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Review of cetacean diversity, status and threats in the Pacific Islands region 2021

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List of Abbreviations

BDEP	By-catch database
DSM	Deep Sea Mining
EEZ	Exclusive Economic Zone
FAD	Fish Aggregation Devices
IUU	Illegal, Unreported and Unregulated (Fishing)
PICT	Pacific Island countries and territories
SPC	Pacific Community
SST	Sea Surface Temperature
WCPFC	Western & Central Pacific Fisheries Commission

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Executive Summary

This authoritative report with over 300 references updates a review conducted by the same author in 2008 and provides an overview of the state of knowledge on threats to cetaceans (whales and dolphins) in the waters surrounding the Pacific Island Countries and Territories of the Pacific Islands region. There are verified records for 33 different cetacean species across the Pacific Islands region, comprising almost half the species known in the world, although it is likely that more species occur across the region but have not been documented.

The human-induced threats identified to cetaceans are:

- Incidental catch (by-catch) and fishing gear interactions
- Harvesting (direct take)
- Pollution
- Vessel traffic
- Pathogens and introduced species
- Resource depletion
- Ocean-physics alteration including climate change.

By-catch by commercial oceanic purse seine and longline vessels fishing within the Exclusive Economic Zones of Pacific Island countries and territories is identified as the most serious current threat to cetaceans based on reports from on board fisheries observers. Although the widespread use of inshore gillnets in the region could be a significant source of mortality, there is little reliable information on the by-catch of cetaceans in subsistence and coastal fisheries. Besides by-catch in active fishing gear, cetaceans may also become entangled and drown in abandoned, lost or discarded fishing gear (ALDFG) and in drifting Fish Aggregating Devices (d-FADs).

The Pacific Community (SPC) trains fisheries observers and provides an archive for storing their reports. In recent years, several analyses have been undertaken of observer data, which provide the best available information on the levels of interaction of commercial fishing with whales and dolphins. The papers containing these analyses are referenced in the report. The low level of observer coverage in the longline fishery inhibits accurate assessment of the number of cetaceans taken as by-catch (with generally less than 5% of sets observed). Until the onset of COVID-19, observer coverage in the purse seine fishery had been over 80% for several years, a sufficiently large sample to provide reliable assessments.

Despite the low level of observer coverage in the longline fishery, 298 cetacean gear interactions were reported between 2015 and 2019, comprising 27 cetacean species or species groups, with almost a quarter of the interactions being with false killer whales. In total, 2,131 individuals from 20 species and species groups were reported to have engaged in “non-gear” interactions with longline fishing vessels. The main species involved in non-gear interactions was again false killer whales (61.8%).

For the regional purse seine fishery, the most recent estimates suggest that annual rates of marine mammal by-catch are in the thousands every year and have ranged from 1,623 (1,378 – 1,939 95% CI) in 2003 to 3,861 (3,789 – 3,945 95% CI) in 2013. The average for the five most recent years with full available data (2015 – 2019) is 1,942. The impact of interactions on species and populations is difficult to assess without more accurate information on the distribution and population levels of the cetacean species interacting with the fisheries as well as more accurate information from the longline fishery on numbers of interactions.

While most of the information on by-catch is from oceanic fisheries, there is also concern about coastal and subsistence fisheries. This is especially the case in the shallow turbid waters of the Kikori Gulf in Papua New Guinea, where an unmanaged and poorly regulated fish maw

(swim bladder) gillnet fishery has caused a steep decline in the abundance of snubfin and Indo-Pacific humpback dolphins, threatening their extirpation in the Pacific Islands region.

In addition to by-catch, cetaceans are also at risk from active fishing gear such as d-FADs, and gear or nets that have been damaged and discarded, known as 'ghost gear'. Ghost gear also drowns turtles, sharks and seabirds, as well as damaging coral reefs and other coastal habitats when they are washed ashore.

While by-catch is the greatest current threat to Pacific whales and dolphins, it is by no means the only one. Hunting also presents a major threat in some areas, most notably the area around Fanalei on the island of Malaita in the Solomon Islands. It is estimated that more than 15,000 dolphins were killed in drive hunts (in which schools of dolphins and small whales were herded into bays by small boats near Fanalei village from 1976 to 2013). Small-scale or occasional hunts have historically also occurred in the Mariana Islands, Kiribati, the western Caroline Islands, Marshall Islands, French Polynesia and Papua New Guinea. An unknown but significant number of bottlenose dolphins were captured alive near Guadalcanal in the Solomon Islands earlier this century, for entertainment parks in several countries, but this was prohibited in 2017, and has not resumed.

The report also highlights pollution as potentially a major risk to cetaceans, and identifies noise, chemical pollution, plastics and microplastics, industrial waste and coastal rubbish disposal as particular issues. Deep Sea Mining is highlighted as a potentially serious emerging issue, with several of these hazards combining in possible future mining operations.

Ship strike represents another danger for cetaceans, especially large whales, and tourist vessels are potentially a particular hazard for whales and dolphins. Poor land-based waste disposal practices and increasing nutrient levels in coastal waters can trigger algal blooms containing organisms that are harmful to whales.

The most significant long-term threat to cetaceans in the Pacific Islands region is climate change. Migratory baleen whales that feed largely on krill in the Antarctic Ocean during the summer and breed in Pacific Islands waters will be especially at risk from warming sea water, because krill can only survive in very cold water. A recent report to the International Whaling Commission suggests that in the southern hemisphere, the current recovery from heavy commercial whaling activity could be negated by climate change impacts, which may cause decreases and some local extinctions for Pacific populations of blue, fin and southern right whales, and Atlantic/Indian fin and humpback whales, by 2100.

The report provides a comprehensive list of recommendations to improve knowledge about the status and threats to cetaceans in the Pacific Islands region. These include:

- Increasing observer coverage in the longline fishery and the use of electronic monitoring gear on all commercial fishing vessels;
- Building capacity within the Pacific Islands to research the range and distribution of cetaceans and to promote community conservation efforts in coastal waters;
- Improve collection and analysis of information on all cetaceans taken as by-catch or stranded; and
- Improve monitoring efforts, especially for drive hunts, including CITES, regional and national databases.

Overview

This report presents a general summary of cetacean species and their threats in the Pacific Islands region. The information in this report is separated into three main sections: i) an overview of cetaceans found in the Pacific Islands region, (ii) a review of key threats for Pacific Island cetaceans, and (iii) identification of knowledge gaps in assessing threats to Pacific Island cetaceans – with particular focus on the monitoring and evaluation of risk in relation to fisheries by-catch. The report represents an update to an initial review entitled "Current state of knowledge of cetacean threats, diversity, and habitats in the Pacific Islands Region" (Miller 2007).

In total, there are verified records for 34 different cetacean species across the Pacific Islands region (Table 1 and Appendix). These species vary greatly in life history characteristics, ecology, biology and habitat range.. It is also likely that many more species occur across the region yet have not been documented. Threats to Pacific Island cetaceans were summarised under broad categories of threat developed by Avila et al. (2018) that sought to (i) comprehensively review and classify global threats to cetaceans and (ii) align with the process and classification used to define threats under the IUCN status assessment process. These categories are:

- Incidental catch (by-catch) and fishing gear interactions
- Harvesting (direct take)
- Pollution
- Vessel traffic
- Pathogens and introduced species
- Resource depletion
- Ocean-physics alteration including climate change

An assessment of relative risk for each of these threats was also undertaken by considering the availability of data, confidence in the available data, and relative risk of the given threat. The key cetacean species most likely impacted by the given threat has also been listed.

Finally, a broad discussion of the gaps in understanding as well as recommendations for remedying and progressing some of these threats, risks and knowledge gaps is provided.

Section 1 - Pacific Islands cetaceans: diversity and status

The Pacific Islands region provides year-round, annual and occasional habitat to more than 30 different species of cetaceans ranging from large, migratory baleen whales such as blue whales and fin whales – to small estuarine-associated dolphins such as the Australian snubfin dolphin (Table 1). For most of these species there is limited information available for important characteristics such as abundance, birth rates, potential biological removal, level of residency or site fidelity, genetic distinctiveness, or critical habitat.

Records for cetaceans sighted across the region are listed in Table 1. Both scientific name and common name are provided along with the International Union for Conservation of Nature (IUCN) status, and which appendices the given species is listed under, both the Convention of Migratory Species (CMS) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Species records were collated from a wide variety of sources including ongoing research projects, peer-reviewed publications, survey reports and documents, state of the environment reports, by-catch and interaction records, national sightings databases and networks, newspaper reports, museum records, anecdotal reports (such as stranding events), and whaling records. Individual cetacean species accounts are arranged by Order (Baleen whales (Mysticetes) and toothed whales, (Odontocetes) and then alphabetically by species name under these two categories.

For each of these species, some general information regarding identification features that are distinctive or particularly important when distinguishing from similar looking species or are of importance in terms of taxonomy for the given species ("Identification"), geographic range and habitat ("Habitat"), and life-history and population characteristics that may be pertinent to consider in a management setting ("Demographics") are listed. Identification and habitat descriptions are based on general reviews (i.e., Cawardine (1995) or Reeves et al. (1999, 2003) unless otherwise indicated. Finally, individual listings of cetacean records for each PICT EEZ (Economic Exclusive Zone) is listed in the Appendix.

Table 1. Listing of all cetacean species with at least one reliable record in any of the PICTs. For each species the IUCN Red List status, CMS appendix, and CITES listings are also given. Individual cetacean listings for each PICT (with associated references) are provided in the Appendix. Note: Those cetacean species, which are found exclusively in Australia and New Zealand – and not in any PICT – are not listed here.

Scientific name	**Common Name**	**IUCN**	**CMS**	**CITES**
Balaenoptera acutorostrata unnamed subsp.	Dwarf minke whale	LC	-	I / II (*B. acutorostrata*)
Balaenoptera bonaerensis	Antarctic minke whale	NT	II	I
Balaenoptera borealis	Sei whale	EN	I/II	I
Balaenoptera edeni	Bryde's whale	LC	II (Eden / Bryde's)	I (Eden / Bryde's)
Balaenoptera edeni edeni	Eden's whales		II (Eden / Bryde's)	I (Eden / Bryde's)
Balaenoptera musculus	Blue whale	EN	I	I
Balaenoptera musculus brevicauda	Pygmy blue whale			
Balaenoptera omurai	Omura's whale			I
Balaenoptera physalus	Fin whale	VU	I/II	I
Delphinus delphis	Short-beaked common dolphin	LC	I/II	II
Feresa attenuata	Pygmy killer whale	LC	-	II
Globicephala macrorhynchus	Short-finned pilot whale	LC	-	II
Grampus griseus	Risso's dolphin	LC	II	II
Indopacetus pacificus	Longman's beaked whale			
Kogia breviceps	Pygmy sperm whale	LC	-	II
Kogia sima	Dwarf sperm whale	LC	-	II
Lagenodelphis hosei	Fraser's dolphin	LC	II	II
Megaptera novaeangliae	Humpback whale	EN (Oceania)	I	I
Mesoplodon densirostris	Blainville's beaked whale	LC	-	II
Mesoplodon ginkgodens	Ginkgo-toothed beaked whale	DD	-	II
Orcaella heinsohni	Australian snubfin dolphin	VU	II	I
Orcinus orca	Orca	DD	II	II
Peponocephala electra	Melon-headed whale	LC	-	I
Physeter macrocephalus	Sperm whale	VU	I/II	II
Pseudorca crassidens	False killer whale	NT	-	II
Sousa sahulensis	Australian humpback dolphin	VU		I
Stenella attenuata	Pantropical spotted dolphin	LC	II	II
Stenella coeruleoalba	Striped dolphin	LC	II	II
Stenella longirostris	Spinner dolphin	LC	II	II

Steno bredanensis	Rough-toothed dolphin	LC	-	II
Tursiops aduncus	Indo-Pacific bottlenose dolphin	NT	II	II
Tursiops truncatus	Common bottlenose dolphin	LC	II	II
Ziphius cavirostris	Cuvier’s beaked whale	LC	I	II

Pacific Islands cetacean species accounts

For each cetacean species identified in Table 1 some brief details regarding habitat, demographics/life history, and identification are presented below. The given details are provided as a platform for discussion of how reporting of cetacean sightings and strandings might be streamlined to ensure better consistency in records. In some cases, where information is not available or does not add to such a discussion it has been omitted.

Baleen whales (Mysticetes)

Balaenoptera acutorostrata unnamed subsp., dwarf minke whales

Identification: Sharply pointed snout, falcate fin, and longitudinal ridge on head. White bands on flippers in some populations. It is unclear whether records collated in this report consistently and accurately differentiate between the common minke whale, Antarctic minke whale and the dwarf form as different sources provide various taxonomies for minke whales (e.g., Committee on Taxonomy 2021, Rice 1998). However, the presence of a solid white area on the upper surface of flippers and dusky collar are considered distinguishing features between dwarf minke whales and Antarctic minke whales (Shirihai and Jarrett, 2006).

Habitat: Virtually worldwide in tropical, temperate and polar waters of both hemispheres. Confirmed records in the Pacific Islands include New Caledonia, Fiji and Tonga. There are also a number of other PICTs with sightings of “minke-like” whales (see below) which may include this species and hence it may be distributed relatively widely across the region.

Demographics: It is probable but uncertain whether minke whale breeding occurs in discrete populations in the eastern and western South Pacific Ocean, or if individuals are perhaps assembled in open waters during the breeding season. The dwarf form apparently moves to high latitudes (at least 65°S) in summer.

Balaenoptera bonaerensis, Antarctic minke whale

Identification: Narrow, pointed rostrum, relatively robust body, and a low splashguard. Prominent, falcate dorsal fin is set about 2/3 way back along their body. As mentioned under *B. acutorostrata* unnamed subsp. it is unlikely that all collected records differentiate between the common minke whale, the dwarf minke whale and the Antarctic minke whale. Therefore, in cases where insufficient genetic and/or morphological evidence was provided the record was listed only as *Balaenoptera* sp.

Habitat: The Antarctic minke whale occurs in highest densities in the Antarctic during the summer feeding season. Records for New Caledonia and Tonga have been reported.

Demographics: During the winter breeding season, individuals are believed to disperse in open ocean areas in tropical and subtropical latitudes (Kasamatsu et al. 1995).

Balaenoptera borealis, Sei whale

Identification: Longitudinal ridge on head, tall, sickle-shaped fin. Both sides of head evenly dark. Does not arch tailstock and rarely shows flukes. The difficulty of distinguishing sei whales from Bryde's whales and Omura's whale has confounded much of the historical literature, and even some modern survey data. Reports in the literature from any time before the mid-1970s are suspect because of the frequent failure to distinguish sei from Bryde's whales and Omura's whales, particularly in tropical to warm temperate waters where Bryde's whales are generally more common than sei whales (Reeves et al. 1999).

Habitat: Worldwide distribution, but primarily in deep, temperate oceanic waters. Reports of this species across the region include Cook Islands, New Caledonia, Niue, Northern Marianas Island, Papua New Guinea, and Tonga.

Demographics: Usually found in small groups (2 – 5 individuals) yet may occur in larger groups up to 30 at good feeding grounds.

Balaenoptera edeni, Bryde's whale (*B. edeni/brydei* complex)

Identification: Easy to identify at close range due to the presence of three parallel ridges on head. Has a prominent, falcate fin and the skin may be mottled yet a dark upper side. The difficulty of distinguishing Bryde's whales from Omura's whales and sei whales has confounded much of the historical literature, and even some modern survey data (Reeves et al. 1999, see sei whale ID also). Bryde's whales have three rostrum ridges which – if able to be seen – are an important diagnostic tool for this species. The animals traditionally called Bryde's whales fall into two species (*B. edeni* and *B. omurai*, with large ('ordinary') and small forms of the former). Therefore, in cases where insufficient genetic and/or morphological evidence was provided, the *B. edeni/brydei* records are not distinguished from one another.

Habitat: Bryde's whales are regarded as having a pantropical distribution, and in some areas (e.g. the western Pacific) they move seasonally into warm temperate latitudes. Sightings are listed for Fiji, Guam, and Samoa.

Demographics: Loose groups of up to 30 are sometimes found at feeding grounds. Smaller groups typically seen during other behaviours.

Balaenoptera omurai, Omura's whale

Identification: Single, defined longitudinal ridge. Lower jaw is white on the right-side and dark on the left-side. They are dark-grey on their upper body and more pale below. They also have four black stripes on the right side of their head. This species was described only very recently (Wada et al. 2003). There has been difficulty in consistently distinguishing between sei, Bryde's whales (large and small forms) and Omura's whale (see above) therefore, several of the Bryde's and sei identifications are considered tentative.

Habitat: Tropical waters of the far western Pacific waters and Southeast Asia (e.g. Solomon Sea, South China Sea, south-eastern Indian Ocean and possibly southern Japan). A recent stranding record in PNG was found to be an Omura's whale, the first record for this country (R. Constantine, pers.comm.).

Demographics: There is limited information about average group size of this species due to the relatively limited number of sightings.

Balaenoptera musculus subsp., Blue whales

Identification: Enormous size, blue-grey body colour, mottled appearance, and broad and flattened U-shaped head. Tiny, stubby fin set far back. Huge blowhole splashguard. It is possible that both Antarctic true blue whales (*Balaenoptera musculus intermedia*) and 'pygmy' blue whales (*Balaenoptera musculus brevicauda*) are present in the Pacific Islands region, yet most records found did not distinguish to the sub-species level. Accompanying information regarding the total length of a given animal would allow differentiation to be made given the very large size of the true blue whale. Given the absence of such information for most records, this report typically refers to blue whales, without further division.

Habitat: Patchily distributed worldwide, mainly in cold waters and open seas. Records for this species have been reported for Marshall Islands, Papua New Guinea, Solomon Islands and Tonga. Confirmation of the pygmy subspecies is available for Cook Islands and New Caledonia.

Demographics: Relatively small group size (1 – 2) yet may be found in larger gatherings at feeding grounds.

Balaenoptera physalus, Fin whale

Identification: Exceptionally large adult size (18 – 22m), asymmetrical head pigmentation, small dorsal fin that is positioned far behind the body centre, longitudinal ridge on head, and a tall, narrow blow. Greyish, white chevron with white underside to flippers and belly.

Habitat: Worldwide distribution, but most common in temperate waters and in the southern hemisphere. It has been proposed that fin whales tend to become widely dispersed in winter, with some possibly migrating into tropical waters, many being scattered in the open ocean in subtropical and sub-Antarctic waters, and some remaining in the Antarctic. Reports of this species are listed for Fiji and Marshall Islands. Sightings of fin whales have been documented east of Pitcairn Islands (Acevedo et al. 2012).

Demographics: Group size has been estimated as relatively small (around 5) yet may be much more (100+) when gathering at productive foraging grounds.

Megaptera novaeangliae, Humpback whale

Identification: Black or dark grey upper side. Low, stubby fin with hump. Large, stocky body and long flippers. Knobs on head and lower jaw. Irregular, wavy edges on flukes. This species is relatively distinctive both in appearance and behaviour and is unlikely to be mis-identified. It has very long arm-like flippers often visible underwater.

Habitat: Humpback whales have a cosmopolitan distribution that generally involves long migrations between high-latitude summer feeding grounds and tropical breeding grounds

(Clapham 2000). Several sites within the Pacific region have been identified as present-day wintering grounds for humpback whales presumed to belong to southern hemisphere populations. The Area V International Whaling Commission (IWC) defined Antarctic stock of humpback whales has two migratory 'streams', one passing the east coast of Australia and the other passing New Zealand and Norfolk Island, the latter thought to winter in proximity to many of the Pacific Islands nations (Dawbin 1964, Constantine et al. 2012). It is also possible that northern hemisphere individuals may migrate further south than Hawaii into the Pacific Islands region.

Demographics: Using genetic and photo-identification data primarily from New Caledonia, Tonga, the Cook Islands and French Polynesia – a population for the Pacific portion of the Oceania humpback whale population was estimated to be between 3,345 – 5,313 (95% CI) individuals (Constantine et al. 2012). There appears to be differential recovery in humpback whale breeding locations across the region although it is unclear whether observed changes may be due to congregation of individuals (Clapham and Zerbini 2015) or non-recovery of populations (Miller et al. 2015).

Toothed whales and dolphins (Odontocetes)

Delphinus delphis, Short-beaked common dolphin

Identification: Possesses a dark cape with "V" under fin. Hourglass patterns on sides. White underside and lower sides. Predominantly dark flippers, flukes and fin. Yellowish patch on sides and a dark line from slipper to beak. Prominent beak and dorsal fin. Highly active.

At sea identification between long and short-beaked common dolphins is very difficult – however, a majority of common dolphin records from the Pacific Islands region indicate that the short-beaked subspecies is the more frequently sighted of the two. Very early records of this species could have been of almost any long-beaked tropical dolphin.

Habitat: Warm temperate, subtropical, and tropical waters worldwide. Sightings of this species have been confirmed in Cook Islands, Marshall Islands, New Caledonia, and Tonga.

Demographics: Group sizes may vary anywhere from 10 to 500+ individuals.

Feresa attenuata, Pygmy Killer Whale

Identification: Robust, dark-coloured body with dark cape. Rounded head with no beak. Has pale grey sides and white undersides. Some animals have a white chin. Has a prominent, falcate fin. There has been some confusion with correctly identifying this species at sea as it is relatively similar in appearance to other 'blackfish' species (i.e., melon-headed whales, short-finned pilot whales, and false killer whales). Hence, some species accounts should be considered tentative if there is insufficient evidence for species confirmation.

Habitat: The pygmy killer whale is patchily distributed in tropical and subtropical offshore waters around the world. Confirmed records of this species have been reported in French Polynesia, Guam, New Caledonia, Northern Marianas Islands, Palau and Tonga.

Demographics: Research in some locations indicates high residency for this species. For example, repeated encounters of the same group of individuals of pygmy killer whales off Guam suggest that they may be island-associated and demonstrate extreme site-fidelity (Hill et al. 2020).

Globicephala macrorhynchus, Short-finned Pilot Whale

Identification: Jet black or dark grey in colour with a rounded forehead and stocky body. The dorsal fin is set forward on the body and sweeps backwards. Short-finned and long-finned (*G. melas*) pilot whales may be difficult to distinguish at sea, though distributional limits make the plausibility of *G. macrorhynchus* in the Pacific region higher than *G. melas*. Short-finned pilot whales are also known to travel in mixed species groups and hence both their presence and numbers in given sightings should be reported carefully. Furthermore, this species is sometimes referred to as one of the "blackfish" species (i.e., pygmy killer whales, melon-headed whales, short-finned pilot whales, and false killer whales). At times, these species have been referred to as a group, yet there is still some experience needed to distinguish them (Yahn et al. 2017).

Habitat: Tropical, subtropical, and warm temperate oceans around the world as well as cold-temperate north Pacific waters (Bernard and Reilly 1999). This species is one of the most commonly recorded across the Pacific Islands region with confirmed sightings in almost every PICT.

Demographics: Widely distributed across the Pacific. Discrete populations have been purported yet not well described. A global phylogenetic review of *G. macrorhynchus* suggests that only one type of short-finned pilot whale (i.e., Naisa) is likely present within the Pacific island region (Van Cise et al. 2018). However, samples were taken from only a selected number of sites in the Pacific I sland region. A more focussed study in the north Pacific suggested complexity in the social dynamics and movement patterns of this species. Research in the Mariana Archipelago highlighted overall strong social networks between individuals yet also recognised the presence of other social groups within the study area on occasion (Hill et al. 2018). Furthermore, overlapping populations, which exhibited both island-associated residency patterns as well as more oceanic movements, were apparent. It is hypothesised that within the Marianas Islands area male short-finned pilot whales may range wider and more extensively than females (Van Cise et al. 2016).

Grampus griseus, Risso's dolphin

Identification: This species is relatively distinctive in appearance and is unlikely to be mis-identified. Body is extremely scarred with older individuals often white in colour. Robust body and an indistinct beak, and a large, rounded head. Fin is prominent and the flippers are long and pointed.

Habitat: Deep tropical and warm temperate waters in northern and southern hemispheres, and notably in the Pacific sightings have been made in equatorial waters, including Guam, Northern Marianas Islands, Papua New Guinea, Solomon Islands, and Palau.

Demographics: Group size is quite variable (between 3 to 50 individuals) yet they may be found in groups of 100 or more.

Lagenodelphis hosei, Fraser's dolphin

Identification: Stocky dolphin with dark lateral stripe, small dorsal fin, short beak, and tiny flippers. Known to swim quite aggressively in large groups yet also often shy of boats. Often found in mixed species groups.

Habitat: Deep tropical and warm temperate waters of the Pacific, Atlantic, and Indian Oceans. Relatively widely distributed across the region including Cook Islands, Federated States of Micronesia, French Polynesia, Nauru, Palau and Samoa.

Demographics: Often found in mixed species' schools – typically numbering at least 100 individuals (average = 100 – 400, range = 4 – 1000).

Orcaella heinsohni, Australian snubfin dolphin

Identification: This species is brownish on top, lighter brown along the sides, and has a white belly. Has a rounded forehead and a stubby, small dorsal fin. Has a neck crease and relatively jagged trailing edge of the flukes. This species was very recently separated from the Irrawaddy dolphin (*O. brevirostris*, Beasley et al. 2005). Hence, historical records of *Orcaella* in the Pacific likely would have likely referred to *O. brevirostris* rather than *O. heinsohni* in any reports.

Habitat: Patchily distributed in shallow, near-shore tropical and subtropical marine waters of the Sahol Shelf from northern and eastern Australia, north to Papua New Guinea. The distribution of this species appears to be somewhat correlated with estuarine and mangrove areas.

Demographics: They are found in small groups of about 2–6, but larger groups (up to 14 individuals) have also been observed.

Orcinus orca, Orca or Killer whale

Identification: This very recognisable species with distinctive black and white colouration pattern and prominent dorsal fin is unlikely to be mis-identified. Has a white patch behind each eye, a grey saddle patch, and large paddle-shaped flippers. The body is robust and heavy .

Habitat: All oceans of the world, particularly cold-temperate and polar. However, there are also numerous records from tropical waters. Notable records for this species have been documented in Papua New Guinea, as well as most other PICTs including Tonga, Tokelau, Kiribati, Vanuatu and American Samoa.

Demographics: This cosmopolitan species occurs both sporadically and possibly seasonally in many parts of the Pacific region. It is unclear as to the population structure and linkage of this species across the region.

Peponocephala electra, Melon-headed whale

Identification: Torpedo-shaped body and long, sharply pointed flippers. Slim, pointed head, dark coloured body and a tall, falcate fin. This species is sometimes referred to within the species group of "blackfish" (i.e., pygmy killer whales, melon-headed whales, short-finned pilot whales and false killer whales) and so records should be carefully verified for accuracy. At times, these species have been referred to as a group yet there is still some experience needed to distinguish them (Yahn et al. 2017).

Habitat: This poorly known species is distributed in deep oceanic and deep nearshore waters at tropical and subtropical latitudes worldwide (Jefferson and Barros 1997). Relatively good records for this species across the PIR including Cook Islands, Federated States of Micronesia, Nauru, New Caledonia, Samoa, and Solomon Islands.

Demographics: A review of photo-identification and survey data in French Polynesia found some evidence for limited movement between relatively close island groups by marked individuals and perhaps suggests a degree of island residency (McClung 2017).

Pseudorca crassidens, False killer whale

Identification: Uniformly dark body colour, unique "elbow" on flippers, and a long, slim body. Has a slender head and rounded beak and a prominent fin. Is a highly acrobatic species that often approaches boats. Commonly referred to as one of the "blackfish" species (i.e., pygmy killer whales, melon-headed whales, short-finned pilot whales, and false killer whales). At times, these species have been referred to as a group yet there is still some experience needed to distinguish them (Yahn et al., 2017).

Habitat: Widely distributed across the Pacific in deep tropical, subtropical, and warm temperate waters, mainly offshore. Records for many PICTs, including American Samoa, Fiji, French Polynesia, Guam, New Caledonia, Niue, North Marianas Islands, Palau, Papua New Guinea, Samoa, Solomon Islands and Tonga.

Demographics: There is known to be a smaller, endangered (under US regulations) insular stock in Hawaiian waters. It is unclear whether populations in other locations are also genetically distinct but this would seem plausible given the similarity in both climatic conditions and terrestrial features (i.e., small islands) across the Pacific Islands region.

Sousa sahulensis, Australian humpback dolphin

Identification: Relatively small dolphin species with no prominent beak or dorsal bump and an extremely low and wide-based dorsal fin (Beasley et al. 2016). Darker grey back and lighter belly, curved dorsal cape – in contrast to the mostly white *S. chinensis* (Indo-Pacific humpback dolphin) which would be the most likely species of confusion. Genetic differences and morphological differences between these two species have also been documented. Records pre-dating 2014 would not distinguish between the two as only *S. chinensis* was commonly described in the region (Jefferson and Rosenbaum, 2014).

Habitat: Found in the tropical/subtropical waters of the Sahul Shelf from northern Australia to the southern waters of the island of New Guinea (Jefferson and Rosenbaum, 2014). Recent records of this species from the Kikori river system (Beasley et al. 2016).

Demographics: Relatively small group sizes have been noted in sightings records, typically less than 5 individuals.

Stenella attenuata, Pantropical spotted dolphin

Identification: Dark, grey cape with a dark line from flipper to beak. Tall, falcate dorsal fin. Slender, elongated body. Long, narrow beak. White-tipped beak and “lips”. Most adults are heavily spotted yet appearance does vary within schools. This species is often active at the surface.

Habitat: Tropical and some warm temperate waters of the Atlantic, Pacific and Indian Oceans, and is known to inhabit both coastal and oceanic waters. In the eastern tropical Pacific, pantropical spotted dolphins occur in tropical, equatorial and southern subtropical water masses. This species has been widely and commonly sighted within the Pacific Islands region, including American Samoa, Cook Islands, French Polynesia, Guam, Kiribati, Marshall Islands, Palau, Papua New Guinea and Vanuatu.

Demographics: Associations between yellow fin tuna and pantropical spotted dolphins have been noted as being widespread and year-round in Hawaiian waters (Baird and Webster 2020).

Significant genetic differentiation has been found between pantropical spotted dolphins in the Marianas Islands and Guam (Hill et al. 2020). Pantropical spotted dolphins from the Mariana Archipelago are significantly differentiated from those in Hawaiʻi, the Marquesas and the Solomon Islands (Hill et al. 2020). This species is often seen in mixed species groups, including with spinner dolphins, bottlenose dolphins and sperm whales. Group sizes are usually under 100 in more coastal waters, and can be up to 3000 in offshore waters. Furthermore, associations occur with other marine species such as yellow fin tuna, skipjack tuna, and various oceanic bird species.

Stenella coeruleoalba, Striped dolphin

Identification: Dark prominent fin and a dark stripe from eye to flipper. Long, dark side stripe. Pale “finger” marking below fin. Prominent beak and a slender body. White or pink underside. This species is typically quite active at the surface.

Habitat: Warm temperate, subtropical, and tropical waters around the world. The species appears to prefer areas with large seasonal changes in surface temperatures and thermocline depth, as well as seasonal upwelling. The species has been confirmed in a number of PICT Exclusive Economic Zones (EEZ), including Federated States of Micronesia, Guam, Marshall Islands, New Caledonia, Samoa, and Solomon Islands.

Demographics: Usually found in large schools – (anywhere from 1 – 500 individuals with an upper range of 3000).

Stenella longirostris, Spinner dolphin

Identification: This species has a slender body and beak, long and pointed flippers, and a tall, somewhat triangular-shaped dorsal fin. The beak is often dark-tipped and the body may have a three-tone colouration pattern. Unique spinning behaviour (on the long axis of the body) can be a distinguishing feature. Differing between subspecies of spinner dolphins at sea – as well as with other small delphinids may be difficult.

Habitat: Tropical and subtropical waters in the Atlantic, Indian, and Pacific Oceans. Subspecies *S. l. longirostris* occurs in all tropical seas, *S. l. orientalis* in pelagic waters of the eastern tropical Pacific, and there is morphological evidence for a subspecies *S. l. roseiventris*, a dwarf form found in shallow, protected waters of inner Southeast Asia and northern Australia (Perrin et al. 1999) and perhaps Papua New Guinea (Miller and Rei 2021). This species (presumably *S. longirostris*) has been seen in almost every PICT.

Demographics: Spinner dolphins occur in large schools throughout the tropics, with numerous locally resident populations centred around islands or archipelagos (Norris et al. 1994, Perrin 1998, Oremus et al. 2007a). These small and discrete populations likely operate and mix independently. Surveys in the Northern Marianas and Guam EEZs found no photo-identification matches between these two EEZs (Hill et al. 2020). Genetic analysis of microsatellite loci found weak but significant differentiation between Guam and the 3-Islands area/Rota (Hill et al. 2020). This research suggests that there are two demographically-independent populations in this area. Other surveys in the north Pacific region suggest that spinner dolphins in this area are primarily island-associated year-round (i.e., resident). However, there is also some support that a pelagic population of spinner dolphins within this region may also be present.

Steno bredanensis, Rough-toothed dolphin

Identification: Tall, falcate fin with a conical head. Diagnostic whitish-pink tip to beak. The long, narrow beak (with white "lips") is continuous with the forehead. Has a dark, narrow cape, and is coloured white or pinkish below – also pinkish white blotches present.

Habitat: Deep tropical, subtropical, and warm temperate waters around the world. In some areas it occurs in aggregations with birds and near-surface fish schools (Poole 1993). Reported in many PICTs including American Samoa, French Polynesia, Guam, Kiribati, New Caledonia, Northern Marianas Islands, Samoa, and Solomon Islands.

Demographics: Recent evidence supports the presence of insular populations within the Pacific Islands region with sufficient genetic differentiation to support separate management units from *S. bredanensis* individuals sampled in Hawaii, French Polynesia, Samoa and American Samoa (Albertson et al. 2017). This species is usually found in small groups.

Tursiops aduncus, Indo-Pacific bottlenose dolphin

Identification: Has a dark back and paler belly (sometimes with spots). Has a longish rostrum and is generally smaller and less robust than *T. tursiops*. Morphologically distinguishing *Tursiops* species at sea is difficult and furthermore some records pre-date *Tursiops* species differentiation from each other.

Habitat: Shallow temperate to tropical waters. One of the two *Tursiops* species that has been seen in almost every PICT.

Demographics: In New Caledonia, habitat differences and limited network connections suggest distinct communities of *T. aduncus* in some areas. This fine-scale segregation may require management at the scale of these subpopulations (Bonneville et al. 2021). Genetic comparisons also suggest that the low level of mtDNA diversity in these populations might be due to a population bottleneck or isolation (Oremus et al. 2015a). A similar review of Solomon Islands *T. aduncus* populations indicate they are genetically isolated (Oremus et al. 2015a). Furthermore, bottlenose dolphins are often encountered in mixed species groups and hence care needs to be taken to ensure this species is identified and enumerated accurately in such circumstances.

Tursiops truncatus, Common bottlenose dolphin

Identification: Relatively well-known species of subdued grey colouring, dark dorsal cape, robust head and body, and a prominent, falcate dorsal fin. Has a distinct beak with a melon crease. Will often bowride and behaves energetically. Morphologically distinguishing *Tursiops* species at sea is difficult and some records pre-date *Tursiops* species differentiation. It is one of the larger dolphins, robust and chunky with a usually uniform colouring.

Habitat: Widely distributed in cold temperate to tropical seas worldwide. One of the two *Tursiops* species has been seen in almost every PICT. Although of the two, *T. truncatus* is more likely to be more widely distributed.

Demographics: Bottlenose dolphins are often encountered in mixed species groups and hence care needs to be taken to ensure this species is identified and enumerated accurately in such circumstances. Group sizes may differ based on location, with smaller groups often reported inshore (1 – 10 individuals) versus in offshore waters (1 – 25 individuals – or sometimes up to 500). In the US (including Hawaii), this species is managed as separate stocks for individual bays as a result of evidence for discrete subpopulations, relatively high residency, and limited movement between areas (Carretta et al. 2021, Hayes et al. 2021).

Kogia breviceps, Pygmy sperm whale

Identification: Whales in the *Kogia* family are small with small underslung jaws and a false shark-like false gill, distinctive from other species of whales. The dorsal fin in the pygmy sperm whale is tiny and hooked compared with the dwarf sperm whale which has a prominent, falcate, pointed dorsal fin. There is some difficulty in distinguishing between *Kogia* species, especially in observations made at sea. Furthermore, when records are sourced from stranding events that again confounds distribution records as these observations may not be consistent with typical geographic range.

Habitat: Deep temperate, subtropical, and tropical waters beyond the continental shelf. Reports of this species are available for Fiji, Kiribati, and New Caledonia.

Demographics: Small group size (typically between 3 – 6 individuals)

Kogia sima, Dwarf sperm whale

Identification: Whales in the *Kogia* family are small with small underslung jaws and a false shark-like false gill, distinctive from other species of whales. The dorsal fin in the pygmy sperm whale is tiny and hooked compared with the dwarf sperm whale which has a prominent, falcate, pointed dorsal fin. There is some difficulty in distinguishing between *Kogia* species, especially in observations made at sea. Furthermore, when records are sourced from stranding events that again confounds distribution records as these observations may not be consistent with typical geographic range.

Habitat: Deep temperate, subtropical, and tropical waters of the northern and southern hemispheres. Species distribution is largely inferred from stranding events. Reports of this species are available for New Caledonia, Northern Marianas Islands, and Samoa.

Demographics: Typically found in groups of just 1 or 2 individuals.

Physeter macrocephalus, Sperm whale

Identification: Asymmetrically situated forward-facing single blow at front end of large, box-like head, up to 18-20 metres in length (mature males), but females and juveniles (12-14 metres) are seen more frequently in tropical waters.

Habitat: Widely distributed in deep waters worldwide, both offshore and inshore. This species was the target for commercial whaling operations across the region and so there are a large number of historical records from all across the region. Females and juveniles generally frequent deep tropical and sub-tropical waters and sightings are widely reported in many PICTs.

Demographics: Sperm whales, like many other toothed whales, are gregarious and live in groups of up to 50 individuals, although male Sperm Whales are sometimes solitary in higher latitudes (above 40° N). The average Sperm Whale school sizes contain about 25 animals, although aggregations of such schools have been reported sometimes apparently numbering several thousand individuals.

Indopacetus pacificus, Longman's beaked whale (or tropical bottlenose whale)

Identification: Many beaked whales have somewhat similar behaviour and at-sea appearance however Longman's beaked whales are larger than most other beaked whale species and have other discernible physical characteristics that make them relatively easy to identify if spotted in the wild, such as a large, pronounced melon and a distinct black band extending from behind the blowhole to the pectoral flippers. They have a well-defined melon that is almost perpendicular to their long, tube-shaped beak.

Habitat: For a long time, this species was known only from a few skeletal records although a few observations in Pacific and Indian Oceans appear to be this species (Pitman et al. 1999, Pitman 2002). They generally live in warm, deep, pelagic waters of tropical and subtropical regions in the Indian and Pacific Oceans. Records in the Pacific are available for New Caledonia and Northern Marianas Islands.

Demographics: Very limited information known about population structure and dynamics. Longman's beaked whales are usually found in tight groups averaging between ten and 20 individuals but have occasionally been seen in larger groups of up to 100 animals. They sometimes associate with other cetacean species such as bottlenose dolphins and spinner dolphins.

Mesoplodon densirostris, Blainville's beaked whale

Identification: Strongly arched lower jaw containing huge, horn-like teeth. A flattened forehead with a dark upper side and pale underside. Blotches present all over the body, thick and prominent beak, prominent fin, and a depression between raised teeth.

Habitat: Widely distributed in warm temperate and tropical waters. This is one of the more commonly sighted beaked whale species – and has been reported in numerous locations such as Cook Islands, Fiji, Guam, Kiribati, and Samoa.

Demographics: Usually found in groups of less than 6 individuals.

Mesoplodon ginkgodens, Ginkgo-toothed beaked whale

Identification: Many beaked whales have somewhat similar behaviour and at-sea appearance. Gingko-toothed beaked whales have moderately long beak, little or no scarring, smoothly sloping forehead, an arched lower jaw, and flaps of skin largely covering their teeth. Teeth protrude close to the middle of the jaw. A small, pointed dorsal fin is present.

Habitat: Found across a broad latitudinal range in the deep waters of the tropical Pacific and Indian Oceans. Records for this species include reports from the Federated States of Micronesia and Kiribati.

Demographics: Typical group size is unknown.

Mesoplodon houtala, Deraniyagala's beaked whale

Identification: This species is known from only a relatively small number of specimens – and was previously synonymised with ginkgo-toothed beaked whale.

Habitat: Based on a small number of specimens (many of which were strandings) this species is hypothesized to have an equatorial distribution in the Indo-Pacific. The only record for this species is in Kiribati (Dalebout et al. 2014).

Demographics: Unknown due to limited number of specimens, and at-sea sightings for this species.

Mesoplodonts (beaked whales of the genus Mesoplodon)

Identification: Mesoplodonts are generally deep-water animals; they occur from cold temperate and sub-polar latitudes to the tropics.

Habitat: Individuals purported to be Mesoplodon are sometimes reported in Pacific Island nations but their cryptic and shy behaviour often make species confirmation difficult. However, it is plausible that the following species are present in the region: Andrew's beaked whale (*Mesoplodon bowdoini*), Hubb's beaked whale (*Mesoplodon carlhubbsi*), Gray's beaked whale (*Mesoplodon grayi*), Hector's beaked whale (Mesoplodon hectori), Layard's beaked (or strap-toothed) whale (*Mesoplodon layardii*), True's beaked whale (*Mesoplodon mirus*), Pygmy beaked whale (*Mesoplodon peruvianus*), and Spade-toothed whale (*Mesoplodon traversii*).

Demographics: Demographics cannot easily be characterised for the different species which may be reported under this category.

Ziphius cavirostris, Cuvier's beaked whale

Identification: Possesses a "goose beak" head shape, short, upturned mouthline, and a small, pale-coloured head. Individuals have a long, robust body with indentation behind the blowhole and small teeth at the tip of the jaw. Long and circular shaped scars are often visible on the body. Swimming style is sometimes described as "lurching" through the water.

Habitat: Worldwide distribution in tropical, subtropical, and temperate waters. Cuvier's beaked Whales may have the most extensive range and be one of the most abundant of any beaked whale species (Culik 2004). Cuvier's Beaked Whale has a worldwide distribution in all temperate and tropical waters, occurring between approximately 60° N and 55° S (Jefferson et al. 1993). There are many reports of this species across the Pacific Islands Region including American Samoa, Cook Islands, French Polynesia, Guam and Kiribati.

Demographics: Group sizes typically vary between 1 – 10 individuals (up to 25 at times). Single individuals are usually found to be older males.

Additional species

The above records provide a conservative list and represent documented sightings and occurrences. However, it is likely that many additional cetacean species may occur as vagrants, occasional visitors, or longer term, undocumented species within this region.

Section 2 – A risk assessment of key threats to Pacific Island cetaceans

The ability to manage and conserve cetaceans relies not only on biological baseline data but also on the understanding, assessment and monitoring of threats. The following summary of threats to Pacific Island cetaceans was collated using the following categories (following Avila et al. 2018):

- Incidental catch and fishing gear interactions
- Direct harvesting
- Pollution
- Traffic
- Pathogens and introduced species
- Resources depletion
- Ocean-physics alteration

These categories were developed in order to overtly link to the structure of threat categories and assessment levels that underpin IUCN threat classes. More complete descriptions for each of these categories were given as follows:

(1) Incidental catch and fishing gear interactions includes by-catch, shield-net, ghost-net and other interactions.
(2) Direct harvesting includes commercial, subsistence, control, research and alive captured.
(3) Pollution (POLL) includes liquid wastes, solid wastes, noise, radioactive and thermal.
(4) Traffic includes boat without collision, boat with collision, pedestrians/swimmers, and aircraft.
(5) Pathogens and introduced species (INFE) include infections, algal blooms and introduced species.
(6) Resources depletion includes food limitation and habitat removal.
(7) Ocean-physics alteration includes storms, temperature, ENSO, ice cover and sea level, and geomagnetic field (included under the title of “Climate change” in this report).

The specificity, level of confidence and amount of detail varies quite markedly for these seven categories. Hence, the ability to assess the relative risk for various species is not straightforward. In addition, the limited background on abundance, demographic parameters and local context further confounds a robust risk assessment in some cases. It is particularly important to note that the lack of data underscores the importance of considering threats at the individual population-level, as there is not necessarily a justified link between the global IUCN listing of a given species and the local status within the Pacific Islands Region or at a smaller geographic scale which may be more appropriate (i.e., region, island, or bay).

Incidental catch and fishing gear interactions: by-catch, shield-net, ghost-net and other interactions

The EEZs of PICTs provide the largest component of the world's tuna catch (SPREP 2020). Predominant target species across the region include various species of tuna, including skipjack, yellowfin, bigeye and albacore, with catches coming primarily from longline and purse seine vessels. There are both commercial and domestic fleets operating in the region, with significant use of Fish Aggregation Devices (FADs) occurring. The management of the regional fisheries is undertaken by the Western and Central Pacific Fisheries Commission (WCPFC), which underpins its scientific assessment processes through the Pacific Community (SPC).

Data held by the SPC on interactions with cetaceans has been collated from observers aboard commercial vessels fishing across the WCPFC region. All observers undergo a training programme run by the Pacific Islands Regional Fisheries Observer (PIRFO) programme (www.pirfo.org) which is a collaborative training programme supported by SPC and the Forum Fisheries Agency (FFA). The training programme is a competency-based system of training and assessment which has been periodically reviewed to ensure it is meeting core quality requirements and provides training in relation to any updates and changes in the Regional Observer Programme. The Certificate 3 in Observer Operations is a requirement for all observers in the WCPFC and "prepares candidates for emergencies that may occur at sea, to work safely and effectively, to perform basic navigation and communication and to undertake observation, monitoring and reporting duties required of an observer. The qualification will specify which fishing methodology or methodologies (pole & line, purse seine, long line) the holder of the qualification is trained in to undertake observer duties." Additional micro-qualifications can be gained by the observer in complementary skills such as port sampling operations, biological sampling of catch, electronic reporting, interpreting electronic monitoring operations, and monitoring and applying chain of custody processes and procedures. There are a relatively large number of observers involved in the PIRFO programme (> 800) with an approximate turn-over of around 15 - 20% each year (T. Park, pers. comm.).

The key fishing gear types covered in this review are longline (LL) and purse seine (PS). The level of observer coverage on LL and PS vessels has varied throughout the years. Historically, PS has had higher priority for reporting. and has achieved much higher levels of observer coverage; although while 100% coverage has been required since 2010 (CMM 2018-01 and CMM 2018-05, and see supporting/historical conservation measures that these have replaced), this has rarely been achieved, especially since the outbreak of the Covid pandemic. The required coverage of all other fisheries operating in the region, especially LL, has been at 5% since 2014 (CMM 2007-01), this has rarely been achieved across the fleet although some individual countries may have significantly greater levels. Observer coverage targets not being met is a particularly important factor to consider when summarising trends seen in the data collected by the PIRFO programme. In addition, there is variability in both LL and PS fishing activities across the region due to such factors as the distributions of target species along with logistics and preferences for fishing boats and fishing nations. Furthermore, there is some variation between this fishing footprint and the spatial (and temporal) observer coverage.

A number of forms are completed by observers for SPC. Information on cetaceans is captured under the category of Species of Special Interest (SSI). For observers working on PS vessels, form PS 3 is used to document (i) the estimated total weight, status when landed and when discarded/released, and description of event for each cetacean, (ii) interaction and condition (i.e., alive, alive and healthy, alive injured, alive but dying, dead or unknown) of any cetaceans with primary gear that were not landed. The length and sex of landed individuals is also recorded on form PS 4. Further, open-ended questions regarding interactions with SSI are included in the PS trip report form. For observers working on LL vessels, form LL 4 is used to document (i) the nature of the interaction with primary gear (entangled; hooked externally; hooked internally; hooked in jaw (circle hook); hooked deeply (throat or stomach); hooked unknown; feeding on bait during set; interacted with primary gear only), (ii) condition when first caught and again when released (alive; alive, healthy; alive – injured; distressed; alive, but dying; dead; condition unknown), (iii) length, and (iv) sex. In addition, the LL report suggests writing a report on each SSI that was landed or interacted with the primary gear. Within this trip report there are also a set of questions which are linked to possible depredation events.

Key SPC reports of relatively recent assessments and overviews of the prevalence of cetacean by-catch provide a starting point for considering the number – and relative extent − of cetacean species that interact with and are caught as by-catch in these fisheries. In addition, a public domain by-catch database provides a readily accessible data source. Each of these is listed below with more details provided for some of these reports.

- Peatman et al. 2018. WCPFC-SC14-2018/ST-IP-04 rev. 1: Estimates of purse seine by-catch (updated) from 2003 – 2017.
- Peatman et al. 2017. WCPFC-SC13-2017/ST-WP-05: Estimates of purse seine by-catch from 2003 – 2016.
- Peatman et al. 2018. WCPFC-SC14-2018/ST-WP-03 rev. 3: Summary of longline fishery by-catch at a regional scale, 2003 – 2017.
- Peatman and Nicol. 2021. WCPFC-SC17-2021/ST-IP-06: Updated purse seine by-catch in the WCPO.
- Peatman and Nicol. 2020. WCPFC-SC16-2020/ST-IP-11: Estimates of by-catch for marine mammals based on longline fishing from 2003 to 2018 in the WCPFC Convention Area, including the region overlapping the IATTC Convention Area.
- Williams, Pilling, and Nicol. 2021. WCPFC-SC17-2021/ST IP-10: An update on available data on cetacean interactions in the WCPFC purse seine and longline fisheries.
- Williams, Pilling and Nicol. 2020. WCPFC-SC16-2020/ST IP-12 rev. 1: SPC data holding of longline interactions and non-gear interactions from 2015 – 2019.
- BDEP database - Public domain by-catch data (https://www.wcpfc.int/doc/by-catch-data-file-bdep) of species bycaught in the longline and purse seine fisheries (2013 – 2019).

<u>Cetacean interactions in the WCPFC longline and purse seine fisheries</u>

Williams et al. (2020) provided an overview of interactions in both the LL and PS fisheries. Total numbers presented reflect totals reported by the 5% (target) coverage of the LL and 100% (target) coverage of the PS fisheries. In addition, the summaries reflect the temporal and spatial coverage of observer trips for each of these fisheries.

There was a total of 298 cetacean gear interactions reported in the long-line fishery between 2015 – 2019. This total comprised 27 cetacean species and species groups with the two groups/species with the highest percentage of individuals (both at ~23%) being reported for a general odontoceti/toothed whale group (*n* = 70) and false killer whales (*n* = 69). Species and species groups with more than 10 individuals reported during this time frame were bottlenose dolphin (*n* = 22), dolphins nei (dolphin - species unknown) (*n* = 8), Indo-Pacific bottlenose dolphins (n = 10), melon-headed whale (n = 10), pantropical spotted dolphin (*n* = 7), Risso's dolphin (*n* = 16), rough-toothed dolphin (*n* = 15), short-finned pilot whales (*n* = 22), spinner dolphin (*n* = 9), striped dolphin (*n* = 5) and unidentified whales (listed separately from toothed whales; *n* = 11). Species and species groups with fewer than 10 reported catches or entanglements were beaked whales, blue whale, common dolphin, dwarf sperm whale, fin whale, Fraser's dolphin, gingko-toothed beaked whale, humpback whale, killer whale, long-beaked common dolphin, Pacific white-sided dolphin, pygmy killer whale, pygmy sperm whale, and sperm whale. The very low observer coverage in the LL fishery makes it difficult to extrapolate these reports to the scale of the total fishery but nevertheless provides an indication of those species most at risk from LLs. The impact of these initial tallies at the species level is speculative yet potentially more serious for those species which are frequently bycaught and may have more structure, fragmentation, local residency or genetic differentiation within their populations or subpopulations across the region.

A total of 2131 individuals from 20 species and species groups were reported to have engaged in "non-gear" interactions with long-line fishing vessels (i.e., sightings alongside the vessel without interacting with gear). A majority of these interactions (>95%) were classified as interactions occurring alongside the boat. The main species involved in non-gear interactions were false killer whales (61.8%), followed by pantropical spotted dolphins (10.4%), rough-toothed dolphins (9.9%), Risso's dolphins (5.5%) and spinner dolphins (4.1%).

Rates of interaction within the PS fisheries were also presented. While raw numbers seem to show a peak in the central reporting period these changes must be considered against the change in required observer coverage which was 5 – 10% from 1995 to 2009 and which has risen to a target of 100% after this time – although there is some variability in meeting this target, due to delayed reporting in some instances, as well as noted difficulties in coverage during the last year due to the pandemic (Panizza et al. 2021). Furthermore, the influence of other factors such as the introduction of mitigation measures related to setting on cetaceans as well as variable environmental conditions should also be considered.

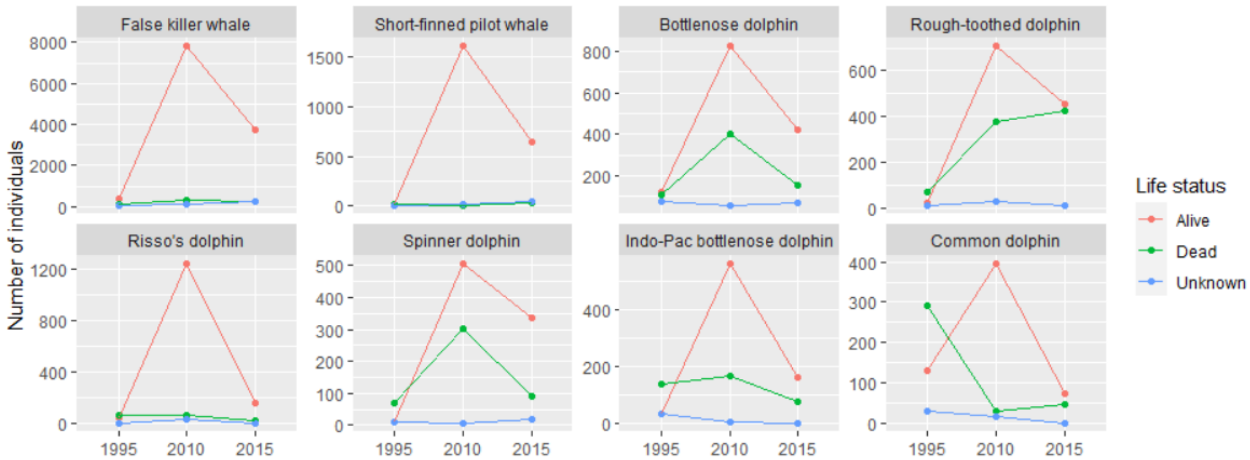

Figure 1. Summary of the number of interactions reported in the purse seine fishery in 1995, 2010 and 2015 for the eight highest ranked overall counts. (Data extracted from Table 9 – Williams et al. 2020). Note that there are different scales on the y-axis – i.e., they range from a maximum of 8000 for false killer whales (top left) to 400 for common dolphins (bottom right). The life status is colour-coded as alive (red), dead (green) or unknown (blue). However, there were also different levels of observer coverage in the first time period (~5%) as compared to the second two time periods (target of 100%).

Williams et al. (2021) released a new report with limited updates (and partial records) for the most recent, additional year. Due to Covid the expected coverage for the PS fishery in 2020 is expected to be much decreased (~ 45 - 50%) as compared with the required 100% for this fishery. False killer whales were the cetacean species with the highest number of interactions with both unassociated (i.e., set on free swimming schools of target species only) and associated sets (i.e., set on floating objects that are either natural, such as logs or palm fronds, or man-made, such as FADs) – with interactions with the latter being 3 – 5 times higher than the former. Review into the post-release survival of released or discarded false killer whale individuals requires some further investigation. Furthermore, reasons as to why fate is listed as "unknown" in some cases is critical. For example, of the 219 individuals involved in interactions between 2020 to present, 23.7% had a life status listed as "unknown". Of the 2831 individuals involved in interactions between 2015 – 2019, 383 (17.6%) were reported as having "unknown" life status. Bryde's and Sei whales were both reported in interactions at relatively high rates in both set types. In 2014 – 2020 there were 55 Bryde's whales (54 - alive and 1 - dead) and 87 Sei whales (79 - alive, 1 - dead, and 7 - unknown). Species with relatively higher interaction rates with unassociated sets were short-finned pilot whales and Risso's dolphins – whereas rough-toothed dolphins and bottlenose dolphins had higher interactions with associated sets. Of particular concern are the proportion of mortalities overall for rough-toothed dolphins since 2020 (alive – 120, dead – 145, and unknown – 3) yet other time periods were of note also.

Summary of regional purse seine by-catch (2003 – 2017 and 2003 − 2020)

Peatman et al. (2018) found strong variability in yearly by-catch estimates with lower values occurring most recently (2010 – 2017) and higher values recorded from 2003 – 2009 (average ~ 1,200 individuals). Median estimated values range from 334 (273 – 421 95% CI) in 2016 to 1,631 (1,114 - 2,369 95% CI) in 2009. There appeared to be a correlation with set choice; the highest proportion of cetacean by-catch was associated with hauls that were set on floating logs from 2003 to 2008, whereas drifting FAD sets were linked to increased counts from 2009 to the end of the data reporting period. The use of FADs has grown rapidly and one of the stock management measures is a closed season on fishing on FADs. PS vessels then switch to fishing on other large floating objects such as logs, whale sharks or cetaceans. Peatman and Nicol (2021) updated this work and used a slightly different approach for estimating by-catch of whales as they considered the previous approach may have underestimated the totals. More specifically, they used a combined definition of category of association (i.e., combining whale and whale-shark associated sets with free school sets) to extrapolate observed by-catch up to estimated numbers of by-catch under the assumption that all events had been observed. This adjustment resulted in an increase of 150% relative to Peatman et al. (2018). These revised estimates proposed that annual rates of by-catch in the purse seine fishery for marine mammals have ranged from 1623 (1378 – 1939 95% CI) in 2003 to 3861 (3789 – 3945 95% CI) in 2013. The average for the five most recent years with full data (2015 – 2019) is 1941.8 individuals. Peatman et al. (2021) suggested that future iterations of this work should consider estimating by-catch rates for individual species or species groups in order to gain more meaningful insights into species-specific by-catch rates. In addition, inspection of these estimates in the context of both the introduction of relevant WCPFC Conservation Management Measures as well as review of compliance would provide additional perspective into these estimated trends.

Summary of regional longline by-catch (2003 – 2017)

Estimated annual median longline by-catch for all marine mammals (estimated collectively as a group) varied between approximately 1,700 in 2006 to 5,000 in 2017. Percentage of sets with recorded marine mammals for different depths and regions range from 0.2 (deep, northern temperate) – 3.0% (shallow, southern temperate). The coefficient of variation is relatively large (37.6%) which suggests large uncertainty around these estimates because of the low level of observer coverage. The highest estimated catches were in deeper sets in more recent years (2012 – 2017) with maximum numbers in 2017. In general, higher values were reported in the northern temperate (>10°) areas. Estimated by-catch of marine mammals in this report was aggregated across species and species groups. Hence, the signal coming from this analysis (Peatman et al. 2018) inherently includes bias which may be associated with observer coverage, fishing effort, and the inclusion of other marine mammal groups. Furthermore, while the use of hooks between floats has been used as a general proxy for relative fishing depth in fisheries models there is not an immediate connection of these two depth categories with numerical depth ranges that could then be linked to habitat preferences of different cetacean species in the region.

BDEP database

A summarised database of by-catch data (BDEP data) is accessible in the public domain and was last updated in July 2020 (https://www.wcpfc.int/doc/by-catch-data-file-bdep). These excel datasheets are inclusive of longline data from 2013 – 2019 and purse seine data from 2013 – 2019. Due to regulations regarding release of some observer records (such as minimum number of observations within a given latitude-longitude block), this public database represents a subset of the full database. For the longline fishery, there is approximately 2.6% observer coverage of the 75.2% of total effort included in the BDEP. For the PS fishery, there is approximately 54.5% observer coverage for the 86.9% of total effort included in the BDEP. The BDEP data for both the longline and the purse seine fisheries is collated in two ways, (i) by year, and (ii) by year and 5°latitude-longitude cell. Within the summaries for the longline data the following data is available: species category (bird, mammal, shark or turtle), species group (individual species name or a broader grouping when species identification is uncertain (for e.g., "toothed whale", "baleen whale", "dolphins nei", "beaked whale" – see BDEP database Species Listing for full list), number of vessels with observer data, reported number of captures (count and rate), reported number of mortalities (count and rate), and observed live releases. Within the summaries for the purse seine data the following data is available: species category, species group, number of vessels with observer data, number of sets observed, reported number of interactions (count and rate), reported number of mortalities (count and rate), and observed live releases. Highest reported catches in the BDEP database for longline vessels were of false killer whale, bottlenose dolphin and toothed whales nei (Figure 2), whereas false killer whales, short-finned pilot whales, rough-toothed dolphins, bottlenose dolphins, and spinner dolphins were the most frequently caught species in the purse seine fishery. Overall, the number of individuals involved in the purse seine fishery is more than 10 times greater than the longline fishery, yet this of course may reflect the uneven observer coverage of the two fisheries also. Nevertheless, the number of false killer whales being caught in both longline and purse seine is greater than all other species (see Figure 2 for reference).

Other reports

More generally, in the north Pacific there have been a number of anecdotal reports of potential fisheries interactions and associations. For example, pantropical spotted dolphins were often encountered near FADs off the west side of Guam. In the Mariana Archipelago this same species – along with short-finned pilot whales, false killer whales and rough-toothed dolphins have been noted to exhibit scars suggesting fisheries interactions (Hill et al. 2020).

Additional, primarily undocumented, risk from fishing gear is also possible through abandoned, lost and discarded fishing gear – and is not only related to direct mortality/injury (ghost fishing) but also the transfer of microplastics and toxins into foodwebs, spread of invasive alien species and harmful microalgae, habitat degradation, obstruction of navigation and in-use fishing gear, and coastal socioeconomic impacts (Gilman et al. 2021). The global risk analysis undertaken by Gilman et al. (2021) listed derelict tuna purse seine gear (including drifting and floating FADs) as one of the key targets for mitigation in order to achieve maximum conservation gains. The fatal entanglement of a *Mesoplodon gingkodens* carcass in a long-line within Federated States of Micronesian waters (Dalebout et al., 2008) highlights that illegal, unreported and unregulated (IUU) fishing should be regularly monitored also as the carcass was only discovered upon inspection in Guam during which the captain indicated intention to sell the animal in Taipei. Further exploration of possible occurrences of IUU may reveal additional prevalence of such activities.

More generally, entanglement in fishing gear, especially gillnets in deep water (set for billfish and tuna), is cited as one of the most significant threats to ziphiids, including Cuvier's beaked whales (Reeves et al. 2003). Human-related mortality of *Orcaella heinsohni* in north-eastern Australian waters is largely attributed to drowning in inshore gillnets set across creeks, rivers and shallow estuaries for barramundi and threadfin salmon (Parra et al. 2002). Dawbin (1972) reported that Irrawaddy dolphins were taken accidentally in fishing nets in the Gulf of Papua, and false killer whales had been taken between Papua New Guinea and Australia. Recent concern for by-catch issues related to small dolphins in the Kikori D elta is of concern and also requires further investigation, with strong indications that current level of by-catch is unsustainable for *S. sahulensis* and *O. heinsohni* (Beasley, pers. comm.). Small numbers of *Peponocephala* have been taken in nets and by harpooning throughout the tropics (Reeves et al. 2003). These findings align somewhat with the recent review of Templeton et al. (2021), which found that tropical regions had disproportionately lower levels of monitoring and surveillance of local fishing activities. Furthermore, in their assessment they listed both *S. sahulensis* and *O. heinsohni* at particularly high risk for by-catch in such fisheries. The study also encouraged increased reporting of local level by-catch within small-scale fisheries as an important way to enhance understanding of the diversity and scale of this problem.

In general, the use of FADs across the region continues to be of significant concern as both a source of direct and indirect harm to cetaceans and other marine species. For example, the reporting of drifting FADs (dFADs) that are lost or abandoned by fishing companies in coastal areas potentially creates both a risk for marine species while in transit to such locations and also in such areas. Projects to enumerate both active and inactive dFADs and work towards guidelines to reduce impact have been initiated in the Pacific region with initial estimates suggesting that between 20,000 – 40,000 dFADs are deployed annually in the Western and Central Pacific Ocean (WCPO) (Escalle et al. 2021a,b,c). Along with the ecological impacts, some suggest that there are management and policy implications of these activities if they might be considered as IUU fishing activity once they are abandoned and move into closed areas or other locations in which fishing is not regulated under the WCPFC (Gomez et al. 2020).

In some locations worldwide, competition and at times conflict between cetacean species and fisheries for the same resources has been noted. In the Pacific, false killer whales and pilot whales have been the species most prevalent in the removal of hooked fish from longlines, or depredation interactions (Donoghue et al. 2003, Hamer et al. 2012). Reports of cetacean depredation on tuna appear to be relatively widely spread across the region and occur throughout the year (Williams et al. 2021). Pilot trials on long line gear modifications with focus on the inclusion of artificial gear tangles on the line as odontocete deterrents reported increase in catch rates and decreased rates of depredation. However, researchers were unsure if this was due to attraction by fish to the "tangles" or avoidance by predators. This work also noted that additional requirements and personnel required for deployment of mitigation devices was a drawback that required further consideration if such approaches were to be operationalised (Hamer et al. 2015). An ongoing mitigation program in Hawai'i has focused on strategies to decrease the unsustainable take of false killer whales who depredate and are bycaught in the deep-set longline fishery (Fader et al. 2021). Gear modification has again been one of the approaches yet has been met with limited success to date. An additional concern in this setting has been the potential impact on the three different stocks of false killer whales known to inhabit this region.

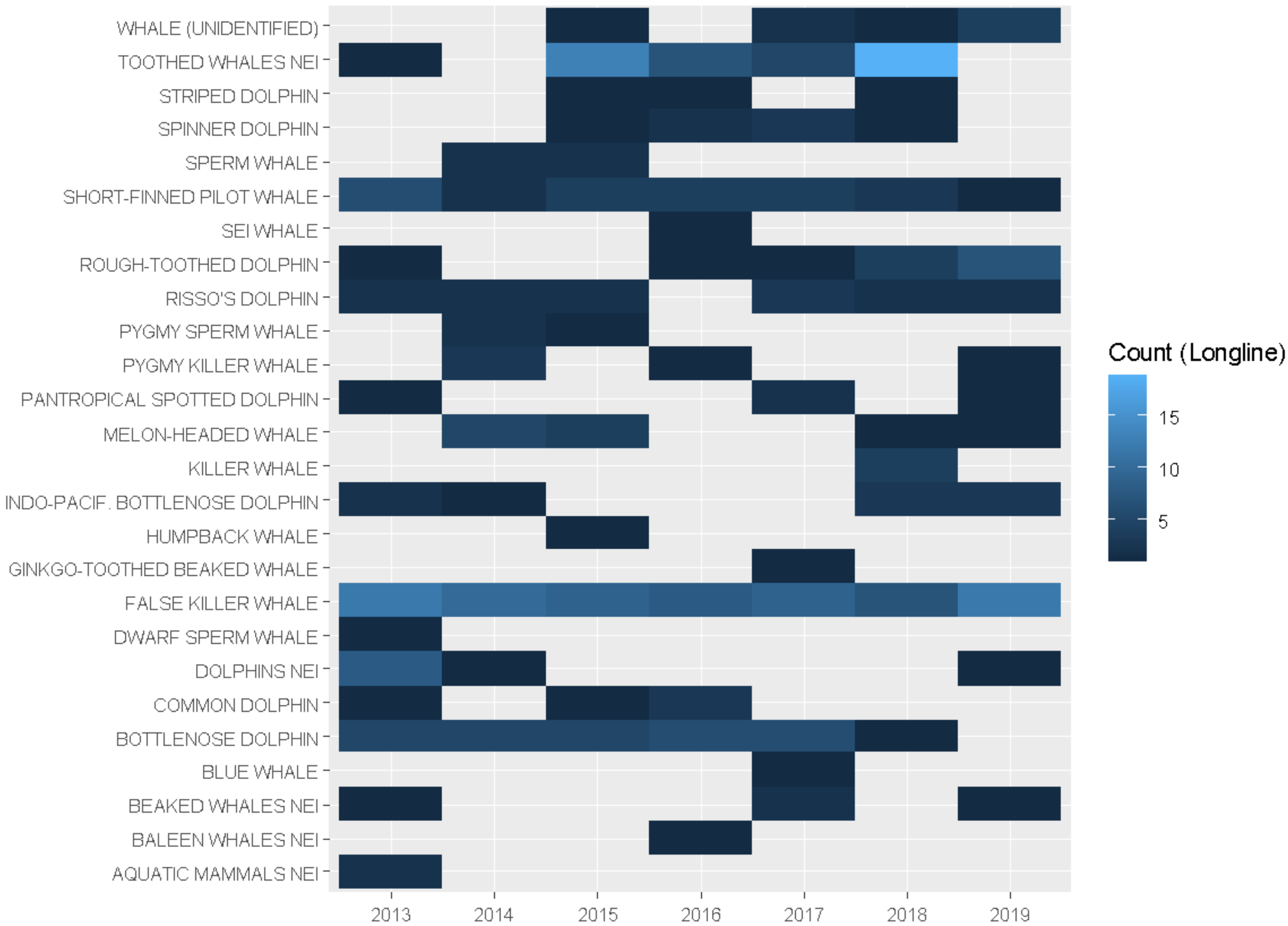

Figure 2: The number of captures reported in the BDEP database for longline vessels between 2013 – 2019

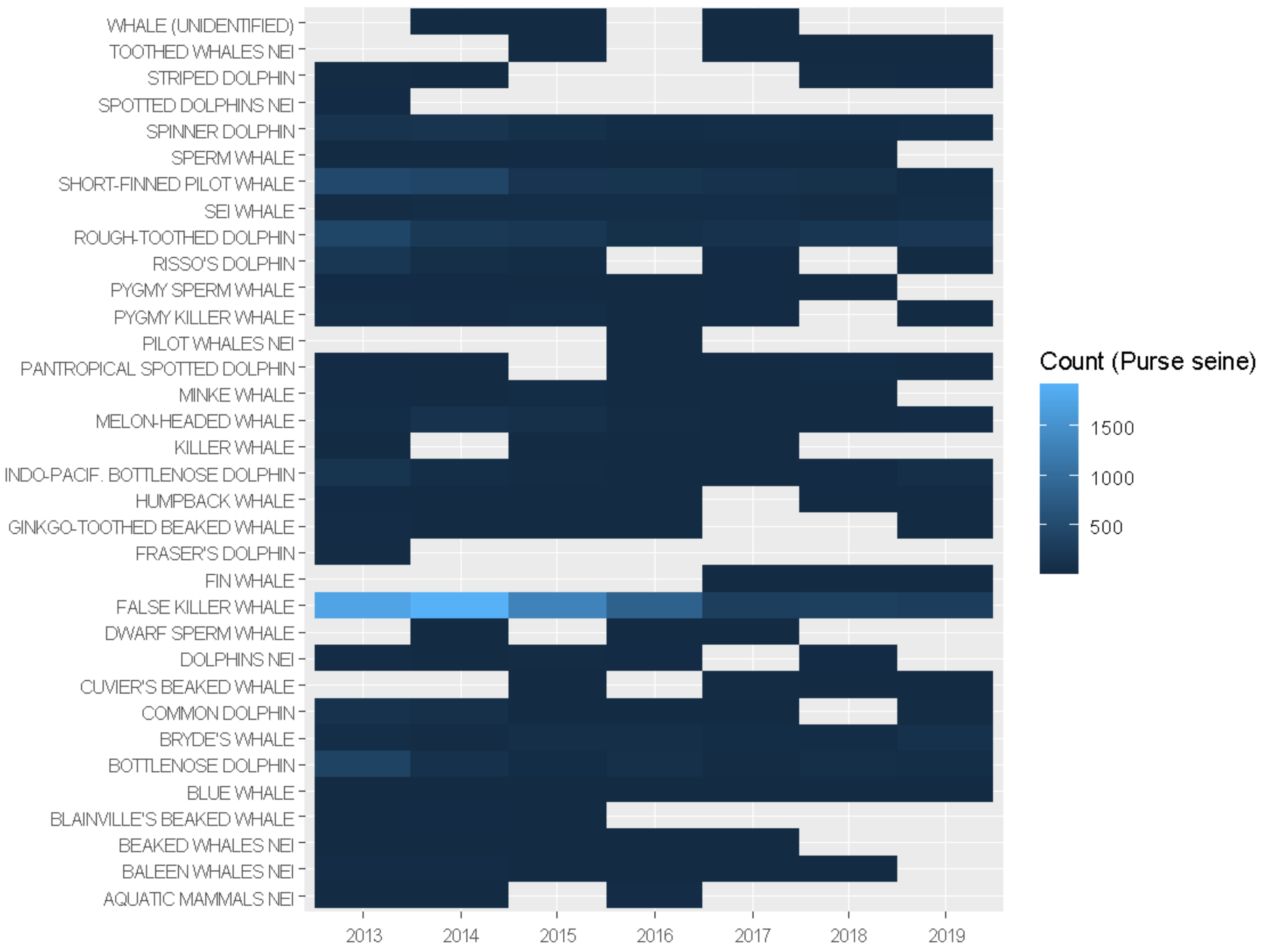

Figure 3. The number of captures reported in the BDEP database for purse seine vessels between 2013 – 2019.

Directed harvesting/take: commercial, subsistence, control, research and live captures

Drive hunts

A drive hunt for small cetaceans has been practiced in Malaita of the Solomon Islands group for many years (Reeves et al. 1999). The majority of dolphins taken in this hunt (termed 'porpoise hunts') are long-beaked oceanic forms, including spinner, pantropical spotted, striped, common and rough-toothed dolphins (Dawbin 1972). The primary objective of these hunts is to obtain teeth that are used as local currency and for collars or headbands and necklaces, as well as to obtain meat. Risso's dolphin have also been taken on occasion, but due to their lower tooth count they were apparently of lesser value to the Malaitans (Dawbin 1966). Other species involved in the hunt have included melon-headed whale (whose teeth were the most highly prized) and Fraser's dolphin (Takekawa 1996, Reeves et al. 1999). Takekawa (1996) indicated that the take of melon-headed whale was reduced in response to a population decline. An average of 840 (approximate range = 50 – 2,000) small cetaceans were taken per year at the islands of Fanalei from 1976 to 1993 (Reeves et al. 1999). Other reports indicate that the hunts may occur about three times a year, mostly in the Malaita area, when 100 – 200 animals may be taken per hunt (Ross et al. 2003). An updated assessment found that hunts that were resumed in 2013 (after a 3-year pause) included approximately 1,500 pantropical spotted dolphins, 150 spinner dolphins and 15 bottlenose dolphins (Oremus et al. 2015b). These same authors re-evaluated historical records due to better access to such information and estimated that more than 15,000 dolphins were killed in the vicinity of Fanalei village between 1976 and 2013. Anecdotal reports suggest that this hunt is ongoing and may have occurred in other communities on Malaita over the past decade. The International Whaling Commission (IWC) in association with SPREP and the SI Govt and other partners are currently developing a research study to provide updated information on the hunt, including its socio-cultural background.

It has also been reported that incidental catches and small drive hunts may have also occurred on an incidental basis in other locations such as the Mariana Islands, Kiribati, the western Caroline Islands, Marshall Islands, French Polynesia and Papua New Guinea (Akimichi 1993, Nitta 1994, Reeves et al. 1999). Discussions with locals in different islands of Kiribati suggest that opportunistic consumption of stranded or trapped (in shallow waters) cetaceans may still occur (Baker et al. 2013).

Live Captures for Display

Capture of small dolphin species, including Indo-Pacific bottlenose dolphins and pantropical spotted dolphins for export has also taken place in the Solomon Islands (Ross et al. 2003, Reeves and Brownell 2009, Oremus et al. 2015b). The capture method for these individuals is believed to be in seine nets from a small motorboat (Ross et al. 2003). There is additional documentation of animals being kept in sea-pens in anticipation of possible international transport – yet such exports have not always proceeded (Fisher and Reeves 2006).

An assessment by Oremus et al. (2013) suggested that the potential biological removal (PBR) of the local bottlenose dolphin populations from which exports were sourced was less than one dolphin every five years for southwest Guadalcanal and the Florida Islands, and less than two dolphins every five years for south Santa Isabel and west Malaita. The Solomon Islands government has prohibited the capture and live export of dolphins (Solomon Islands government 2017). Ongoing monitoring of this situation is important to confirm no further exports or holding of animals is undertaken. Captive facilities in French Polynesia and Palau each housing a small number of cetaceans have also been reported (Reeves et al. 1999).

Hunting

Historical whaling activity did take place in the Pacific Islands region on southern right whales, sperm whales, humpback whales and Bryde’s whales (Reeves et al. 1999).

Baker and Clapham (2002) estimated that between 1904 and 1980 approximately two million whales were killed in the Southern Hemisphere, mostly on high-latitude feeding grounds. This figure includes over 200,000 humpbacks, 350,000 blue whales, almost 400,000 sperm whales, and 725,000 fin whales (Baker and Clapham 2002).

A subsistence hunt, focused on mothers and calves, took place in Tonga between 1900 and 1978, probably accounting for up to several hundred whales. Perrin (2006) reported that Bryde’s whales (possibly also Omura’s whales) were taken by pelagic operations working within the Federated States of Micronesia, Palau and the Philippines. In addition, some takes have been made by Pacific

Islanders for cultural or subsistence reasons – for example sperm whales in Fiji (Reeves et al. 1999) and beaked whale species in Kiribati (Baker et al. 2013).

‘Scientific’ Whaling

Although the International Whaling Commission (IWC) placed a moratorium on commercial whaling (coming into effect in 1986), the United States, Japan, Norway and Iceland have all, at some time, issued scientific permits to conduct lethal sampling. Japan, however, was the only nation that continued to conduct whaling activities under scientific permit in southern hemisphere waters, including in the feeding areas of minke and fin whales that overwinter in the Pacific Islands designated as Area V by the IWC (www.iwcoffice.org). Australia and New Zealand took a case to the International Court of Justice in 2014, seeking a prohibition on Japanese “scientific” whaling activities, which had been taking fin and minke whales in Antarctic waters. The prohibition that was sought was upheld by the International Court of Justice (ICJ). Japan finally ceased all whaling activities in the southern hemisphere in 2018.

Bryde’s whales and Omura’s whales have also been taken in the Pacific Islands Region under scientific permit. Previous to the IWC moratorium Japan took 120 Bryde’s and Omura’s whales in the Coral Sea during the 1976 Antarctic season (October−November). Seven of these (Omura’s whales) were taken just south of the Solomon Islands and 113 were taken in the waters between Fiji and New Zealand (Kawamura 1977). Once again, due to an incomplete understanding of the distribution of the two species in the region it is difficult to assess the implications of these takes.

Pollution: liquid wastes, solid wastes, noise, radioactive and thermal

Pollution in the world’s oceans is known to be increasing through a variety of sources, including rapid industrialisation, an increase in the manufacturing and release of chemicals and plastics into the environment, the expansion of agricultural methods that rely on chemicals, and uncontrolled development and rapid increase of human populations in coastal areas (Landrigan et al. 2020). Even when pollutants occur at moderate levels there may be more serious consequences for predators, such as cetaceans, due to elevated biomagnification and bioaccumulation of such substances through the food chain, in muscle tissues and organs (Kershaw and Hall 2019, Zeng et al. 2017).

A serious source of noise pollution within the Pacific Islands region is the US Navy detonation areas off Guam. Numerous species, including pantropical spotted dolphins, bottlenose dolphins and false killer whales, have been documented to occur within or have transited through detonation areas (Hill et al. 2020). Ongoing monitoring of these areas is an important consideration for cetaceans in the region. Military operations and testing in the Marianas Islands are still ongoing. Furthermore, previous military activities have been conducted in the Line Islands, Marshall Islands and French Polynesia (for nuclear weapons testing), with additional islands in Hawaii and elsewhere used for bombing (Crosby et al. 2002). An additional concern in this instance is the repeated use of foraging areas by beaked whales despite military activities (Southall et al. 2019).

Deep sea mining (DSM) operations across the region also present another potential source of both direct waste and noise pollution – with development and activities increasing in Papua New Guinea, Tonga and Cook Islands, among others. The breadth and extent of potential threats is somewhat unknown and so once again, careful monitoring of immediate and long-term environmental threats is required. Many argue that the progress of such activities should not go ahead without the tightening of environmental frameworks (Van Dover 2011, Blue Ocean Law 2018). Many PICTs have been proactive in developing their DSM management frameworks − the Cook Islands, Kingdom of Tonga, Fiji and Papua New Guinea have initiated the process of DSM legislation (Kakee 2020). Pressure on the development and implementation of DSM activities has been increased by a request by the government of Nauru to the International Seabed Authority (ISA) "to complete the adoption of rules, regulations, and procedures required to facilitate the approval of plans of work for exploitation in the area within two years" (RNZ 2021). This action has triggered the so-called "two-year rule" which implies that if the ISA is unable to finalise regulations governing the industry within two years of this notification date (i.e., June 2023) then mining contractors will be able to initiate operations under whatever regulations are in place at the time. Of particular interest in the region is the Clarion-Clipperton Zone (CCZ) due to the reported presence of polymetallic nodules (primarily manganese). PICT Governments sponsoring mining claims in the CCZ include Cook Islands, Tonga, Nauru, and Kiribati have been part of ongoing discussions and engagement in future development. Previous activities in the Bismarck Sea, Papua New Guinea, represented the first deep sea mining project approved within a country's EEZ (Solwara I). The focus of the operation was to mine mineral-rich hydrothermal vents. However, the operation has since ceased due to financial difficulties of the mining operator, Nautilus.

The implications of any DSM operations on cetaceans are somewhat speculative as operations are yet to be completed. However, both direct impacts due to physical structures and excavation as well as indirect impacts such as increases in water turbidity, pollution, and noise will be of concern (Christiansen et al. 2020). Finally, land-based mining operations also pose risks for cetaceans across the region. There has been concern expressed for the dumping of mine tailings into submarine canyons as such activities have occurred in other locations such as Sulawesi, Indonesia (Kahn 2000). In addition to point-source pollution, the atmospheric transport of contaminants from these operations also represents a danger.

Local issues with waste management such as high nutrient loads, poor water quality and landfill leaching have also been documented in numerous places across the Pacific Islands region (Dorfman 2004, SPREP 2020, Devlin et al. 2021). Poor waste management practices have significant impacts on local marine ecosystems and also have the potential to move into related marine communities and food webs. General run-on effects from anthropogenic activities which increase nutrient loads into the marine environment possibly decrease oxygen in the water column – with some research studies showing evidence that hypoxic conditions may become more prevalent under such polluted conditions (Chen et al. 2020). Likewise, repercussions of development and construction activities in proximal locations have created concerns for local dolphin populations and likely also do so in areas where development is taking place in the Pacific (Piwetz et al. 2021). Marine debris also presents direct threats to cetaceans through ingestion and entanglement. Prevalence of marine debris in Hawai'i was reported to be relatively widespread and in areas frequented by cetaceans (Currie et al. 2017). Entanglement by large whales in fishing gear in Hawaii appears to be a regular occurrence, with over 200 confirmed reports since 2002, mostly humpback whales and has resulted in the establishment of a large whale entanglement response team through NOAA (see https://hawaiihumpbackwhale.noaa.gov/protect/entanglement.html for more details).

Furthermore, cetaceans have been reported within the infamous "Great Pacific garbage patch" (Gibbs et al. 2019). Microplastic prevalence in the world's oceans is another concern and remains an issue to be investigated across the South Pacific (Pan et al. 2019).

A global study on the prevalence of heavy metals in the marine environment used sperm whales as an indicator species (Ocean Alliance 2001). Sampling took place at numerous locations within the Pacific region, including Papua New Guinea and Kiribati. Levels of lead found in a female sperm whale biopsied in Papua New Guinea were amongst the highest recorded for the entire study (Wise et al. 2009). A review of the trace element concentrations in the livers of cetaceans stranded in Hawai'i (predominantly) as well as Guam and Saipan from 1997 to 2013 found these to be at levels of concern for some species (Hansen et al. 2015). The authors also noted correlations in the concentration levels of given elements as well as relationships with age class of the given individual. Heavy metal accumulation rates have been reported to be relatively high in false killer whales in Chile (Cáceres-Saez et al. 2019) and long-finned pilot whales in New Zealand. High concentrations of anthropogenic contaminants have been shown to increase the likelihood of negative health effects for marine mammals (Bossart 2011, Cáceres-Saez et al. 2019, Lischka et al. 2021).

Traffic: boat without collision, boat with collision, pedestrians/swimmers and aircraft

Cetacean Tourism

Cetacean tourism is an important industry in the Pacific Islands region that has provided economic opportunities in numerous locations (O'Connor 2008, Hoyt 2011). Important cetacean tourism operators are present within Guam, Tonga, New Caledonia, Fiji, Palau, French Polynesia and Niue. Primary species of interest are spinner dolphins, bottlenose dolphins and humpback whales. Many of these tours include close interactions, including swimming, scuba diving and snorkelling with cetaceans (Samuels et al. 2003). In-water operations also exist in various locations of French Polynesia (melon-headed whale and humpback whales), Tonga (humpback whales; Orams 2001, 2004, Kessler and Harcourt, 2013), New Caledonia (humpback whales; Garrigue and Virly 2000), and Niue (spinner dolphins and humpback whales, Constantine 1999).

Ecotourism efforts in Guam focus primarily on spinner dolphins yet also interact with short-finned pilot whales (Hill et al. 2010). Although these operations signify an important way of generating income, it is important to note that intensive, persistent, and unregulated vessel traffic that focuses on animals while they are resting, feeding, nursing their young, or socialising can disrupt those activities, and possibly cause long-term problems for populations (Reeves et al. 2003, Bejder et al. 2006). Regional guidelines for best practice for tourism operations have been developed and actively endorsed in many PICTs (SPREP/Operation Cetaces/IFAW/FFEM 2008).

Ship Strikes

Van Waerebeek et al. (2006) compiled records of ship strike records for small cetaceans worldwide and large whales in the southern hemisphere. The opportunistic and limited records which were collated for the Oceania region included Bryde's whale, sei whale, minke whale, the pygmy blue whale, and a number of different beaked whale species. Ship-strikes of cetaceans have been reported from New Caledonia (Sylvestre 1988) and French Polynesia, especially the high-speed ferry between Papeete and Mo'orea (Miller 2003). Heavy shipping and transport activities in the Marianas Islands has been noted as a potential threat to cetaceans in this area with a possible humpback whale strike having been noted in 2014 (Hill et al. 2020). The issue has risen in prominence as further work reveals the extent and magnitude of the issue on a global scale. The IWC has provided a strategic plan to mitigate ship strikes on cetacean populations: 2017 – 2020 (IWC 2017) that includes increasing the reporting, centralized collation of data records, identification of factors affecting ship strikes, and key areas (and species) of concern. An initial recommendation is to identify areas of spatial overlap between whale migration and shipping use.

Pathogens and introduced species: infections, algal blooms and introduced species and Resources depletion including food limitation and habitat removal.

Increased marine pollution in the environment likely has some consequences for Pacific cetaceans. Analysis of samples from *Tursiops aduncus* individuals in the Solomon Islands suggests the presence of *Brucella* spp. or a *Brucella*-like organism (Tachibana et al. 2006). Furthermore, Omata et al. (2005) detected the presence of *Toxoplasma gondii* for this same species, again in the Solomon Islands region. Raised and ovoid skin lesions have been observed on humpback whales in the waters of American Samoa although the cause of these marks is unknown (Mattila and Robbins 2008). The prevalence of very high lead levels in sperm whales sampled in Papua New Guinea waters by the Odyssey research team indicates bioaccumulation of such materials may be occurring in some Pacific cetaceans (Ocean Alliance 2001). East of the Pacific Islands region (in Peruvian waters) tattoo skin lesions characteristic of poxvirus infection were found in small cetaceans captured in the gillnet fisheries (Van Bressem and Van Waerebeek 1996). Infected species included *Lagenorhynchus obscurus, Delphinus capenensis*, *Phocoena spinipinnis* and *Tursiops truncatus*. Increasing prevalence of algal blooms in a variety of locations is an issue to watch in the Pacific Islands also. In some locations the dumping of rotting fish has been the culprit (Armijo et al. 2020) and increased nutrient levels in the water (Gobler et al. 2020).

In some locations worldwide, there has been noted competition between cetacean species and fisheries for the same resources. In some places across the Pacific, the occurrence of depredation occurs, which may suggest competition or perhaps (more likely) conflict in the take of resources.

Ocean-physics alteration: storms, temperature, ENSO, ice cover and sea level, and geomagnetic field

Observed, predicted and potential impacts of climate change on the marine environment have been widely discussed, particularly in the Pacific Islands region (SPREP 2020). In particular, projected rises in sea level and increased frequency of extreme weather events makes the low-latitude tropical and subtropical Pacific Island region coastlines highly susceptible. Such changes will see run-on effects for associated coastal habitats – and the species assemblages which they support. The potential impacts of climate change on cetaceans are in many cases speculative (Simmonds and Isaac 2007), but it is contended that they will be (i) direct, such as when a species may have to change its typical geographic distribution as a result of an oceanographic shift, and (ii) indirect, such as implications for reproductive success when prey distribution, abundance or composition is altered (Learmouth et al. 2006).

A species-specific review by McLeod (2009) explored how potential climate change impacts (including increased sea temperature, decreased sea ice extent, and possible changes to prey assemblages) may impact individual species. In general, more temperate and polar species were hypothesised as possibly having unfavourable consequences. Of the 34 Pacific Island species that were included in this review, it was the baleen whales that were listed as having stable (as opposed to potentially favourable) outcomes. This general outlook concurs with discussions of the changes to key prey items, such as krill, which would again seem to have a more direct impact on baleen whales (Moline et al. 2004). However, more recent work uses a coupled climate-biology modelling approach to explore potential climate change impacts on Southern Ocean ecosystems, including baleen whales and key prey species such as copepods and krill (Tulloch et al., 2019). This approach suggests that recovery from heavy commercial whaling activity will be negated by climate change impacts which may cause decreases and some local extinctions for Pacific populations of blue, fin and southern right whales, and Atlantic/Indian fin and humpback whales, by 2100. Key drivers of these declines were a combination of reduced prey density and increasing competition between whale species. Alternative scenarios which allowed somewhat more positive outcomes for blue and minke whales incorporated adjustments to migratory routes to counter shifting prey and changes to sea ice extent. A recent review by van Weelden et al. (2021) summarised the literature on documented changes to cetacean distribution, habitat and migration as a result of climate change. As with previous studies, key environmental indicators for both observed and predicted responses were linked to sea surface temperature (SST) and sea-ice extent. Their work demonstrated a strong bias in research on this topic in the northern hemisphere, particularly proximal to North America. They also noted the absence of many species, such as beaked whales, in research efforts to date. As previously, it seems that baleen whales such as humpback whales, Bryde's whales, fin whales, and Antarctic minke whales are likely to be affected, with time spent in warmer locations (i.e., Pacific Island waters) potentially reduced due to earlier migration both into and out of such areas. Hence, these populations may contract southward. These findings seem consistent with the work of Derville et al. (2018) who undertook a detailed review of temperature at humpback whale breeding sites in New Caledonia and found a negative relationship between sea surface temperature and encounter rates. More specifically, there is a decrease in sighting rates with increased SSTs measured. Hence, there are potentially finer scale patterns at play, which may be driving cetacean responses and behaviour. The geographic and taxonomic gaps noted by van Weelden et al. 2021 are issues for this current review also.

On a more localised scale, land loss of small islands across the Pacific as a result of climate change will likely have both environmental and pollution impacts on water quality (i.e., increased turbidity and release of chemicals), which may have knock-on effects for marine ecosystems, including cetaceans, their prey items and habitat. Martin and Barefoot (2017) reviewed Pacific-focused impacts on cetaceans and outlined both direct and indirect impacts. Direct impacts include warming oceans, which may change whale movement and distribution into warmer seas such as the Pacific Islands as well as an increase in the prevalence of disease transmitted through warmer waters. Sound transmission in the ocean is also predicted to change with ocean acidification potentially enabling sound to travel further – which may be useful for communication, yet also have impacts on general movement and ranging patterns. In turn, these changes may increase the background noise present in the region. Indirect threats are speculative, yet important to consider. They include disrupted food chains, increased competition and climate-induced human activity. Associated impacts may occur on the reliant whale watching industry in terms of timing of migrations, diversity, location, abundance and behaviour.

Summary

A general summary of the data availability, confidence in the available data, and relative impact of the given threat (i.e., direct versus indirect) is presented below (Table 2). The threats as summarised in this report can be generally classified as:

- High: Incidental catch and fishing gear interaction, Directed harvesting, and Pollution
- Moderate: Traffic and Ocean-physics alteration

- Low: Pathogens and introduced species, and Resources depletion

However, an incomplete understanding of target species' ecology makes these gradings of risks preliminary in nature. Important gaps in knowledge include geographic range and abundance. Furthermore, the impacts for species with population substructure (i.e., smaller, discrete populations, high residency in some areas, or low genetic diversity) may be more serious. Likewise, those species with higher levels of conservation concern or in which key groups or activities constitute the loss (such as calves, breeding mothers) may have particularly adverse impacts. As discussed in more detail below – the quality and quantity of data available regarding a given threat also limits the ability to accurately assess the relative risk of each threat.

Table 2. General summary of threats to cetaceans in the Pacific Islands with reference to data availability, confidence (in available data), and the impact of the given threat/s.

	Data availability	Confidence	Impact	Species of concern
BY-CATCH	Observer reports from regional fisheries is the primary source of information on by-catch across the region. Primary fisheries of concern are LL and PS. Observer coverage is highly variable in space and time compared to the commercial fishing footprint itself, particularly for LL. Publicly available databases (such as BDEP) represent proportions of the overall observer data as some aspects of the data have been removed for reasons such as confidentiality and commercial sensitivity. In some cases, the resolution and detail of the data is not available, i.e., data may be collated over a given spatial scale or temporal scale, or, a given code status may simply be designated as unknown. There is much less data and coverage of local and domestic fishing activities.	Observer coverage in the LL and PS are mandated to be 5% and 100% respectively, however these targets have not generally been met. There is more confidence in PS data due to higher coverage. There are some issues with reliability and accuracy of species identification for some species of cetaceans. Lack of data on cetacean entanglements in ALDFG.	Both direct (fatalities) and indirect (interactions or release with unknown longer-term impacts) The impacts for species with population substructure (i.e., smaller, discrete populations, high residency in some areas, or low genetic diversity) may be more serious. Likewise, those species with higher levels of conservation concern or in which key groups or activities constitute the take (such as calves, breeding mothers) may have particularly adverse impacts.	Regional fisheries: False killer whale, short-finned pilot whale, Bryde's whale (but also "Bryde's-like" whales which may be misidentified as Bryde's whales such as Omura's whale, Sei whale, and Eden's whale), Risso's dolphin, rough-toothed dolphin, and bottlenose dolphin (both common and Indo-Pacific species) Kikori, PNG: Indo-Pacific humpbacked dolphin, snubfin dolphin
DIRECTED HARVESTING	Harvest reports (including live capture for sale, and drive hunts) have been collated for some delphinid species (notably in the Solomon Islands). There are anecdotal reports for a variety of other species across the region.	Reasonably good coverage with some valuable local reports however there is a possibility that some catches and activities have been missed or not reported.	All impacts are generally direct (mortality events) and therefore impose immediate consequences on the given populations. Decline of one local population of melon-headed whales indicated in Solomon Islands. Estimates of PBR based on take of local bottlenose dolphins for export activities indicated that such levels were unsustainable if they are continued. There may also be welfare impacts	Spinner dolphins (*S. longirostris* with a chance of other subspecies being involved), bottlenose dolphin (*T. aduncus*), pantropical spotted dolphin, melon-headed whale, Fraser's dolphin

	Data availability	Confidence	Impact	Species of concern
			for those individuals not caught yet somehow involved in the hunt or due to loss of group/family members.	
POLLUTION	Reports of pollution levels are sporadic and largely limited to local incidences where monitoring has occurred.	Relatively limited. There is not much data available to robustly assess the extent of this threat in the Pacific Islands Region. Evidence of high levels of lead in sperm whales in PNG	Connections to cetacean populations has been proposed in some cases yet is also somewhat difficult to measure.	Potentially many species may be impacted by different forms of pollution. Species with more coastal distribution that may interact with tourism operations or other anthropogenic activities may be more susceptible. In addition, species that feed on local food webs that are also impacted by pollution may be more vulnerable due to bioaccumulation impacts. Deeper diving species may be at increased risk to deep sea mining activities. Large migratory species more at risk from entanglement in ALDFG
TRAFFIC	Major shipping channels across the region are available. From these there are anecdotal reports of boat strikes. Interactions with fishing vessels are documented above . Tourism activities in some locations are known to directly interact with cetaceans in some locations through cetacean watching and swimming occurring.	Data is restricted to proactive reporting of events and activities. Furthermore, coverage spatially and across taxa is very variable.	Mortality due to ship strikes has been documented. Impacts on welfare and health have been documented in relation to increased presence of vessels with population-level impacts occurring in some cases.	Large migratory whale species are likely to be the most susceptible to ship strikes. Cetacean species that are the focus of tourism operations include humpback whales, spinner dolphins, bottlenose dolphins, and short-finned pilot whales.

	Data availability	Confidence	Impact	Species of concern
INFECTION	Reports of infections and associated issues are sporadic and limited to local incidences.	Limited. More widespread necropsies of dead stranded cetaceans would be useful.	Impacts of infections on cetaceans may have impacts on health and fitness but are also somewhat speculative.	Unknown although perhaps species with a more coastal distribution may be more vulnerable to infections.
HABITAT	Reports of impacts on habitat are very limited and somewhat speculative for the Pacific Islands region.	Limited.	Impacts of habitat loss and degradation on cetaceans may impact fitness or fecundity (for example) but are also somewhat speculative.	Unknown although perhaps species with a more coastal distribution may be more vulnerable to habitat degradation issues. Species with linkages and reliance on coral reef systems may be affected due to the impacts of tourism, pollution and climate change on these systems. Species with geographic range within deep sea mining operations are likely to incur impacts on their habitats.
CLIMATE CHANGE	Global assessments of vulnerability of cetaceans have been conducted. One study directed on this topic in the Pacific Islands included data collected from New Caledonia, Vanuatu, Tonga, Niue, American Samoa, Samoa, and French Polynesia. Temporal coverage varied from 1 to 14 years for these locations. Focus was on one species (humpback whales).	Limited.	There has been some exploration of the potential impacts of climate change on cetacean species yet it is still difficult to predict the extent and scope. Impacts may be direct (for e.g., changes in distribution due to temperature change) or indirect (changes in prey availability, e.g. krill mortality in warming ocean, affecting migratory whales).	Baleen whales including humpback whales, Bryde's whales, fin whales, and Antarctic minke whales.

Section 3 – Knowledge gaps in assessing risk to Pacific Islands cetaceans – with focus on fisheries by-catch and interactions

Although there has been great improvement in our understanding of cetacean diversity and distribution in the Pacific Islands Region over the last 20 years there are still many gaps. Some recommendations for increasing our understanding of cetacean diversity, distribution and threats in the Pacific Islands include:

(i) a focus on increasing the quality and quantity of data collected in the regional observer programme
(ii) improving general knowledge of cetacean diversity, distribution and populations in the region
(iii) increasing data coverage, confidence and availability of data on key threats to cetaceans
(iv) promoting targeted in-country funding, partnerships and support for cetacean related research and conservation for use by PICTs
(v) mainstreaming cetacean issues in relevant national and regional environmental initiatives.

Regional observer programme (ROP)

Given that by-catch and fisheries interactions represent one of the most serious threats to the region's cetaceans it is important to identify ways in which to increase the data quality and quantity from fisheries operations, so that risk can be adequately assessed. Specific recommendations falling under the categories of training and resources and reporting/recording of observations are given below.

Training and resources

A review of key training materials and resources (including ID manual, ID cards and training presentations) for observers has been undertaken as part of this review and has enabled the development of some suggestions for improvements and additions to these materials.

- *Include all species that are known to inhabit the region (see Table 1)*
- *Provide distribution / geographic range of each species with some indication of relative likelihood of presence within this range (if known)*
- *Show images of relative size of the given species in relation to other species as well as humans, vessel etc.*
- *Highlight the most significant / identifying / unique features. It is recognised that key features have been indicated yet some of these are very distinctive and provide certainty to identification whereas others are at times variable and not as distinct.*
- *Add information on common surface behaviour*
- *Add images of species' surface profiles, diving sequence, blow shape etc.*
- *The two images of each species appear to be relatively similar. Could these images represent different sexes, ages, colouration patterns etc. to assist with identification?*
- *Provide some focus or increase resources to assist with separation of commonly confused species*
- *Fish damage section – as it is difficult to directly observe this occurring it may be more objective to categorise different "types" of damage and then ask observers to identify which*

is the most similar. Including questions about whether animals (including cetaceans) were seen in the vicinity of the given damage would also be helpful.

- *Change the scientific name of dwarf sperm whale from* Kogia simus *to* Kogia sima
- *Delete the inclusion of the gray whale in presentation materials*
- *Provide additional video footage or develop an app*

Table 3. Notes to assist in correct and consistent observations of cetaceans within WCPFC observer reports and also to avoid "false precision" when species differentiation is difficult.

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Species (as listed in observer records)	**Notes and suggestions**
Blue whale	Pygmy blue whales have been noted to occur in the Pacific Islands Region also. Suggestion: List all blue whales as *Balaenoptera musculus* sp. unless additional identification or size records, and/or data (such as images, genetics etc.) is available or expertise is sufficient.
Bottlenose dolphin (*Tursiops truncatus*) and Indo-Pacific bottlenose dolphin (*Tursiops aduncus*)	Relatively similar in at-sea appearance. *T. truncatus* are generally larger (> 2m) and more robust animals. *T. aduncus* are more coastally located and often have reasonable site-fidelity for given bays or coastline. *T. tursiops* have varying life-history characteristics including both wider ranging patterns as well as demonstration of residency to smaller regions and bays. Suggestion: List all bottlenose dolphins as *Tursiops* sp. unless additional identification records (images, genetics etc.) available or expertise is sufficient.
Short-beaked common dolphin (*Delphinus delphis*) and long-beaked common dolphin (*Delphinus capensis*)	Relatively similar in at-sea appearance. Key differences in features include slightly elongated beak in the latter case as well as more robust body type for the short-beaked common dolphin. Geographic range differences occur also with *D. capensis* having a more southerly distribution. Suggestion: List all common dolphins as *Delphinis* sp. unless additional identification records (images, genetics etc.) is available or expertise is sufficient.
Dwarf sperm whale (*Kogia sima*) and pygmy sperm whale (*Kogia breviceps*)	Relatively similar in at-sea appearance. Key differences in features are slight differences in physical size as well as relative location and shape of dorsal fin. Suggestion: List all diminutive sperm whales as *Kogia* sp. unless additional identification records (images, genetics etc.) is available or expertise is sufficient.
Pacific white-sided dolphin	Distribution is generally north of the tropics (and only in the northern hemisphere) and so unlikely to

	occur in a majority of fisheries operating in the WCPO
Spinner dolphin	Species most likely to occur in the region is *Stenella longirostris* however it is possible that a dwarf subspecies may occur in some parts of the region. Hence, any morphometrics, size referenced images or samples from this species would be very useful.
Bryde's whale, Omura's whale, and sei whales	The difficulty of distinguishing Bryde's whales from Omura's whales and sei whales has confounded much of the historical literature, and even some modern survey data. The animals traditionally called Bryde's whales fall into two species (*B. edeni* and B. *omurai*, with large ('ordinary') and small forms of the former. Suggestion: In cases where insufficient genetic and/or morphological evidence was provided, the *B. edeni*/ *brydei* records are not distinguished from one another.
Dusky dolphin	Geographic range is generally restricted to coastal waters around New Zealand and South America and hence is unlikely to occur in any other regions across the WCPFC.
Long-finned pilot whale	In the southern hemisphere the geographic range of this species is generally restricted to waters south of the tropics.
Minke whale	There is much similarity between the appearance of the different species of minke whales. Furthermore, it is unclear in some publications as to whether they consistently and accurately differentiate between the common minke whale and the dwarf form. Furthermore, some difficulty has been noted in distinguishing the *B. acutorostrata* species from Antarctic minke whale – as well as Bryde's whales in some cases. The present convention is to regard this species as consisting of two, and possibly three subspecies; the North Atlantic population *B. a. acutorostrata*, the North Pacific population *B. a. scammoni*, and the 'dwarf' minke whale, *B. a.* unnamed subsp., which is found in parts of the Southern Ocean (Rice 1998). Suggestion: In cases where insufficient genetic and/or morphological evidence was provided, minke whales and/or Bryde's whales should not necessarily be distinguished from one another and may be classified as minke-like whales or Bryde's-like whales.
Northern right whale	Geographic range is restricted to coastal areas in the northern hemisphere and is very unlikely to occur in any of the regions of the WCPFC

An observer undertaking the initial training programme will cover whale and dolphin identification in an approximate 2-hour window on the 4th day of a relatively information dense two-week schedule. Refresher training for observers is conducted annually which provides some reinforcement of learning, however overall there is a relatively limited time available for observers to build their knowledge on cetacean identification.

Recommendations:

(i) Explore methods which may innovatively increase exposure to understanding cetacean identification and ecology (for example an app which would allow a way for observers to test or reinforce their knowledge over time) or expand the array of resources available to observers on cetacean identification and ecology would be helpful.

(ii) Ensure knowledge sharing of best practice for safe handling and release of cetaceans to observers (USA 2021).

Reporting/recording of observations

Observer coverage in the PS fishery is targeted to be 100% whereas in the LL fishery it is 5%. Increasing data collection and ensuring even coverage would greatly benefit understanding of by-catch and fisheries interactions in the region.

Recommendations:

(i) Increase observer coverage in the LL fishery. A recommended percentage of coverage could be informed by a power analysis that considered current rates and variability in interactions rates for species of highest concern.

(ii) Explore approaches to increase the spatial and temporal overlap of observer coverage with commercial fishing activity.

Increase photographic capture of cetaceans that are landed or interact with fishing vessels.
Recommendation:

(iii) Provide observers with suitable devices to capture photographic images and/or video footage of cetaceans landed or interacting with fishing vessels (see below also regarding data collection for landed cetaceans).

In observer reports there are a number of places in which a given category (such as interaction type, code, status) can be coded as "unknown". In overall summaries of observer data it is evident that this code is sometimes used relatively frequently.

Recommendation:

(iv) Explore the frequency of different categorical responses to identify which observer responses are often listed as "unknown". This review will provide a platform to then explore whether additional resources, training or information is needed for observers to understand how to assess and categorise their observations accurately. Alternatively, it may reveal that other issues such as task prioritization, time available etc. are impacting the collection of such data.

There are general sections in both the PS and LL trip reports to provide additional detail on cetacean interactions. It is noted that the space available to provide this information is relatively small, and there are many questions in these cetacean-related queries.

Recommendation:

(v) Conduct an analysis of the responses to cetacean related questions in observer trip reports to gain a more detailed understanding of whether (i) there is information which may assist with the development of new resources, and (ii) there are any consistent gaps in responses in this section which may need to be strengthened.

Some species are relatively difficult to tell apart at sea, even to an experienced observer. Other species may be able to be differentiated at close range (i.e., possibly if landed on the deck) or with verification from photographs, measurements, DNA samples etc. A summary of useful species category combinations and when they might be most useful is listed in Table 3. Additional notes on geographic range of some species are also given.

Recommendations:

(vi) Include descriptions of – and create codes – for the species groupings listed in Table 3, and
(vii) Update relevant geographic range information as has been noted in Table 3.

There should be priority placed on recording the condition of a landed cetacean – and also in collecting as much additional information as possible within welfare considerations and the need to release the given animal.

Recommendations;

(viii) Condition of landed animals when they first appear on the vessel and when they are released should always be directly assessed (rather than listed as "unknown"),
(ix) Length, morphometric measurements, and description of each individual should be reported, including any injuries or marks which may be present,
(x) Identification of species or species group categories should be used in line with the taxonomic level at which the observer feels most confident in reporting to,
(xi) Photographic images or video footage should be taken, and
(xii) Genetic samples should be extracted appropriately and stored to verify species identification.

Additional research areas of interest to consider in relation to cetaceans and the regional observer programme include:

(xiii) Exploration of electronic monitoring as means of collecting complementary and/or useful data on cetaceans documented by observers. At present, the focus of EM is to enhance accurate detection and counts of target species and fish by-catch (Brown et al. 2021) however future work is focusing on (among other things) how to incorporate length measurements, assess status of given species, and potentially document species that are not landed on deck. As this area of work develops in the WCPFC it will be useful to monitor if the processes are able to include work into species of special interest as well.
(xiv) More detailed review of the condition of cetaceans that are landed on board on long-term health and survival would be useful. Targeted research efforts to address these questions would be required.

Limited knowledge

A lack of detailed understanding about many of the cetaceans across the Pacific Islands creates a major obstacle in conservation and management. This limitation in part inhibits mainstreaming of cetacean issues into broader environmental policies and initiatives by national governments. In a nutshell, it's difficult to protect and conserve what you do not know exists or are not aware of. Some of the topics that require focus and attention include:

- confirmed diversity records for each PICT,
- distributional and range information for each cetacean species,
- population estimates for a majority of species,
- population structure of each species including whether populations are resident or migratory, or whether subpopulations are present,
- habitat use, and prey and diet requirements.
- The spatial scale at which management should apply is also important to consider. Furthermore, studies into cetacean social and movement patterns suggest that cetacean populations may operate at both small, local scales as well as larger ocean basin level groupings. More specifically, examples of small, discrete populations being confined to a single bay or reef system – or perhaps a given island – have been reported.
- Research into taxonomy is also critical. For example, relatively recent studies have provided support for the presence of species previously unknown in the region (i.e., Australian snubfin dolphin and Deraniyagala's beaked whale) that were assumed to be other species, i.e., Irrawaddy dolphin and a Mesoplodon species (of some type), respectively.

Recommendations:

(i) Where there is uncertainty in how or where to prioritise effort or increasing knowledge the following order of priorities are intended to assist;
    - Understanding cetacean diversity within a given PICTs waters or across an area of interest,
    - Exploring patterns of high and low density as well as geographical distribution of cetacean species, and
    - Documenting trends in the demographics of cetacean populations.

(ii) Develop national points of contact for collation and updating of current cetacean diversity listings for each PICT (see Appendix), strandings, sightings, and research activities.

(iii) A review of species-specific information at a regional-level for species with IUCN redlist conservation status categories of concern should be undertaken to facilitate a more species-specific focus for such cetacean species.

(iv) A variety of modelling approaches and statistical techniques to inform species risk assessments would be useful to explore. It would seem helpful to start with species that have a relatively high number of bycatch records and/or have data available that broadly aligns with the data requirements for the particular approach.

Recommendations:

- Bycatch estimates by species or group. Extrapolations of purse seine by-catch (see Peatman et al. 2018 and 2021) currently are collectively grouped as "marine mammals". Consideration of individual cetacean species and species groups analyses is needed to better understand the risk of by-catch to cetaceans. Ideally all species should be assessed, however as a starting point the following species are suggested: false killer whale, short-finned pilot whale, Bryde's whale (but also "Bryde's-like" whales which may be misidentified as Bryde's whales such as Omura's whale, Sei whale, Fin whale, and Eden's whale), Risso's dolphin, rough-toothed dolphin, and bottlenose dolphin (both common and Indo-Pacific species).

- Species distribution models. Undertake species distribution models (SDMs) for cetacean species. It is likely that many species will have insufficient data available to populate some varieties of SDMs and/or have only a limited number of known, strong environmental correlates to be useful in a habitat modelling approach. Hence, one approach would be to attempt to locate and extract not only presence but also absence data from relevant research surveys and databases. Suggested species are false killer whales, "Brydes-like" whale species, Risso's dolphin, rough-toothed dolphin and bottlenose dolphins.
- Species abundance indices. Examine methods to robustly calculate an index of abundance or density across the region for individual species. Direct assessment may be one approach yet interpolation using appropriate predictors such as environmental variables (SDMs) or other approaches could be undertaken. An understanding of any population, social or demographic structure within an estimation of abundance is also required. For example, resident populations, geographically or genetically distinct populations, subspecies, critical habitats, or vulnerable groups (calves, pregnant females). Without knowing both the population size and having a clear understanding of suitable management unit to use for a given cetacean species it is very difficult to model long-term impacts or possible conservation risks.
- Species risk assessments. Investigate whether any rapid risk assessment methods that have been used within the WCPFC or other Regional Fisheries Management organisations to evaluate the vulnerability of data-poor stocks and species of species interest to fishing activities may be applicable to cetacean species. One approach that is currently being investigated by the WCPFC in this setting is the EASI-Fish (i.e., Ecological Assessment of the Sustainable Impacts of Fisheries) method (Griffiths et al. 2019, Phillips et al. 2021). It is recommended that at least a few candidate cetacean species are used as species of investigation within this programme of work. Given that EASI-Fish requires length measurements it is suggested that dolphin species or small whale species for which this information is routinely (and more likely accurately) measured such as false killer whales, rough-toothed dolphins and bottlenose dolphins could be utilised.

<u>Threats</u>

A number of important direct and indirect threats for cetaceans have been identified across the region. However, the data quality and quantity of these threats varies greatly which makes it difficult to assess the overall risk level of each given threat. However, this report suggests that by-catch and fisheries interactions, direct take and pollution (particularly in relation to development and deep-sea mining) are the most immediate and serious threats to cetaceans in the Pacific Region. Increasing data and monitoring on all threats is essential to increasing our understanding of the level and scope of impacts such factors have on cetaceans in the region.

Recommendations:

(i) increase monitoring efforts of any direct take (drive hunt) activities
(ii) monitor CITES databases to identify any imports and exports of Pacific Island cetaceans
(iii) investigate any evidence of local holding of dolphins in sea pens

(iv) document all regional stranding events and submit records to the Oceania strandings database on flukebook
(v) where possible, undertake necropsies of stranded individuals and/or collect samples for further analysis
(vi) report and document cetacean ship strikes in the region into a central repository
(vii) review relevant environmental impact assessments undertaken in the region to identify processes which have identified and managed cetacean populations appropriately.

Additional efforts could also look to existing global reviews of gaps in knowledge of cetacean threats to highlight key areas of importance and opportunity for development in the Pacific region (Nelms et al. 2021).

Targeted in-country funding for cetacean research and support

Delivery of positive conservation and management outcomes for cetaceans across the region requires strong support of national governments to participate, engage and progress cetacean research and policy on a national level. Such support may include (but is not limited to) technical support through solid partnerships and collaborations, ongoing mentorships and scholarships to train up-and-coming researchers and policy staff, as well as broader educational opportunities for those government staff engaged in cetacean issues. Provision of all research outputs and data collected would also assist governments in their progress. Furthermore, the active sharing of priorities and plans by PICT governments with all researchers that have shown interests in cetacean research in their country (regional cetacean staff, previous/recent permit holders, new enquiries/applications) may enhance these collaborations.

Recommendations:

(i) Request that visiting researchers provide assistance to the given PICT in reporting against national targets and plans (such as the regional whale and dolphin action plan) relevant to their research activities
(ii) Active sharing of priorities and plans by PICT governments with any interested researchers and collaborators to assist in the development and delivery of mutually beneficial research activities and outcomes.

Partnerships and mainstreaming

As above, PICT governments need to be partners in research processes and regional management in order to be better equipped to integrate relevant policies and processes within broader government initiatives. Much has been said through various environmental initiatives and planning processes about the importance of mainstreaming a variety of environmental issues and ensuring there is comprehensive coverage of relevant topics as well as supportive frameworks for moving joint and complementary environmental issues forward (www.sprep.org). Hence, embedding priority cetacean conservation and management within national planning processes, discussions and research activities is critical.

Provide input from this report to WCPFC and the IWC-led project on assessing and addressing cetacean by-catch in tuna fisheries which will initially focus on the western-central Pacific and the Indian Ocean (Secretariat of the International Whaling Commission 2021).

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Appendix: A summary of cetacean sightings and records across the Pacific Islands region

The following summary tables are a collation of records that have subsequently been referenced to geographic location and have been classified on a coarse reliability scale of Confirmed (documentation or record of relatively recent occurrence has been verified) or Unconfirmed (documentation is limited, anecdotal, or historical). The records have been collected opportunistically and from a wide variety of sources. It is also important to note that diversity information within a given PICT is likely heavily influenced by effort between locations and over time. Each table provides a list of both the scientific name and common name for records (with references) that could be attributed to a given EEZ. Records have been adapted in instances where there are noted difficulties with individual species identification or subspecies differentiation, and/or instances where taxonomic nomenclature is unresolved or has changed. Specifically, *Tursiops*, *Delphinus*, and *Kogia* individuals have been listed as sp. (respectively) in cases where there was insufficient genetic or morphological evidence provided to determine species. In the case of *Kogia* sp. the common name used is "diminutive sperm whale". When insufficient evidence for minke whale sightings was presented, records have been listed as "minke-like" whales (*Balaenoptera* sp.) regardless of which species or subspecies was inferred by the author. The same is true for Bryde's whales – with the additional inclusion of sei whale records when insufficient evidence for separation exists. In these cases, the combined Bryde's and sei records are referred to as "Bryde's-like" whales. This step was deemed necessary due to historic difficulties with distinguishing these species from one another at sea.

Records of Cetaceans in the Waters of American Samoa	
Balaenoptera sp. Minke whale	Kasamatsu et al. 1995, Craig 2005
Megaptera novaeangliae Humpback whale	Reeves et al. 1999, UNEP-WCMC 2003, Craig 2005, Robbins and Mattila 2006
Globicephala macrorhynchus Short-finned pilot whale	Reeves et al. 1999, Craig 2005
Orcinus orca Orca	Reeves et al. 1999, Craig 2005
Pseudorca crassidens False killer whale	Craig 2005, Robbins and Mattila 2006
Stenella attenuata Pantropical spotted dolphin	Reeves et al. 1999, Craig 2005
Stenella longirostris Spinner dolphin	Reeves et al. 1999, Craig 2005, Robbins and Mattila 2006
Steno bredanensis	Craig 2005, Robbins and Mattila 2006

Rough-toothed dolphin	
Tursiops sp. Bottlenose dolphin	Reeves et al. 1999, Craig 2005
Physeter macrocephalus Sperm whale	Lever 1964, Grant 1995, Reeves et al. 1999, Craig 2005
Ziphius cavirostris Cuvier's beaked whale	Craig 2005
Unconfirmed Species	
Kogia sima, Dwarf sperm whale (D. Johnston pers. comm.)	

Records of Cetaceans in the Waters of Cook Islands	
Balaenoptera sp. Minke whale	SPWRC 2004, Cook Islands SOE 2018
Balaenoptera borealis Sei whale	Cook Islands SOE 2018
Balaenoptera musculus Blue whale	SPWRC 2004, Cook Islands SOE 2018 (notes probably *B. m. brevicauda*)
Megaptera novaeangliae Humpback whale	Hauser et al. 2000, Olavarria et al. 2003, SPWRC 2009, Cook Islands SOE 2018
Delphinus sp. Common dolphin	SPWRC 2004, Cook Islands SOE 2018
Globicephala macrorhynchus Short-finned pilot whale	SPWRC 2004, Cook Islands SOE 2018
Lagenorhynchus australis *Peale's dolphin*	Cook Islands SOE 2019 (refers to Leatherwood et al. 1991)
Lagenodelphis hosei Fraser's dolphin	Hauser 2002, SPWRC 2004
Orcinus orca Orca	Reeves et al. 1999, SPWRC 2004, Cook Islands SOE 2018
Peponocephala electra Melon-headed whale	Hauser 2002, SPWRC 2004

Stenella attenuata Pantropical spotted dolphin	SPWRC 2004, Cook Islands SOE 2019
Stenella longirostris Spinner dolphin	SPWRC 2004
Physeter macrocephalus Sperm whale	Hauser 2002, SPWRC 2004, SPWRC 2008, Cook Islands SOE 2018
Mesoplodon densirostris Blainville's beaked whale	SPWRC 2004, Cook Islands SOE 2018
Ziphius cavirostris Cuvier's beaked whale	SPWRC 2004, SPWRC 2008, Cook Islands SOE 2018
Unconfirmed Species	
Grampus griseus, Risso's dolphin (Cook Islands Biodiversity database 2006) *Pseudorca crassidens*, False killer whale (Cook Islands Biodiversity database 2006) *Stenella coeruleoalba*, Striped dolphin (Cook Islands Biodiversity database 2006) *Tursiops* sp., Bottlenose dolphin (Cook Islands Biodiversity database 2006)	

Records of Cetaceans in the Waters of the Federated States of Micronesia	
Balaenoptera sp. Bryde's-like whale	Eldredge 1991, Patterson and Alverson 1986, Perrin 2006
Globicephala macrorhynchus Short-finned pilot whale	Patterson and Alverson 1986, Hoyt 2001
Lagenodelphis hosei Fraser's dolphin	Miyazaki and Wada 1978, Eldredge 1991
Peponocephala electra Melon-headed whale	Miyazaki and Wada 1978, Eldredge 1991
Stenella coeruleoalba Striped dolphin	Eldredge 1991, Miyazaki and Wada 1978
Stenella longirostris Spinner dolphin	Eldredge 1991, Hoyt 2001
Tursiops sp. Bottlenose dolphin	Hoyt 2001

Physeter macrocephalus Sperm whale	Eldredge 1991, Patterson and Alverson 1986, Ashby 1995
Mesoplodon gingkodens Gingko-toothed beaked whale	Dalebout et al. 2008
Unconfirmed Species	
Orcinus orca, Orca (Eldredge 1991, Rock 1993) *Stenella attenuata,* Pantropical spotted dolphin (Gilpatrick et al. 1987 *in* Wiles 2005) *Ziphius cavirostris*, Cuvier's beaked whale (Reeves et al. 1999)	

Records of Cetaceans in the Waters of Fiji	
Balaenoptera sp. Minke whale	Ohsumi 1979, Kasamatsu et al. 1995, Paton and Gibbs 2002, Miller et al 2016
Balaenoptera sp. "Bryde's-like" whale	Dawbin 1959, Ohsumi 1979
Balaenoptera edeni Bryde's whale	Ohsumi 1978, Kawamura 1980, Paton and Gibbs 2002, Kanda et al. 2007
Balaenoptera physalus Fin whale	Ohsumi 1979, Paton and Gibbs 2002
Megaptera novaeangliae Humpback whale	Dawbin 1964, Paterson 2001, Paton and Gibbs 2002, SPWRC 2009, Miller et al 2016
Globicephala macrorhynchus Short-finned pilot whale	Dawbin 1974, Gibbs and Paton 2003, SPWRC 2009, Miller et al 2016
Pseudorca crassidens False killer whale	Paton and Gibbs 2002, Gibbs and Paton 2003, SPWRC 2009
Stenella attenuata Pantropical spotted dolphin	Gibbs and Paton 2003, UNEP-WCMC 2003
Stenella longirostris Spinner dolphin	Gibbs and Paton 2003, Bourke and Powell 2004, SPWRC 2009, Cribb et al 2012, Miller et al 2016
Tursiops sp. Bottlenose dolphin	Reeves et al. 1999, SPWRC 2009
Kogia breviceps	Dehm et al. 2021

Pygmy sperm whale	
Physeter macrocephalus Sperm whale	Lever 1964, Paton and Gibbs 2002
Mesoplodon densirostris Blainville's beaked whale	Leslie et al. 2005
Unconfirmed Species	
Balaenoptera musculus, Blue whale (Ohsumi 1979) *Delphinus* sp., Common dolphin (Reeves et al. 1999) *Lagenodelphis hosei*, Fraser's dolphin (Baker 1983 in Reeves et al. 1999) *Orcinus orca*, Orca (Anonymous 1995) *Steno bredanensis,* Rough-toothed dolphin (Paton and Gibbs 2002)	

Records of Cetaceans in the Waters of French Polynesia	
Megaptera novaeangliae Humpback whale	Lefèvre et al. 1999, Gannier 2000 and 2004, Bourreau and Gannier 2001, Olavarria et al. 2003, SPWRC 2009
Feresa attenuata Pygmy killer whale	Gannier 2002a, SPWRC 2004
Globicephala macrorhynchus Short-finned pilot whale	Rancurel 1973, Gannier 2000 and 2002a, SPWRC 2004, 2007
Grampus griseus Risso's dolphin	Gannier 2000 and 2002a, SPWRC 2004
Lagenodelphis hosei Fraser's dolphin	Gannier 2000, SPWRC 2004, 2007
Orcinus orca Orca	Gannier 2002a, Eldredge 1991, SPWRC 2004
Peponocephala electra Melon-headed whale	Gannier 2000 and 2002a, SPWRC 2004, 2007
Pseudorca crassidens False killer whale	Gannier 2002a, SPWRC 2004
Stenella attenuata Pantropical spotted dolphin	Gannier 2002a, SPWRC 2004

Stenella longirostris Spinner dolphin	Gannier 2000 and 2002b, SPWRC 2002, 2004, 2007
Steno bredanensis Rough-toothed dolphin	Gannier 2000 and 2002a, SPWRC 2002, 2004, and 2007, Gannier 2003, Gannier and West 2005
Tursiops sp. Bottlenose dolphin	Gannier 2000 and 2002a, Brasseur et al. 2002, SPWRC 2004
Kogia sp. Diminutive sperm whale	Gannier 2000, SPWRC 2004, 2007
Physeter macrocephalus Sperm whale	Jacquet et al. 1996, Gannier 2000, SPWRC 2004
Mesoplodon densirostris Blainville's beaked whale	Gannier 2000, SPWRC 2004, 2007
Ziphius cavirostris Cuvier's beaked whale	Gannier 2000, SPWRC 2004
Unconfirmed Species	
Balaenoptera sp., Minke whale (A. Gannier pers. comm.) *Balaenoptera edeni*, Bryde's whale (UNEP-WCMC 2003) *Balaenoptera physalus*, Fin whale (UNEP-WCMC 2003)	

Records of Cetaceans in the Waters of Guam	
Balaenoptera Bryde's whale	Hill et al. 2020
Megaptera novaeangliae Humpback whale	Eads 1991, Eldredge 1991
Feresa attenuata Pygmy killer whale	Hill et al. 2020
Globicephala macrorhynchus Short-finned pilot whale	Birkeland 1977, Kami and Hosmer 1982, Eldredge 1991, Thorson et al. 2007, Hill et al. 2018, Hill et al. 2020
Grampus griseus Risso's dolphin	Miyazaki and Wada 1978, Eldredge 1991, Miyashita et al. 1996

Mesoplodon densirostris Blainville's beaked whale	Hill et al., 2020
Peponocephala electra Melon-headed whale	Thorson et al. 2007, Hill et al. 2020
Pseudorca crassidens False killer whale	Thorson et al. 2007, Hill et al. 2020
Stenella attenuata Pantropical spotted dolphin	Wada 1981, Hill et al. 2020
Stenella coeruleoalba Striped dolphin	Hill et al. 2020
Stenella longirostris Spinner dolphin	Eldredge 1991, Trianni and Kessler 2002, Hill et al. 2020
Steno bredanensis Rough-toothed dolphins	Hill et al. 2020
Tursiops sp. Bottlenose dolphin	Wada 1981, Hill et al. 2020
Kogia sp. Diminutive sperm whale	Kami and Lujan 1976, Eldredge 1991, Reeves et al. 1999, UNEP-WCMC 2003, Eldredge 2003, Hill et al. 2020 (*K. sima*)
Physeter macrocephalus Sperm whale	Eldredge 1991, Reeves et al. 1999, Thorson et al. 2007, Hill et al. 2020
Ziphius cavirostris Cuvier's beaked whale	D. Johnston pers. comm., NOAA 2007
Unconfirmed Species	
Balaenoptera sp., Bryde's-like whale (Eldredge 1991, Eldredge 2003) *Balaenoptera borealis*, Sei whale (D. Johnston pers. comm.) *Orcinus orca,* Orca (Kami and Hosmer 1982) *Stenella coeruleoalba,* Striped dolphin (Eldredge 1991, Eldredge 2003)	

Records of Cetaceans in the Waters of Kiribati	
Globicephala macrorhynchus	Patterson and Alverson 1986, Ocean Alliance 2001

Short-finned pilot whale	
Kogia breviceps Pygmy sperm whale	Baker et al. 2013
Lagenodelphis hosei Fraser's dolphin	Perrin et al. 1973, Miyazaki and Wada 1986, Wilson 1994, UNEP-WCMC 2003
Mesoplodon densirostris Blainville's beaked whale	Baker et al. 2013
Mesoplodon houtala Deraniyagala's beaked whale	Baker et al. 2013; Dalebout et al 2014
Orcinus orca Orca	Miyashita et al. 1995
Stenella attenuata Pantropical spotted dolphin	Perrin 1975, Reeves et al. 1999
Stenella longirostris Spinner dolphin	Wilson 1994, Reeves et al. 1999, Stone et al. 2001
Steno bredanensis Rough-toothed dolphin	Miyazaki and Perrin 1994
Tursiops sp. Bottlenose dolphin	Patterson and Alverson 1986, Reeves et al. 1999, Stone et al. 2001
Physeter macrocephalus Sperm whale	Lever 1964, Patterson and Alverson 1986, Eldredge 1991, Wilson 1994, Dufault and Whitehead 1995, Reeves et al. 1999
Hyperoodon planifrons Southern bottlenose whale	Wade and Gerrodette 1993, Reeves et al. 1999
Ziphius cavirostris Cuvier's beaked whale	Reeves et al. 1999; Baker et al., 2013

Unconfirmed Species
Balaenoptera musculus, Blue whale (Wilson 1994) *Eubalaena australis,* Southern right whale (Wilson 1994) *Mesoplodon gingkodens* subsp., (Dalebout et al. 2007) *Peponocephala electra*, Melon-headed whale (Reeves et al. 1999) *Pseudorca crassidens*, False killer whale (Reeves et al. 1999) *Stenella coeruleoalba,* Striped dolphin (Reeves et al. 1999)

Records of Cetaceans in the Waters of the Marshall Islands	
Balaenoptera sp. Minke whale	Reese 1984, Crawford 1993
Balaenoptera musculus Blue whale	Reese 1984, Crawford 1993
Balaenoptera physalus Fin whale	Reese 1984, Crawford 1993
Megaptera novaeangliae Humpback whale	UNEP-WCMC 2003, Kellogg 1928 *in* Wiles 2005
Delphinus sp. Common dolphin	Reese 1984, Crawford 1993
Globicephala macrorhynchus Short-finned pilot whale	Reese 1984, Crawford 1993
Orcinus orca Orca	Reese 1984, Crawford 1993
Peponocephala electra Melon-headed whale	Eldredge 1991
Stenella attenuata Pantropical spotted dolphin	Reese 1984, Crawford 1993
Stenella coeruleoalba Striped dolphin	Reeves et al. 1999
Stenella longirostris Spinner dolphin	Eldredge 1991

Tursiops sp. Bottlenose dolphin	Reese 1984, Crawford 1993
Unconfirmed Species	
Balaenoptera sp., Bryde's-like whale (Patterson and Alverson 1986) *Steno bredanensis,* Rough-toothed dolphin (Reeves et al. 1999) *Physeter macrocephalus,* Sperm whale (Reeves et al. 1999)	

Records of Cetaceans in the Waters of Nauru	
Balaenoptera sp. Bryde's-like whale	Ohsumi 1978, Eldredge 1991
Lagenodelphis hosei Fraser's dolphin	Miyazaki and Wada 1978
Peponocephala electra Melon-headed whale	Miyazaki and Wada 1978
Physeter macrocephalus Sperm whale	Lever 1964, Berzin 1972, Eldredge 1991
Unconfirmed Species	
Orcinus orca, Orca (Eldredge 1991) *Ziphius cavirostris,* Cuvier's beaked whale (Miyazaki and Wada 1978)	

Records of Cetaceans in the Waters of New Caledonia	
Balaenoptera acutorostrata subsp. Minke whale	Arnold et al. 1987, Garrigue and Greaves 2001, SPWRC 2008
Balaenoptera bonaerensis Antarctic minke whale	UNEP-WCMC 2003, Borsa 2006
Balaenoptera borealis Sei whale	Borsa 2006
Balaenoptera sp. Bryde's-like whale	Kawamura 1980, Reeves et al. 1999
Balaenoptera musculus brevicauda Pygmy Blue whale	Clua 2002, Garrigue et al. 2003, Borsa and Hoarau 2004

Balaenoptera omurai *Omura's whale*	Garrigue and Poupon 2013; Van Canneyt et al. 2015
Megaptera novaeangliae Humpback whale	Dawbin 1964, Eldredge 1991, Garrigue and Gill 1994, Gill et al. 1995, Garrigue and Greaves 2000, Garrigue et al. 2001, Paterson 2001, Garrigue et al. 2002, Olavarria et al. 2003, Garrigue et al. 2004, SPWRC 2009
Delphinus sp. Common dolphin	Heyning and Perrin 1994, Reeves et al. 1999
Feresa attenuata Pygmy killer whale	Garrigue 2006
Globicephala macrorhynchus Short-finned pilot whale	Garrigue and Greaves 2001, Bustamante et al. 2003, UNEP-WCMC 2003
Grampus griseus Risso's dolphin	Garrigue and Greaves 2001, UNEP-WCMC 2003
Lagenodelphis hosei Fraser's dolphin	Pers. comm.
Orcinus orca Orca	Garrigue and Greaves 2001
Indopacetus pacificus *Longman's beaked whale*	Garrigue and Poupon 2013; Garrigue et al 2016
Peponocephala electra Melon-headed whale	Garrigue 2006
Pseudorca crassidens False killer whale	Greaves and Garrigue 1999, SPWRC 2004, SPWRC 2008
Stenella attenuata Pantropical spotted dolphin	Garrigue and Greaves 2001, UNEP-WCMC 2003
Stenella coeruleoalba Striped dolphin	Pers. Comm (?)
Stenella longirostris Spinner dolphin	Garrigue and Greaves 2001
Steno bredanensis	Garrigue, unpubl., SPWRC 2007

Rough-toothed dolphin	
Tursiops aduncus Indo-Pacific bottlenose dolphin	Bonneville et al., 2021; Hale et al. 2000, Garrigue 2006, SPWRC 2008
Tursiops truncatus Common bottlenose dolphin	Garrigue and Greaves 2001
Kogia breviceps Pygmy sperm whale	Sylvestre 1988, Bustamante et al. 2003, SPWRC 2009
Kogia sima Dwarf sperm whale	Rancurel 1973, Reeves et al. 1999, SPWRC 2004, Garrigue 2006
Physeter macrocephalus Sperm whale	Garrigue and Greaves 2001, UNEP-WCMC 2003, SPWRC 2008
Mesoplodon densirostris Blainville's beaked whale	Garrigue and Greaves 2001, UNEP-WCMC 2003, Borsa 2005
Ziphius cavirostris Cuvier's beaked whale	Garrigue 2006
Unconfirmed Species	
Delphinus delphis, Common dolphin (Borsa 2006)	

Records of Cetaceans in the Waters of Niue	
Balaenoptera sp. Minke whale	Kasamatsu et al. 1995, Constantine 1999, SPWRC 2009, Niue SOE 2019
Balaenoptera borealis Sei whale	Niue SOE 2019
Megaptera novaeangliae Humpback whale	Constantine 1999, Reeves et al. 1999, SPWRC 2002, 2004, 2009; Niue SOE 2019
Globicephala macrorhynchus Short-finned pilot whale	Constantine 1999, Niue SOE 2019
Mesoplodon densirostris Blainville's beaked whale	Friedlander et al. 2017
Orcinus orca Orca	Constantine 1999

Pseudorca crassidens False killer whale	Constantine 1999
Stenella longirostris Spinner dolphin	Constantine 1999, Hoyt 2001, SPWRC 2009, Niue SOE 2019
Physeter macrocephalus Sperm whale	Ohsumi 1979, Niue SOE 2019
Ziphius cavirostris Cuvier's beaked whale	Niue SOE 2019

Records of Cetaceans in the Waters of the Northern Mariana Islands	
Balaenoptera sp. 'Bryde's-like' whale	Thorson et al. 2007, Hill et al. 2020
Balaenoptera borealis Sei whale	Norris et al. 2007
Balaenoptera sp. 'Minke-like' whale	Norris et al. 2007, Oleson et al. 2015
Megaptera novaeangliae Humpback whale	Eldredge 1991, Reeves et al 1999, UNEP-WCMC 2003, Thorson et al. 2007, Hill et al. 2020
Feresa attenuata Pygmy killer whale	Norris et al. 2007, Hill et al. 2020
Globicephala macrorhynchus Short-finned pilot whale	Miyashita et al. 1995, Thorson et al. 2007, Hill et al. 2018, Hill et al. 2020
Grampus griseus Risso's dolphin	Miyashita et al. 1996, Hill et al. 2020
Indopacetus pacificus Longman's beaked whale	Hill et al. 2020
Mesoplodon densirostris Blainville's beaked whale	Hill et al., 2020
Peponocephala electra Melon-headed whale	Jeffersen et al. 2006, Hill et al. 2020

Pseudorca crassidens False killer whale	Norris et al. 2007, Hill et al. 2020
Stenella attenuata Pantropical spotted dolphin	Thorson et al. 2007, Hill et al. 2020
Stenella coeruleoalba Striped dolphin	Thorson et al. 2007
Stenella longirostris Spinner dolphin	Stinson 1994, Thorson et al. 2007, Hill et al. 2020
Steno bredanensis Rough-toothed dolphin	Miyashita et al. 1996, Jeffersen et al. 2006, Thorson et al. 2007, Hill et al. 2020
Tursiops sp., Bottlenose dolphin	Hill et al., 2020
Kogia sp. Diminutive sperm whale	Kami and Lujan 1976, UNEP-WCMC 2003, Hill et al. 2020 (*K. sima*)
Physeter macrocephalus Sperm whale	Kasuya and Miyashita 1988, Eldredge 1991, Thorson et al. 2007, Hill et al. 2020
Ziphius cavirostris Cuvier's beaked whale	Hill et al., 2020
Unconfirmed Species	
Balaenoptera sp., 'Bryde's-like' whale (Horwood 1987, Eldredge 2003) *Delphinus* sp., Common dolphin (Masaki 1972 *in* Eldredge 1991) *Orcinus orca,* Orca (Miyashita et al. 1995) *Pseudorca crassidens,* False killer whale *Stenella coeruleoalba,* Striped dolphin (Miyashita et al. 1996)	

Records of Cetaceans in the Waters of Palau	
Balaenoptera sp. Bryde's-like whale	Eldredge 1991, Perrin 2006
Feresa attenuata Pygmy killer whale	Andrews 2013
Globicephala macrorhynchus	Reeves et al. 1999, Wiles 2005, Andrews 2015

Short-finned pilot whale	
Orcinus orca Orca	Iwashita 1963 *in* Visser and Bonoccorso 2003, Rock 1993, PCS 2003
Peponocephala electra Melon-headed whale	Donaldson 1983, Eldredge 1991, Andrews 2013
Pseudorca crassidens False killer whale	Eldredge 1991, Andrews 2013
Stenella attenuata Pantropical spotted dolphin	Eldredge 1991, Andrews 2013
Stenella coeruleoalba Striped dolphin	Miyazaki and Wada 1978
Stenella longirostris Spinner dolphin	Eldredge 1991, Andrews 2013
Lagenodelphis hosei Fraser's dolphin	Eldredge 1991, web (islandtimes.org)
Physeter macrocephalus Sperm whale	PCS 2003, Wiles 2005, Andrews 2013
Unconfirmed Species	
Balaenoptera sp., Minke whale (A. Bauman pers. comm.) *Grampus griseus,* Risso's dolphin (Eldredge 1991, A. Bauman pers. comm.) *Tursiops* sp., Bottlenose dolphin (A. Bauman pers. comm.) *Ziphius cavirostris,* Cuvier's beaked whale (Eldredge 1991, Wiles 2005)	

Records of Cetaceans in the Waters of Papua New Guinea	
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	Ohsumi 1978, Williams et al. 2020
Balaenoptera omurai	R. Constantine, pers. comm. 2022

Omura's whale	
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 Snubfin dolphin	Beasley et al. 2005
Orcinus orca Orca	Munday 1994, Visser and Bonoccorso 2003, Miller and Rei 2021
Peponocephala electra Melon-headed whale	Munday 1994, Reeves et al. 1999, Williams et al. 2020
Pseudorca crassidens False killer whale	Munday 1994, Ocean Alliance 2001, Williams et al. 2020
Sousa sahulensis Australian humpback dolphin	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 sp. Bottlenose dolphin	Munday 1994, Visser 2003, Williams et al. 2020, Mavea et al 2021
Kogia sp. Diminutive sperm whale	Visser 2003, Mavea et al 2021
Physeter macrocephalus Sperm whale	Lever 1964, Berzin 1972, Dawbin 1972, Munday 1994, Miller and Rei 2021
Ziphius cavirostris Cuvier's beaked whale	Visser 2003, Mavea et al 2021

Unconfirmed Species
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)

Records of Cetaceans in the Waters of the Pitcairn Islands	
Balaenoptera sp. *Minke-like whale*	Horswill and Jackson 2012
Megaptera novaeangliae Humpback whale	Horswill and Jackson 2012
Globicephala macrorhynchus Short-finned pilot whale	Reeves et al. 1999, Horswill and Jackson 2012
Physeter macrocephalus Sperm whale	Lever 1964
Ziphius cavirostris Cuvier's beaked whale	Horswill and Jackson 2012

Records of Cetaceans in the Waters of Samoa	
Balaenoptera acutorostrata 'Minke-like' whale	Ward et al. 2006, Samoa SOE 2013
Balaenoptera edeni Bryde's whale	SPWRC 2002, 2004
Megaptera novaeangliae Humpback whale	Paterson 2001, Paton and Gibbs 2002, Noad et al. unpub., Ward et al. 2006, Ward and Asotasi 2007
Globicephala macrorhynchus Short-finned pilot whale	Paton and Gibbs 2002, Childerhouse 2005
Grampus griseus Risso's dolphin	SPWRC 2002, 2004
Lagenodelphis hosei	SPWRC 2004

Fraser's dolphin	
Orcinus orca Orca	Miyashita et al. 1995
Peponocephala electra Melon-headed whale	SPWRC 2004, SPWRC 2009
Pseudorca crassidens False killer whale	Paton and Gibbs 2002, Noad et al. unpub.
Stenella coeruleoalba Striped dolphin	SPWRC 2004
Stenella longirostris Spinner dolphin	Paton and Gibbs 2002, Childerhouse 2005, Noad et al. unpub., Ward et al. 2006, Ward and Asotasi 2007, Ward et al. 2008
Steno bredanensis Rough-toothed dolphin	SPWRC 2004, Childerhouse 2005
Tursiops sp. Bottlenose dolphin	Bourke and Powell 2004, UNEP-WCMC 2003, SPWRC 2004, Childerhouse 2005
Kogia sima Dwarf sperm whale	Olavarría et al. 2005, Samoa Stranding Database 2006
Physeter macrocephalus Sperm whale	Townsend 1935, SPWRC 2004, Ward et al. 2008
Mesoplodon densirostris Blainville's beaked whale	Samoa SOE 2013
Ziphius cavirostris Cuvier's beaked whale	Samoa Stranding Database 2006
Unconfirmed Species	
Balaenoptera sp., Minke whale (Kasamatsu et al. 1995 *in* Paton and Gibbs 2002) *Mesoplodon* sp., Beaked whale sp. (Olavarría et al. 2005)	

Records of Cetaceans in the Waters of Solomon Islands	
Balaenoptera musculus Blue whale	Ohsumi and Shigemune 1993 *in* Shimada and Pastene 1995

Balaenoptera omurai *Omura's whale*	Oremus et al. 2011
Globicephala macrorhynchus Short-finned pilot whale	Shimada and Pastene 1995, Kahn 2004
Grampus griseus Risso's dolphin	Shimada and Pastene 1995, Kahn 2004
Lagenodelphis hosei Fraser's dolphin	Shimada and Pastene 1995
Orcaella heinsohni Snubfin dolphin	Hill 1989 *in* Kahn 2004, Bass 2009
Orcinus orca Orca	Shimada and Pastene 1995, Kahn 2004
Peponocephala electra Melon-headed whale	Shimada and Pastene 1995
Pseudorca crassidens False killer whale	Dawbin 1972, Shimada and Pastene 1995
Stenella attenuata Pantropical spotted dolphin	Dawbin 1972, Shimada and Pastene 1995, Kahn 2004
Stenella coeruleoalba Striped dolphin	Dawbin 1972, Takekawa 1996
Stenella longirostris Spinner dolphin	Shimada and Pastene 1995, Kahn 2004
Steno bredanensis Rough-toothed dolphin	Dawbin 1972, Kahn 2004
Tursiops sp. Bottlenose dolphin	Kahn 2004, Kurihara and Oda 2007, Oremus et al. 2015a (*Tursiops aduncus*)
Physeter macrocephalus Sperm whale	Berzin 1972, Shimada and Pastene 1995

Unconfirmed Species
Balaenoptera sp., Bryde's-like whale (Miyazaki and Wada 1978, Ohsumi 1981) *Balaenoptera* sp., Bryde's-like whale (Shimada and Pastene 1995, Reeves et al. 1999) *Delphinus* sp., Common dolphin (Dawbin 1972) *Megaptera novaeangliae,* Humpback whale (UNEP-WCMC 2003) *Mesoplodon densirostris,* Blainville's beaked whale (Dawbin 1974) *Ziphius cavirostris,* Cuvier's beaked whale (Dawbin 1974)

Records of Cetaceans in the Waters of Tokelau	
Physeter macrocephalus Sperm whale	Dufault and Whitehead 1995
Unconfirmed Species	
Orcinus orca, Orca (Miyashita et al. 1995)	

Records of Cetaceans in the Waters of Tonga	
Balaenoptera acutorostrata subsp. Dwarf minke whale	SPWRC 2004
Balaenoptera bonaerensis Antarctic minke whale	SPWRC 2002 and 2004
Balaenoptera borealis *Sei whale*	D. Donnelly, pers. comm.
Balaenoptera musculus Blue whale	Balcazar et al., 2015
Megaptera novaeangliae Humpback whale	Dawbin 1964, Eldredge 1991, Paterson 2001, SPWRC 2002, Olavarria et al. 2003, SPWRC 2004, Eriksen et al. 2005
Delphinus delphis Common dolphin	SPWRC 2009
Feresa attenuata Pygmy killer whale	SPWRC 2004
Globicephala macrorhynchus Short-finned pilot whale	Hoyt 2001, SPWRC 2004

Grampus griseus Risso's dolphin	SPWRC 2004
Orcinus orca Orca	Visser and Bonoccorso 2003, SPWRC 2004
Peponocephala electra Melon-headed whale	SPWRC 2004
Pseudorca crassidens False killer whale	Reeves et al. 1999, SPWRC 2004, Childerhouse 2005
Stenella attenuata Pantropical spotted dolphin	SPWRC 2004
Stenella longirostris Spinner dolphin	UNEP-WCMC 2003, SPWRC 2004, SPWRC 2008
Tursiops sp. Bottlenose dolphin	SPWRC 2004
Physeter macrocephalus Sperm whale	Dufault and Whitehead 1995, SPWRC 2004
Unconfirmed	
Steno bredanensis, rough-toothed dolphin (L. Eyres, pers. comm.)	

Records of Cetaceans in the Waters of Tuvalu	
Balaenoptera sp. 'Minke-like' whale	Childerhouse and Wheeler 2008
Orcinus orca Orca	Miyashita et al. 1995, Childerhouse and Wheeler 2008
Stenella attenuata Pantropical spotted dolphin	UNEP-WCMC 2003, Oremus et al. 2007b
Stenella longirostris Spinner dolphin	Oremus et al. 2007b
Tursiops sp. Bottlenose dolphin	Anon. 2006, Watson 2006

Kogia sp. Diminutive sperm whale	Oremus et al. 2007b
Physeter macrocephalus Sperm whale	Berzin 1972, SPWRC 2008
Unconfirmed	
Pseudorca crassidens, false killer whale, V. Iese, pers. comm. *Ziphiid* sp., beaked whale, V. Iese, pers. comm.	

Records of Cetaceans in the Waters of Vanuatu	
Megaptera novaeangliae Humpback whale	Dawbin 1964, SPWRC 2004
Globicephala macrorhynchus Short-finned pilot whale	Rancurel 1973, SPWRC 2004
Orcinus orca Orca	C. Garrigue pers. comm.
Peponocephala electra Melon-headed whale	Rancurel 1973, SPWRC 2004
Stenella attenuata Pantropical spotted dolphin	SPWRC 2004
Stenella longirostris Spinner dolphin	Delcloitre 1995, SPWRC 2004
Tursiops sp. Bottlenose dolphin	Reeves et al. 1999
Physeter macrocephalus Sperm whale	Berzin 1972, SPWRC 2004
Unconfirmed Species	
Balaenoptera sp., Bryde's-like whale (Ohsumi 1978, Ivashin 1980) *Stenella coeruleoalba,* Striped dolphin (UNEP-WCMC 2003)	

Records of Cetaceans in the Waters of Wallis and Futuna	
Megaptera novaeangliae	C. Garrigue pers. comm.

Humpback whale	
Unconfirmed Species	
Physeter macrocephalus, Sperm whale (Berzin 1972)	