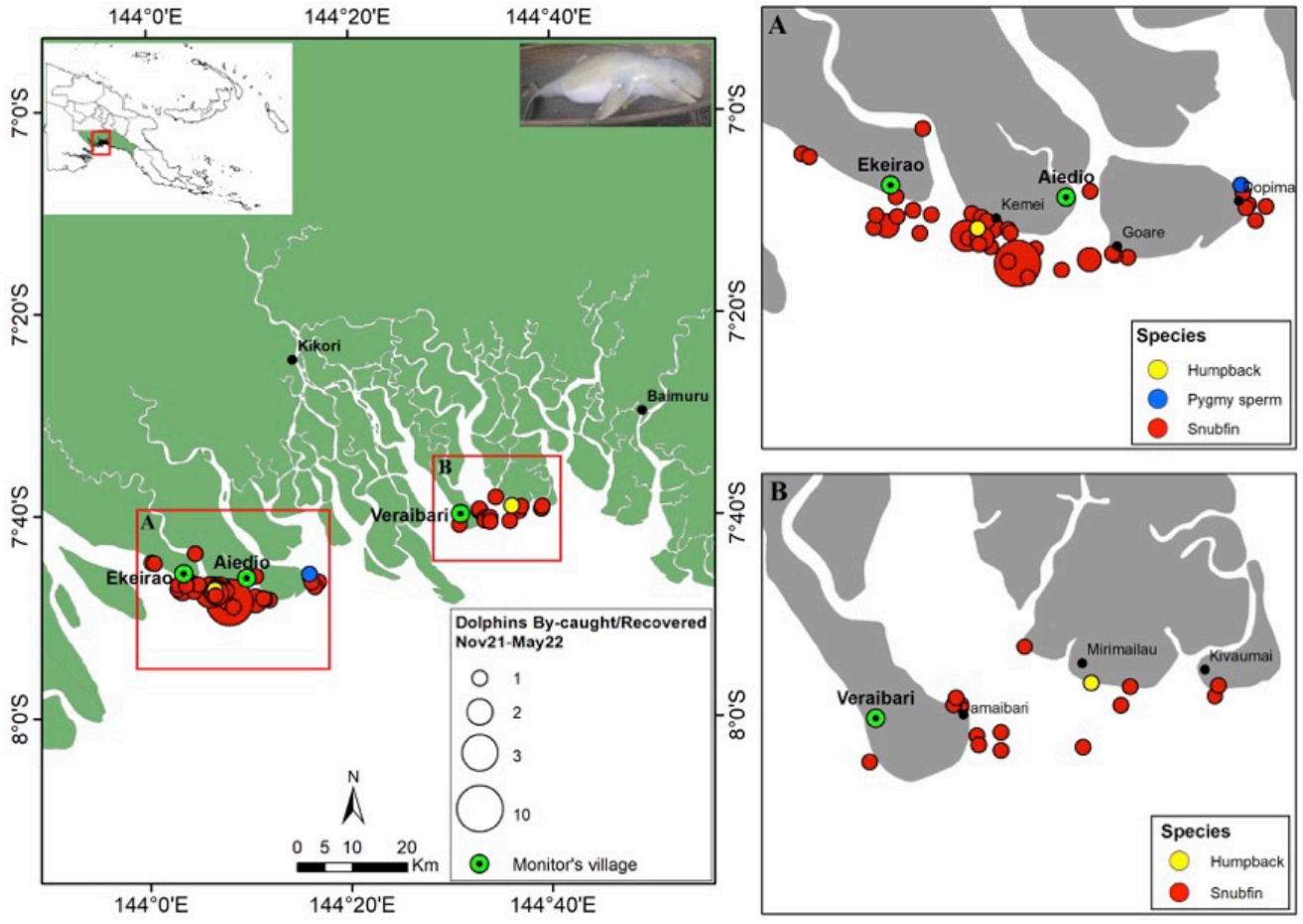

Figure 25. Locations of carcasses found from 18 November 2021 – 31 May 2022 (top image). Dolphin in insert is JK05, found at Naiwagi Village on 10 February 2022.

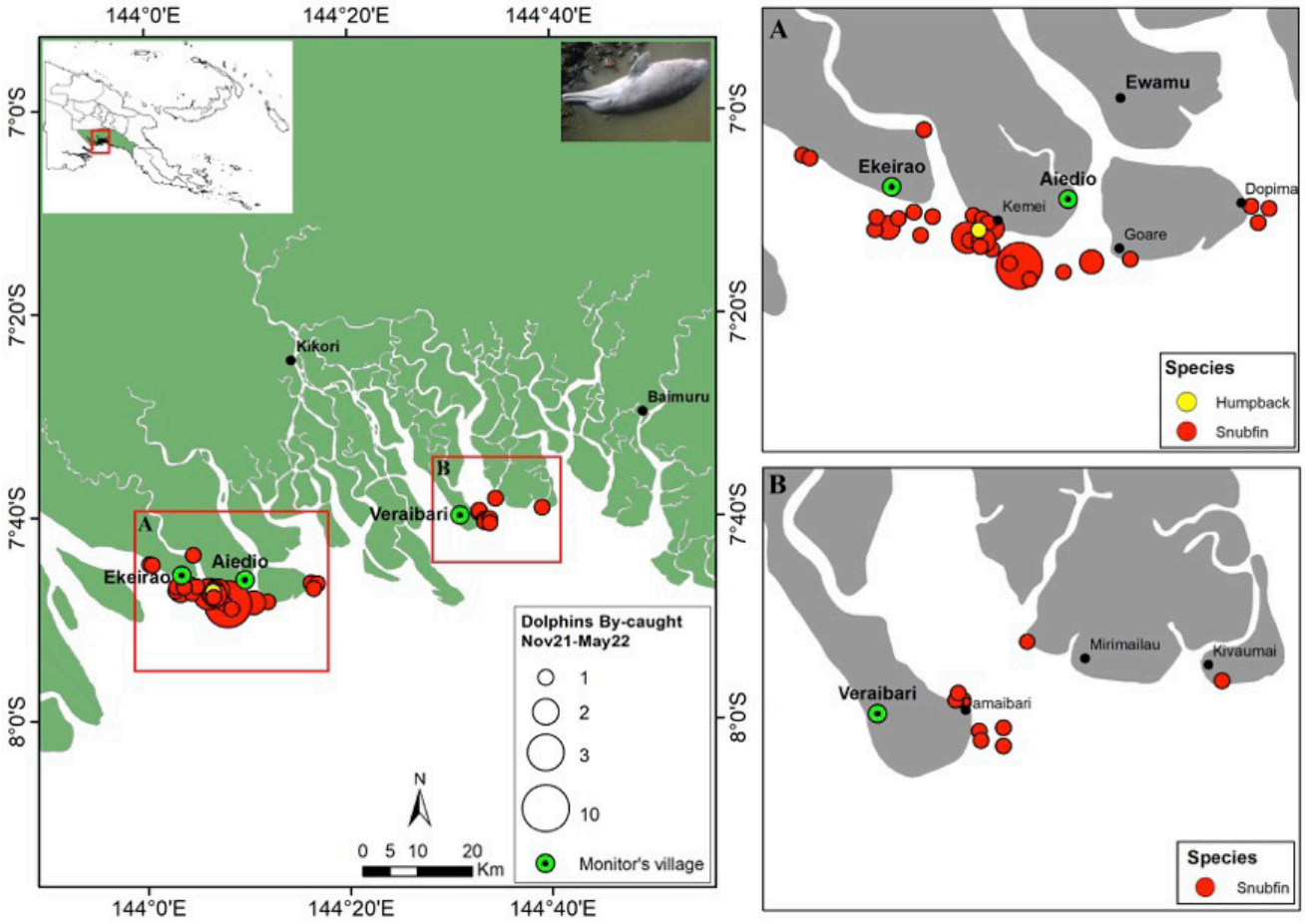

Figure 26. Locations of confirmed by-catch occasions from 18 November 2021 – 31 May 2022 (top image). The humpback dolphin in insert is AE23, found at Kemei Village on 8 April 2022.

Potential Biological Removal Calculation

To investigate the potential effect of human-caused mortality in the Kikori Delta, the Potential Biological Removal (PBR) approach was used (Wade 1998). PBR is an estimate of the maximum number of animals, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum Sustainable Population (Wade 1998). Population estimates for snubfin and humpback dolphins in the Kikori Delta have not yet been obtained. Therefore, a review of the literature was undertaken, to establish the largest population sizes that have been recorded for both species, to obtain a conservative estimate of PBR.

Parra and Cagnazzi (2016) provide a summary on the status of Australian humpback dolphins, where it was found that Australian humpback dolphins occur in small populations averaging 54-89 individuals. The largest population recorded was from Port Essington, Northern Territory, Australia, by Palmer et al (2014) of 207 individuals (CV=0.32). **The resulting PBR is 0.32 (i.e. no more than 1 human-caused dolphin every 3.1 years) (Table 6).**

Parra et al (2017) summarise the status of snubfin dolphins, where available abundance estimates indicate that snubfin dolphins occur in small populations of typically fewer than 150 individuals. The largest population recorded was also at Port Essington, with an estimate of 136-222 individuals. **The resulting PBR is 0.37 (i.e. no more than 1 human-caused dolphin every 2.7 years) (Table 7).**

Table 6. PBR calculations for humpback and snubfin dolphins in Kikori Delta, based on the largest known populations of humpback and snubfin dolphins in Australian waters.

SPECIES	STUDY SITE	ABUNDANCE	NMIN	PBR	REFERENCE
Humpback	Port Essington	207 (CV=0.31)	160	0.32	
(no more than 1 dolphin every 3.1 years)	Palmer et al. (2014)				
Snubfin	Port Essington	222			
(CV=0.21)	186	0.37			
(no more than 1 dolphin every 2.7 years)	Palmer et al. (2014)				

For both humpback and snubfin dolphins, it is clear that the current confirmed mortality of 69 dolphins and 1 humpback dolphin is unsustainable. Inshore dolphin populations in the Kikori Delta are no doubt in significant decline.

SPREP Consultancy to Lead Dolphin By-catch Mitigation Development and Implementation in Kikori Delta, Papua New Guinea

Aims and Objectives

As a result of the extremely high inshore dolphin by-catch confirmed for the Kikori Delta, in November 2022, a consultancy was awarded to the Piku Biodiversity Network (PBN) in partnership with the Snubfin Dolphin Conservation Project (SDCP) to 'lead dolphin by-catch mitigation and implementation in Kikori River Delta, Papua New Guinea'. This consultancy is funded by the Secretariat of the Pacific Regional Environment Program (SPREP) through the Pacific-European Union Marine Partnership Program (PEUMP) which is funded by the European Union and the Government of Sweden. The goal of this project is to 'build on previous work to collaborate with the Kikori community to develop and implement mitigation methods to reduce by-catch of inshore dolphins in artisanal gillnet fisheries, and to continue engagement and data collection. This work is to be undertaken in partnership with CEPA and all relevant stakeholders'.

In combination with the existing carcass recovery program, the by-catch mitigation component of this project had six primary objectives:

- **Objective 1:** Raise community awareness throughout the Kikori Delta about pinger use and function, and the objectives of pinger trials (Figure 27);
- **Objective 2:** Familiarise Pidu staff with use and function of pingers, and their placement on nets;
- **Objective 3:** Determine which type of pingers (i.e. Fishteck Marine and Future Oceans) the fishers would prefer to use for the formal trials;
- **Objective 4:** Being comprehensive CPUE data collection with at least one fisher in the study area;
- **Objective 5:** Begin an assessment of the number of gillnets being used in the Kikori Delta through a census of households in the initial study area;
- **Objective 6:** Develop a comprehensive study design for formal pinger trials in 2023, including an assessment of constraints and potential solutions.

Figure 27. Pidu project Officer Wilma Mavea discussing pingers and their use to Kikori fishers.

Community Monitors

Six community monitors worked with the Pidu project to report on dolphin by-catch and mortalities. These monitors are from Ekeirau, Aideo, Ewamu, Veraibari, Damaibari and Wowobo Villages within the Kikori Delta. The community monitors play an important role in collecting data to answer questions on how many dolphins are dying, and why they are dying in the Delta each year. We are very thankful to the community monitors for their continued efforts and assistance. Thanks also to village leaders and the community for their support of the dolphin monitors' work in providing information to the Pidu project.

The community monitor component concluded in February 2023. However, it is hoped that additional funding can be found to continue this important component in the future.

Carcass Recovery Program

Between November 2021 – March 2023 (duration of both SPREP funded projects), 82 by-catch/stranding events were recorded by the community monitors, consisting of six humpback dolphin events (6 humpback dolphins), 51 snubfin dolphin events (91 snubfin dolphins) and 2 pygmy sperm whale events (2 pygmy sperm whales) (Figure 28).

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) (Figure 29),
- **2 pygmy sperm whales** (2 unknown mortality) (Table 7).

Table 7. Pidu 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)

The carcass recovery component concluded in February 2023. However, it is hoped that additional funding can be found to continue this important component in the future.

Figure 28. Location of dolphin carcasses recovered by the community dolphin monitors between November 2021 – March 2023.

Figure 29. Humpback dolphin caught in a 7-inch nylon guardline net.

By-catch Questionnaires

During the March fieldtrip, 34 fishers were interviewed regarding their dolphin by-catch in the past 1-2 years. Twenty-three fishers had by-caught dolphins that were included in the Pidu carcass recovery program, primarily because these fishers were targeted for interviews since they were known to have previously caught dolphins in their nets. Based on these 34 by-catch interviews:

- Gillnets that caught dolphins were a combination on guardline and nylon, primarily guardline;
- Gillnet net size ranged from 5-7 inch;
- From these 34 fishers, a total of 55 snubfin dolphins and 6 humpback dolphins were reported to have been by-caught;
- Two snubfin dolphins were reportedly released alive;
- Of the 61 by-catch occasions reported through the by-catch questionnaires, the Pidu team were previously aware of 23 occasions through the monitor program.

Main Results from Both SPREP Projects

- Community awareness raising was very successful, with many months of awareness about the pingers use and function being conducted with numerous Kikori communities. Based on the feedback from the Feb/Mar 2023 fieldtrip and community meetings, many fishers and communities support pinger trails and are enthusiastic about future trials.
- Unfortunately the by-catch mitigation component of this project was not successful. Every effort was made to address the limitations of this component as they arose, however it was unfortunately not possible within the time-frame of the project. The main limiting factors were significant delays with funding coming through to the PNG Bank which restricted field work time, inexperienced and uncommitted officers leading the pinger trails, and the increased community awareness which required more time and resources.
- Important lessons have been learnt about the challenges faced with the by-catch component of this project. It is believed that pinger trials are still very beneficial for future by-catch mitigaton in the Kikori Delta. These trials are beneficial to trial pingers for by-catch mitigation, but also to continue positive engagement of Kikori communities and fishers with dolphin conservation efforts.
- The primary constraint with undertaking effective inshore dolphin research and conservation efforts in PNG is a lack of national marine mammal expertise, with no PNG national available to independently lead and manage project efforts. Without a PNG team lead, it is extremely difficult to effectively implement project activities.
- Between November 2021 – March 2023 (duration of both SPREP funded projects), 82 by-catch/stranding events were recorded by the community monitors, consisting of: 99 individuals
  - » 6 humpback dolphin events (6 humpback dolphins),
  - » 51 snubfin dolphin events (91 snubfin dolphins) and
  - » 2 pygmy sperm whale events (2 pygmy sperm whales).
- Based on the results of this project, very conservative Potential Biological Removal estimates for humpback and snubfin dolphins are 0.32 (i.e. no more than 1 human-caused dolphin every 3.1 years), and 0.37 (i.e. no more than 1 human-caused dolphin every 2.7 years) respectively. With these estimates compared to the known mortalities from this project, it is clear that the current confirmed mortality is unsustainable, and Kikori inshore dolphin populations are no doubt in significant decline.
- The high level of mortality is very concerning for the persistence of snubfin dolphins in the Kikori Delta, but also for northern Australian populations of snubfin dolphins which, based on genetic studies, must be moving between PNG and northern Australia and being by-caught in PNG.
- The work of the community dolphin monitors, and Kikori community, is very important to understand dolphin mortalities in the Kikori Delta, and should be continued year-round, if further funding can be obtained.
- In addition to recording dolphin mortalities and by-catch release events, the monitor program has confirmed a new cetacean species, not previously recorded for Gulf Province, the pygmy sperm whale, Kogia breviceps.

- Population estimates for humpback and snubfin dolphins in the Kikori Delta (and southern PNG) remain unknown.
- The workshops and by-catch questionnaire found that fishers and community leaders are very supportive of conservation and management programs to be implemented to mitigate by-catch, and many fishers support trialing mitigation techniques on the fishing gear.
- Discussions with international experts have determined that pingers may be useful at reducing inshore dolphin by-catch. The project is very thankful to Future Oceans and Fishteck Marine for supplying six pingers each to implement the pinger component of this project. However, pingers should not be the only mitigation strategy considered.
- The success of this project is entirely dependent on the excellent relationship and partnerships that the PBN has with Kikori communities and local Government. Collaboration with the Gulf Provincial Fisheries office, the Conservation and Environment Protection Authority, and other national and provincial stakeholders will be essential for community-based management actions to be implemented and enforced.
- Most Kikori Delta communities rely on artisanal fisheries for their daily food intake. Dolphin and fisheries conservation and management is therefore also important for the livelihood of local communities in the Delta. Basic fisheries management strategies, such as managing fishing activity during fish spawning and dolphin foraging times, need to be implemented as a matter of priority.
- In addition to the potential damage to fisheries in the Delta, the gillnet fisheries are also impacting on endangered fauna that inhabit the Delta, such as leatherback turtles, Demochelys coriacea, the green turtle, Chelonia mydas and the freshwater pig-nosed turtle, Carettochelys insculpta, sawfish and sharks.

Recommendations for High Priority Future Activities

- Re-start local capacity building efforts to identify a PNG National that can lead project activities (i.e. support a University Papua New Guinea postgraduate student)
- Continue the community monitor and carcass recovery program (including the community awareness program), with monthly checks of all monitors to check data and collect samples
- Continue the pinger component of the project, once a suitable project officer can be found
- Follow up with the expert review of the Kikori by-catch mitigation document, to ensure it is reviewed, finalised and published
- Publish the results of the SPREP funded projects in peer-reviewed journals
- Continue to partner with CEPA and SPREP to provide support and advice nationally regarding the by-catch issue in Kikori, and provide project results where required

Conclusion

With regards to the Kikori Delta IMMA, recommendations from this review are:

- Conservation status of inshore dolphins in the Kikori Delta is now critical, with unsustainable by-catch in gillnet fisheries threatening local extinction of Australian snubfin and humpback dolphins in PNG waters. Development of community-based solutions to mitigate by-catch are urgently required;
- Recent sightings in 2018 (described in this report) have confirmed that Australian snubfin and humpback dolphins occur near the Purari River Delta region of Gulf Province. Future boat-based surveys in this region for Total Energies PNG will provide essential information on the current-day occurrence and potential hotspots of inshore dolphins outside the Kikori Delta;
- If future sightings are confirmed east of the Kikori Delta, it is recommended that the Kikori Delta IMMA is expanded to include coastal waters east of Kikori to Kerema.
- Based on Tetley et al. (2002) proposal to devise an 'early warning system', for IMMA's it is proposed that based on the unsustainable number of confirmed inshore dolphin mortalities from 2021-2023, the Kikori Delta IMMA is potentially designated as 'in danger' (or similar) status. This designation may help to direct international and national expert advice and assistance to develop strategies to mitigate by-catch.

Figure 30. Urgent conservation management strategies are now required to prevent the local extinction of Australian humpback (top) and snubfin (bottom) dolphins from Gulf Province, PNG.

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