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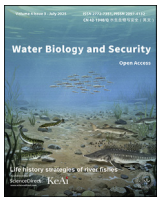

Review

An updated range-wide assessment of *Neophocaena*: Threats and priorities for research and conservation

Tishma Patel [a,*], John Y. Wang [b,d], Denise Greig [c], Ellen Hines [a]

[a] Estuary and Ocean Science Center and Department of Geography and Environment, San Francisco State University, Tiburon, CA, USA
[b] CetAsia Research Group, Thornhill, Ontario, Canada
[c] California Academy of Sciences, CA, USA
[d] Trent University, Peterborough, Ontario, Canada

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ABSTRACT

The genus *Neophocaena* includes two species, the Indo-Pacific finless porpoise (*N. phocaenoides*) and the Narrow-ridged finless porpoise (*N. asiaeorientalis*). The Indo-Pacific species is found in coastal waters from the Persian Gulf through south and southeast Asia to as far north as the Taiwan Strait. The Narrow-ridged finless porpoise ranges from the Taiwan Strait to the waters of northern China, Korea, and Japan. Within *N. asiaeorientalis* there are two subspecies, the Yangtze finless porpoise (*N. a. asiaeorientalis*), found in the Yangtze River and adjoining lakes in China, and the East Asian finless porpoise (*N. a. sunameri*), found in coastal marine waters of China (including Hong Kong and Taiwan), Korea, and Japan. In 2019, an international workshop was held on finless porpoise research and conservation. Participants shared that, in many regions, information on distribution, abundance and population structure is lacking or inadequate. A global assessment of research is critical to provide a basis for conservation planning. Anthropogenic activities (i.e., habitat degradation, pollution, etc.) are known threats, with fisheries bycatch the primary threat throughout the known distribution of finless porpoises. To conserve these cetaceans, research priorities include studies of abundance and distribution, habitat and ecology, fisheries-related mortality, increased public awareness, and bycatch mitigation.

1. Introduction

Finless porpoises (*Neophocaena* spp.) are elusive and, like other small cetaceans, threatened by anthropogenic activities (Reeves et al., 1997; Jefferson and Hung, 2004). Like other members of the porpoise family, they are especially vulnerable to bycatch (Jefferson and Curry, 2004). This paper provides an updated summary on the ecology of, habitat use by, and threats to *Neophocaena* spp. (Reeves et al., 1997), based on available literature with additional information from regional scientists and managers on current research, recommendations for additional research, and local conservation management needs.

1.1. The Finless Porpoises

There are two recognized species of finless porpoises, the Indo-Pacific finless porpoise (*N. phocaenoides*) and the Narrow-ridged finless porpoise (*N. asiaeorientalis*). Within *N. asiaeorientalis* there also are two subspecies, the Yangtze finless porpoise (*N. a. asiaeorientalis*) and the East Asian finless porpoise (*N. a. sunameri*) (Jefferson and Wang, 2011). Generally, finless porpoises are distributed in riverine and shallow marine waters less than 50 m deep along the coastline from the Persian Gulf throughout Southeast Asia and north along the coasts of China, Korea and Japan. Their habitats overlap with numerous human activities, placing populations at risk of human-caused mortality (Jefferson and Hung, 2004; Amano, 2009; Brownell et al., 2019).

1.2. Indo-Pacific Finless Porpoise

The distribution of the Indo-Pacific finless porpoise ranges from the Persian Gulf eastward throughout the Indian Ocean and Indo-Malay region, to Indonesia and northwards to the Taiwan Strait and central Chinese waters (Jefferson and Hung, 2004; Amano, 2009; Wang et al., 2008; Wang and Reeves, 2017b). Its distribution coincides with some of the highest concentrations of human populations and is assumed to be considerably impacted by anthropogenic activities (e.g., bycatch, coastal development, and habitat degradation) (IWC, 2006; Wang and Reeves,

* Corresponding author.
E-mail address: patel.tishma@gmail.com (T. Patel).

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2017b). There are insufficient data on the species' population trends throughout its distribution, however an inferred decline of approximately 30% over three generations (around 45 years) qualified the species to be categorized as "Vulnerable" under the IUCN Red List criteria (Wang and Reeves, 2017b).

1.3. Narrow-ridged finless porpoise

The Narrow-ridged finless porpoise is found in the coastal waters of the western Pacific Ocean from the Taiwan Strait to the waters of northern China, Korea, and Japan (Reeves et al., 1997; Reeves et al., 2003; Wang et al., 2008; Wang and Reeves, 2017a). Throughout its range, data are insufficient to make a quantitative assessment on the species' population trends; many areas are un-surveyed contributing to the lack of data. However, two subpopulations have abundance estimates showing declines of over 50% in less than three generations (Wang and Reeves, 2017a, pg. 1). In the Yellow Sea near Korea, there is an estimated decline of approximately 70% between 2000-2011 (Park et al., 2015; Wang and Reeves, 2017a). This decline coupled with increasing human populations and the threats this species faces throughout its range meets the threshold of IUCN Red List criteria for "Endangered" (Wang and Reeves, 2017a).

1.3.1. East Asian finless porpoise

The East Asian finless porpoise (*N. a. sunameri*) inhabits marine coastal waters from the Taiwan Strait to the coastal waters of northern China, Korea and Japan and as with *N. asiaeorientalis,* there are insufficient data pertaining to its population trends (Jefferson et al., 2011; Wang et al., 2017a). Throughout this subspecies' range, human populations are increasing with anthropogenic activities expected to intensify in and adjacent to their habitat, especially fishing with increased risk of bycatch (IWC, 2006; Wang and Reeves, 2017a). Populations are suspected to be in decline due to decreasing sightings from surveys conducted in some areas of their range (Jefferson and Wang, 2011; Hao et al., 2020; Cheng et al., 2021). There are insufficient data for an IUCN Red List assessment for this subspecies, however, because it is a subspecies of the endangered narrow-ridged finless porpoise, it is also listed as "Endangered" (Jefferson and Wang, 2011; Wang and Reeves, 2017a).

1.3.2. Yangtze finless porpoise

The Yangtze finless porpoise is currently distributed in the middle-lower Yangtze River and its two adjoining lakes, Poyang and Dongting, in eastern China and is the only subspecies of *N. asiaeorientalis* found solely in freshwater (Wang, 2009; Wang et al., 2013; Mei et al., 2019). In the early 1990s, the estimated total abundance was approximately 2700 individuals (Reeves et al., 1997; Mei et al., 2012). By 2006, the population declined to approximately 1225 individuals (Zhao et al., 2008; Mei et al., 2014), then to approximately 1040 individuals by 2012 (of which 505 inhabited the main river system), and to 1012 by 2017 (with 445 individuals in the main river system, 457 individuals in Poyang Lake, and 110 individuals in Dongting Lake) (Mei et al., 2014; Huang et al., 2020). Between 1990 and 2007, the populations within the main Yangtze channel declined at an average rate of 6.4% yr^{-1} (Wang et al., 2013). Extrapolating this population's decline from 1990-2040 yielded a 92.4% reduction in numbers, therefore the Yangtze finless porpoise meets the threshold for "Critically Endangered" under the IUCN Red List criteria (Wang et al., 2013).

1.4. Current threats

The main threats to finless porpoise populations have been identified as bycatch, oil and gas exploration, sand extraction, overall development (e.g., coastal, domestic, and industrial), pollution, and noise and vessel traffic (Reeves et al., 1997; Jefferson and Hung, 2004; Wang et al., 2013; Wang and Reeves, 2017a, 2017b). The increasing human population is placing continuing pressures on natural resources, especially within the habitat of finless porpoise populations (Reeves et al., 1997; Jefferson and Hung, 2004; Amano, 2009; Wang et al., 2013; Wang and Reeves, 2017a, 2017b). Fresh, brackish and marine waters are being transformed at a rapid rate to serve human economic interests while compromising the health of wildlife populations (Reeves et al., 1997; Perrin et al., 2005; Hines et al., 2015).

Incidental entanglement in non-selective fishing gear is a major threat to small cetaceans globally, including finless porpoises, and is regarded as one of the biggest global conservation threats to marine mammal populations (Reeves et al., 1997; Reeves et al., 2003; Jefferson and Curry, 2004; Perrin et al., 2005; Amano, 2009; Wang et al., 2013; Wang and Reeves, 2017a; Wang and Reeves, 2017b; Nelms et al., 2021). In coastal communities throughout their distribution, incidental catch and mortality of finless porpoises are known to occur in a wide range of active and passive fishing gear and pose a significant risk to populations (IWC, 2006; Read et al., 2006; Hines et al., 2015; Gray and Kennelly, 2018). Few estimates of the magnitude of the bycatch exist for most of the finless porpoise distribution with the exception of Hong Kong SAR (Collins et al., 2005; Braulik et al., 2010; Mansur et al., 2012; Wang et al., 2013; Wang and Reeves, 2017a, 2017b).

In this paper, we summarize the known threats affecting finless porpoise populations throughout their range. We identify data-deficient geographic areas where the risk is not known. In the geographic areas with some information, we identify which are posing the greatest risk to the populations. Uncited comments in the Results and Discussion sections are based on notes from a workshop held in 2019 including participant presentations, discussions, and post-workshop follow-up with some participants.

2. Methods

In 2019, an international workshop was held with 30 scientists presenting research from a large proportion of the known ranges of both species of finless porpoises (*Neophocaena* spp.) (Table 1). Scientists discussed research, management and conservation efforts regarding known finless porpoise populations from various geopolitical areas. The workshop consisted of presentations from invited delegates (Table 2), breakout sessions, and plenary discussions. The main issues and threats concerning finless porpoises were identified to be: (i) bycatch, (ii) a lack of standardized research protocols, and (iii) poorly funded and understaffed management and conservation planning. These topics were first discussed in breakout groups and then reviewed by all workshop participants together. We compiled all available information from the workshop and conducted a comprehensive literature search on finless porpoise distribution from west to east, habitat criteria and ecology, bycatch and other threats (i.e., habitat degradation, pollution, vessel traffic, etc.). For areas where published information in English was limited, we solicited assistance from local researchers for data regarding past and current research, threats to finless porpoises, and information on conservation and management programs. From all the available information obtained, we have generated an updated range-wide assessment on these species, including recommended actions for conservation planning.

3. Results

3.1. The Middle East

3.1.1. The Persian Gulf

Of the eight nations whose coastlines surround the Persian Gulf, there is published information on finless porpoises from Iran and the United Arab Emirates (UAE), specifically the Emirate of Abu Dhabi, (Braulik et al., 2010; Díaz López et al., 2021; Natoli et al., 2024). No data were available from Bahrain, Iraq, Kuwait, Oman, Qatar, or Saudi Arabia.

Table 1
Summary of threats to Indo-Pacific finless porpoise and Narrow-Ridged finless porpoise populations throughout their distribution from west to east.

Region	Bycatch	Oil/ Gas	Sand Extraction	Development	Pollution	Noise	Vessel Traffic	References
The Persian Gulf	Yes	Yes	No	Yes	Yes	Yes	Yes	Jefferson and Curry (1994); FAO, 2005; Braulik et al. (2010); Owfi et al. (2015); Díaz López et al. (2021)
Pakistan	Yes	Yes	No	Yes	Yes	Yes	Yes	Pilleri and Gihr (1972); Gore et al. (2012); Ali and Dinshaw (2016); Anderson et al. (2020); Shahid et al. (2016)
India	Yes	No	No	Yes	Yes	Yes	Yes	Yousuf et al. (2009); Kumarran (2012); Jeyabaskaran et al. (2016); Sule et al. (2016); Jog et al. (2017)
Bangladesh	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Islam (2003); FAO, 2010; Mansur et al. (2012); Smith et al. (2015); WCS Bangladesh, 2021
Myanmar	Yes	Yes	Yes	Yes	Yes	No	Yes	Mohan (1994); Tun (2006); Smith and Tun, 2008; Wang and Reeves (2017b); Altherr and Hodgins (2018); Hte et al. (2023)
Thailand	Yes	No	No	Yes	Yes	Yes	Yes	Perrin et al. (2005); FAO, 2009; Junchompoo et al. (2013); Hines et al. (2015); Mustika et al. (2017)
Cambodia	Yes	No	Yes	Yes	Yes	No	Yes	Beasley et al. (2001); Beasley and Davidson (2007); Hines et al. (2015); Smith et al. (2014)
Vietnam	Yes	No	No	Yes	Yes	Yes	Yes	Smith et al. (2016); Smith et al. (2003); FAO, 2005; Perrin et al. (2005); Pham et al. (2014); Hines et al. (2015)
Malaysia	Yes	Yes	No	Yes	Yes	Yes	Yes	Perrin et al. (2005); Peter et al. (2015); Hines et al. (2015); Rajamani et al. (2018); Ali et al. (2023); Rajamani et al. (2023)
Indonesia	Yes	Yes	No	Yes	Yes	Yes	Yes	Perrin et al. (2005); FAO, 2014; Hines et al. (2015); Sahri et al. (2020); Mustika et al. (2021)
Brunei	Yes	Yes	No	Yes	Yes	Yes	Yes	Beales, 1982; Brunei Darussalam Fisheries Statistic in Brief, 2018; Ruangsivakul et al., 2007
China (including Hong Kong and Taiwan)	Yes	No	Yes	Yes	Yes	Yes	Yes	Zhou and Wang (1994); Parsons and Jefferson (2000); Cheung and Sadovy (2004); Hung et al. (2006); Moon et al. (2010); Turvey et al. (2013); Wang et al. (2013); Hines et al. (2015); FAO, 2017; Mei et al. (2019); Phelps Bondaroff (2020); Cheng et al. (2021); Fang et al. (2023); Hao et al. (2023); Xie et al. (2024)
Korea	Yes	No	No	Yes	Yes	Yes	Yes	Kang and Phipps (2000); FAO, 2001; Moon et al. (2010); MacMillan and Han (2011); Tatar, 2014; Park et al. (2015); Jeong et al. (2016); Altherr and Hodgins (2018); Lee, 2019; Lee et al., 2019b; Jeong et al. (2020); Kim et al. (2020); Jeong et al. (2024); Lee et al. (2024)
Japan	Yes	No	Yes	Yes	Yes	Yes	Yes	Shirakihara et al. (1993); Kasuya et al. (2002); Shirakihara et al. (2008); Shirakihara and Shirakihara (2013)

Table 2
Checklist of major fishery gear types found throughout finless porpoises' distribution from west to east.

Region	Gillnets	Stow Nets	Trawl Nets	Seine Nets	Hook and Line	Set nets	Long Lines	Traps	Lift/ Push Nets	Kelongs	Fish Stakes	Ring Nets	Purse Nets	Small Handheld Gear
The Persian Gulf	x													
Pakistan	x		x											
India	x		x	x										x
Bangladesh	x		x			x	x							
Myanmar	x		x	x			x							
Thailand	x		x	x										
Cambodia	x		x	x		x								
Vietnam	x		x				x	x	x					
Malaysia	x		x							x	x			
Indonesia	x		x	x					x					
Brunei	x				x	x		x				x		
China (including Hong Kong and Taiwan)	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Korea	x	x	x			x								
Japan	x		x			x								

3.1.1.1. Historic Distribution and Habitats. In Iranian waters, there are two distinct habitats; the warm, shallow and semi-enclosed waters of the Persian Gulf, and the more exposed and deeper waters of the Gulf of Oman (Preen, 2004; Collins et al., 2005; Braulik et al., 2010). Throughout the Persian Gulf, Indo-Pacific finless porpoises are thought to be uncommon (Preen, 2004). Early records from 1960s to 1970s reported sightings of live finless porpoises during boat surveys within the Persian Gulf and the Strait of Hormuz. More recently, however, many of the animals reported in this region were bycaught or deceased stranded individuals with rare live sightings (Reeves et al., 1997; Preen, 2004; Collins et al., 2005; Braulik et al., 2010). Overall, there is a lack of information on marine mammal species inhabiting coastal waters within this region.

3.1.1.2. Current Research. Currently, there is no specific research being conducted on finless porpoises. Most live sightings of individuals are bycatch or stranding cases and overall information on cetaceans is data deficient (Natoli et al., 2024; B. Díaz López and N. Mohsenian pers. Comm.). In 2012, the UAE Dolphin Project Initiative began with the intention of gathering data on cetaceans to support conservation measures. Two surveys were conducted, one from 2013-2014 and another from 2021-2022. The first survey confirmed the presence of finless

porpoises and the second survey was a boat-based survey using passive acoustic monitoring and analysis of stomach contents from stranded cetaceans (Natoli et al., 2024). In 2021, a stranding response program was launched by the Sharjah Environment Protected Areas Authority to collect data on cetaceans to further inform and educate the public on the importance of conservation (Natoli et al., 2024).

3.1.1.3. Bycatch. Iran has the largest fishing fleet in the Persian Gulf (FAO, 2005; Braulik et al., 2010; Owfi et al., 2015). As demand for marine resources increases with the growing human population, fisheries using techniques and gear known to adversely affect and cause mortality to finless porpoises, such as fixed and drift gillnets (Jefferson and Curry, 1994; FAO, 2005; Braulik et al., 2010), have also expanded. Along the southern coast of the Persian Gulf, stranded finless porpoises that were recorded from 2004-2007 showed signs of gillnet entanglement (Braulik et al., 2010). In Iranian waters, there are nine known records of incidental mortality due to fishing gear (Owfi et al., 2015). In Abu Dhabi, there is no information on cetacean bycatch (Díaz López et al., 2021).

3.1.1.4. Other Threats. The Persian Gulf is a potentially stressful environment for cetaceans due to human impacts, especially increasing coastal development (Price, 1993; Collins et al., 2005). A major anthropogenic issue within the Gulf is oil pollution. The Strait of Hormuz is one of the busiest shipping lanes in the world with about 25,000 tankers sailing through annually, carrying approximately 60% of the world's oil (Braulik et al., 2010; Sheppard et al., 2010). Annually, about two million barrels of oil are discarded through routine discharge of ballast water and tank washing (Sheppard et al., 2010). In addition, there have been multiple oil spills, including the Gulf War Oil Spill, which was the world's largest oil spill in 1991 (Braulik et al., 2010). The Persian Gulf has approximately 800 offshore oil-gas platforms with 25 key oil depots (Sheppard et al., 2010). Under normal oil extraction operations, tons of oil can be released into the surrounding waters, which can affect marine mammal health and behavior (i.e., loss of prey, consuming contaminated prey, dispersants, etc.) (Braulik et al., 2010; Sahri et al., 2021). Oil exposure, via inhalation, ingestion, and contact with skin, has been shown to impact small cetacean reproduction, immunity, respiratory function and the stress response (Smith et al., 2016; De Guise et al., 2017; Takeshita et al., 2017). Oil extraction and transportation activities can negatively affect cetaceans and their prey and contribute to habitat degradation. Coastlines are heavily contaminated with oil residue, trace metals and tar balls, which likely affect key nearshore habitats of finless porpoises (Collins et al., 2005; Sheppard et al., 2010).

Infilling, dredging, and the conversion of coastal waters to land (i.e., terraforming) is a growing issue and the development of surrounding coastal regions is increasing (Al-Ghadban and Price, 2002; Sheppard et al., 2010). A major development is the construction of new resorts for a growing tourism industry (Braulik et al., 2010). Iran's coastal areas are less developed than other nations in the Persian Gulf. However, if coastal development and reclamation continue at the current pace, they will cause a dramatic decline in finless porpoise habitat and increase their risk of extirpation (Braulik et al., 2010; Owfi et al., 2015).

3.2. South Asia

3.2.1. Pakistan

3.2.1.1. Historic Distribution and Habitats. In Pakistani waters, the Indo-Pacific finless porpoise was historically found near the Indus Delta (Piller and Gihr, 1972) and is still seen in coastal waters, including creeks, mangroves and tributaries (Collins et al., 2005). Pakistan's coastline is under the jurisdiction of two provinces, Balochistan and Sindh (Gore et al., 2012, 2017). The Balochistan coast borders Iran and extends eastward approximately 800 km with predominately large rocky cliffs (Gore et al., 2012, 2017; Ali and Dinshaw, 2016). The Sindh coast continues 250 km eastward to the border with India and generally comprises sandy or muddy shores, creeks, mudflats and mangroves (Gore et al., 2012, 2017; Ali and Dinshaw, 2016). Available data on the distribution of finless porpoises in these provinces are sparse and the majority of the records have been from live sightings or strandings within coastal waters (Collins et al., 2005).

3.2.1.2. Current Research. The Cetacean Conservation Project (CCP), begun in 2005, records sightings of finless porpoises during surveys focused on other species (Gore et al., 2012; Kiani et al., 2013). Currently, there is no published estimate of finless porpoise abundance.

3.2.1.3. Bycatch. Although Pakistan's waters are a part of the Indian Ocean Sanctuary that was established in 1979 to protect species against whaling, the protection does not extend to small cetaceans (Gore et al., 2012; Wang and Reeves, 2017b). Historically, considerable numbers of bycaught finless porpoises, in addition to beach strandings, were found in the Indus Delta annually (Pilleri and Gihr, 1972), and finless porpoises have been sighted in the coastal waters in areas where gillnet and trawl fisheries were present (Gore et al., 2012). Gillnets are favored by artisanal and commercial fisheries in coastal and offshore waters (Ali and Dinshaw, 2016), with approximately 200 artisanal vessels and 620 larger vessels operating in Pakistani waters (Anderson et al., 2020; Shahid et al., 2016). Since 2012, the World Wildlife Fund Pakistan (WWF-Pakistan) launched an observer program to train fishers on safely releasing endangered, threatened and protected species. This program is also raising awareness on the importance of these species and how they are susceptible to becoming bycaught.

3.2.1.4. Other Threats. Industrial development is a major threat to finless porpoise habitat as exemplified by the steel works in the Indus Delta and the expansion of the Karachi Port along the Sindh coastline (Collins et al., 2005). The Karachi Port is one of the busiest ports along South Asia's coastline and is near current major shipping routes (Ali and Dinshaw, 2016). Along the southeastern coast of Balochistan, pollution from dismantling ships releases significant amounts of heavy metals, persistent organic pollutants (POPs), and asbestos into coastal waters (Gore et al., 2012).

Untreated domestic and industrial waste is a major contributor to pollution and is discharged into shallow coastal areas that are important finless porpoise habitats (Collins et al., 2005; Ali and Dinshaw, 2016). Oil spills are another source of pollution. Since the 1980s, there have been two major oil spills affecting Pakistan's coast. In 1984, 700 tons of crude oil were spilled and in 2003, approximately 30,000 tons (Gore et al., 2012). Researchers believe these oil spills may have long-term impacts on finless porpoises, including their displacement from important habitats due to contamination (Alrai and Rizvi, 2005).

3.2.2. India

3.2.2.1. Historic Distribution and Habitats. There are records of sightings, strandings and entanglements of Indo-Pacific finless porpoises in the west, south, and southeast waters of India (Sule et al., 2016). Porpoises have been observed (including strandings) in Gujarat, Goa, Kerala, Karnataka, Tamil Nadu, Pondicherry and Maharashtra (Jeyabaskaran et al., 2016; Jog et al., 2017). Although finless porpoises are commonly found, there is little published research on this species (Kumarran, 2012; Jog et al., 2017).

3.2.2.2. Current Research. Information on distribution and abundance is needed to successfully develop conservation measures for *N. phocaenoides*, although a sizeable amount of information is available from stranding records from local response networks (D. Sutaria pers. comm). The Central Marine Fisheries Research Institute (CMFRI) has cetacean stranding records dating back to the 1800s (Jeyabaskaran et al.,

2016). Since the 1950s, CMFRI has documented approximately 380 stranding cases (Jeyabaskaran et al., 2013; Balaji and Sekar, 2021). Jeyabaskaran et al. (2016), analyzed stranding records from 1800-2016 along the Indian Peninsula, and found a total of 25 species including finless porpoises. Tamil Nadu had most of the finless porpoise strandings (53%), followed by Karnataka and Kerala (16% each) (Jeyabaskaran et al., 2016).

3.2.2.3. Bycatch. Along the coast of India, fishers largely use shore seines, small handheld gear, gillnets, and trawl nets (Yousuf et al., 2009; Kumarran, 2012; Jog et al., 2017). Gillnets are most often used in artisanal fisheries due to their low cost and ease of use with any type of vessel (Kumarran, 2012). Along the southwestern coast of India, approximately 80% of all fisheries gear was from gillnet and trawl fishery operations and entangled finless porpoises have been mostly reported in gillnet fisheries (Yousuf et al., 2009; Sule et al., 2016).

The majority of reports on bycatch come from interviews. Of 143 fishers interviewed along the coast of Sindhudurg, most had a neutral perception (neither positive nor negative) towards finless porpoises (Jog et al., 2017). Many fishers were able to identify finless porpoises from images of stranded mammals but not from images of porpoises in the water. According to respondents, entire pods of six to eight finless porpoises are commonly entangled in fishing gear, especially gillnets, shore seines and trawl nets (Sule et al., 2016; Jog et al., 2017). Fishers also reported that finless porpoise encounters and pod sizes have decreased over the past two decades along India's coast (Sule et al., 2016; Jog et al., 2017). Between 1800-2016, a total of 45 finless porpoises were found bycaught by fishing gear along India's peninsula. In Karnataka, of the 34 individuals that were found, 32 were entangled in gillnets and two in purse seine nets. In Kerala, nine individuals were found in gillnets, one in a dol net from Gujarati and one in a gill net from Tamil Nadu (Jeyabaskaran et al., 2016).

3.2.2.4. Other Threats. Coastal development is rapidly growing along India's coastline where millions of people reside, and the population is steadily increasing as livelihood opportunities expand (Rodriguez and Sridhar, 2010; Sutaria et al., 2015). There is also a rapid growth of industrialization, especially near major ports along the coast (Sutaria et al., 2015; Jeyabaskaran et al., 2016).

Direct takes of finless porpoises for their blubber and meat have been reported. On the west coast of India, for example, an open market for cetacean meat including finless porpoises has been observed (Kumarran, 2012). The meat or skin with attached blubber was used as bait in shark fisheries until the 1960s, and finless porpoise blubber was used to make tallow to waterproof boats (Sule et al., 2016). Demand for tallow decreased with the introduction of cheaper substitutes and the increased use of fiberglass versus wooden boats; however, fishers still use tallow from finless porpoises for wooden beach seine crafts (Sule et al., 2016).

3.2.3. Bangladesh

3.2.3.1. Historic Distribution and Habitats. The Bay of Bengal, bordering Bangladesh, is a tropical ocean basin that is influenced by seasonally reversing currents and freshwater flow from the Ganges-Brahmaputra-Meghna (GBM) Delta (Smith et al., 2008a). Waters are generally shallow with mangroves along the western coast. The first known occurrence of the Indo-Pacific finless porpoise was a stranding case in 1960 (Reeves et al., 1997). Since then, sightings of Indo-Pacific finless porpoises have been recorded within coastal waters, although little is known about their abundance or distribution and few surveys have been conducted (Smith et al., 2008a, 2008b).

3.2.3.2. Current Research. In 2006, the Bangladesh Cetacean Diversity Project (BCDP), initiated by the Wildlife Conservation Society (WCS), was created to study cetaceans in local waters (Fahrni and Mansur, 2012). Since 2006, systematic surveys and research have been conducted on cetacean populations (B. Smith pers comm.). Another program, the Citizen Science Fishermen Safety Network, engages gillnet fishers to become citizen scientists, collecting important information on their catch, bycatch, and fishery operations in exchange for training on increasing their fuel economy, navigational safety, and safe release procedures for marine wildlife (WCS Bangladesh, 2021; B. Smith pers comm.). The data collected are being used to plan marine protected areas and to optimize conservation and the needs of local fishers (WCS Bangladesh, 2021).

3.2.3.3. Bycatch. Bangladesh's coast is dominated by artisanal fisheries (Islam, 2003; FAO, 2010). These fisheries consist of both non-motorized and motorized vessels using gillnets, longlines, set bag nets and trawl nets (FAO, 2010). Nearshore waters are heavily fished by gillnet, trawl net, and set bag net vessels with operations substantially overlapping finless porpoise habitat (Mansur et al., 2012; Smith et al., 2015). Observations of small cetaceans foraging near these fishery operations have been reported (Mansur et al., 2012). In 2007, a database was created to record annual cetacean mortality and six finless porpoise deaths were recorded between 2007-2020.

3.2.3.4. Other Threats. Finless porpoises in the Bay of Bengal are also threatened by various pollutants. The major sources of pollution are from domestic and industrial wastes and oil pollution (Islam, 2003). Domestic waste treatment facilities are lacking and effluent from industries (i.e., industrial, agricultural and municipal) are directly, or indirectly, discharged into rivers and coastal waters (Islam, 2003). Oil exploration is expanding into finless porpoise habitats in Bangladesh's waters: there are currently 26 shallow and deep-sea areas in the Exclusive Economic Zone approved for exploration (WCS Bangladesh, 2021). Since 1980, ship dismantling operations have increased to meet the nation's demands for raw materials (Islam, 2003; Hussain and Hoq, 2010). Metal fragments, crude oil, and other chemical wastes are discharged during these operations affecting crucial finless porpoise habitats (Islam, 2003; Hussain and Hoq, 2010).

3.3. Southeast Asia

3.3.1. Myanmar

3.3.1.1. Historic Distribution and Habitats. The Indo-Pacific finless porpoise inhabits coastal waters and into the Sittaung River (Smith et al., 2008a; Hines et al., 2015; Hte et al., 2023). In-depth surveys of Myanmar's coastal regions are sparse, largely due to a lack of financial resources. Finless porpoises have been sighted in shallow waters in the Myeik Archipelago, located in Southern Myanmar (Smith and Tun, 2008).

3.3.1.2. Current Research. Before 2018, no surveys were conducted in the Gulf of Mottama (Holmes et al., 2014; Hte et al., 2023). During the Gulf of Mottama Project (GoMP), researchers learned from local fishers that small ceteaceans were regularly seen as they fished, which prompted researchers from the Myanmar Coastal Conservation Lab (MCCL) to conduct local ecological knowledge (LEK) interviews within villages along the Gulf of Mottama. These surveys, along with rapid bycatch assessment (RBA) surveys, indicated that sightings of porpoises in the area potentially extended up to the Sittaung River and that their group sizes have decreased over time. Habitat change resulting from erosion and bycatch were thought to have caused the decline in numbers (Hte et al., 2023). In 2018–2019, the first boat-based surveys were conducted from the LEK and RBA interviews confirming the presences of finless porpoises. The GoMP expanded the scope of their research and conservation efforts for monitoring populations, including implementing an acoustic monitoring program for finless porpoises in the Gulf of Mottama

(Hte et al., 2023). In 2022, a pilot acoustic monitoring program was inititated for finless porpoises using full waveform capture porpoise detectors F-PODs to monitor their use of echolocation indicating their presence. With participation from fishers, these devices were deployed for six-week intervals throughout the year (Hte et al., 2023). The MCCL is also focusing on community engagement to raise awareness of marine mammal conservation efforts. This includes collaborating with local communities by training locals on how to conduct boat-based surveys, to identify marine mammals, publish stories based on fishers' experiences, and conducting marine mammal stranding response training (Hte et al., 2023). The MCCL will continue monitoring the Gulf of Mottama and, in collaboration with the GoMP and other local conservation groups, will continue raising community awareness (Hte et al., 2023).

3.3.1.3. Bycatch. The coastal waters are heavily fished with various gear types (long lines, beach seine nets, stern trawlers, set bag nets, and purse seine nets), with gillnets including trammel nets being extensively used by both artisanal and commercial fisheries (Mohan, 1994; Smith and Tun, 2008; Hte et al., 2023). Concentrations of gillnetters are significant in coastal waters with many operating within finless porpoise habitats (Smith and Tun, 2008). According to fisher interviews, most bycatch occurs during nearshore fishing. The magnitude of bycatch is unknown, but fishers report that entanglements of cetaceans are common (Tun, 2006). In late 2018 through early 2019, opportunisitc boat-based surveys and a pilot line transect survey were conducted in the Gulf of Mottama, mostly within small-scale fisheries showcasing finless porpoises feeding close to fishing gear (Hte et al., 2023). In the LEK and RBA interviews, researchers recorded a total of 132 bycaught animals, of which 44 were finless porpoises. Finless porpoises were found to be bycaught more in both nearshore and offshore fishing areas in Zee Gone and Kyauk Seik villages (Hte et al., 2023). In Maungmagan, dolphins and finless porpoises are sold for consumption at local fish markets. Consumption of finless porpoises appears to be concentrated in local communities (Tun, 2006). Fish sellers have reported almost thirty small cetaceans sold monthly; this would correspond to hundreds of small cetaceans sold annually within Maungmagan and surrounding areas. (Tun, 2006; Altherr and Hodgins, 2018).

3.3.1.4. Other Threats. Offshore oil and gas exploration is rapidly increasing since the economy opened to foreign investment (Smith et al., 1997). Off the coast of Myanmar, there are approximately 14 offshore oil companies operating in 28 offshore blocks for exploration and extraction (Holmes et al., 2014; Hines et al., 2015).

Myanmar is also a major exporter of sand for the construction industry. Sand is extracted from beaches and rivers for domestic use and exported to support coastal development in Asia (Lamb et al., 2019). Dredgers extract sand from coastal and riverine areas, which affects the morphology and contributes to erosion and habitat degradation (Lamb et al., 2019; Hübler, 2021). The magnitude of these operations is limited, but the detrimental effects of directly altering the physical environment are a major concern regarding declining biodiversity in finless porpoise habitats (Hübler, 2021).

3.3.2. Thailand

3.3.2.1. Historic Distribution and Habitats. In the Andaman Sea and the Gulf of Thailand, sightings and strandings of the Indo-Pacific finless porpoise have been reported from coastal waters (Chantrapornsyl et al., 1996; Hines et al., 2015). Live sightings of finless porpoises are sparse, and most records are from stranding cases (Junchompoo et al., 2013).

3.3.2.2. Current Research. Since 1993, cetacean research has been conducted regularly by the Phuket Marine Biological Center (PMBC) and other coastal research centers affiliated with the Department of Marine and Coastal Resources (DMCR) (Adulyanukosol et al., 2012). Most finless porpoises are examined or necropsied once they have stranded (C. Junchompoo pers. comm.). For the past 10 years, the PMBC has been collecting cetacean stranding data, although the cause of death is often difficult to determine. Entanglement in gillnets has been documented from stranded porpoises throughout Thailand (Adulyanukosol et al., 2012). Stomach contents from stranding cases have been collected to identify prey and determine how much overlap there is between fishery operations and cetacean foraging. Stomach content analysis has shown that in the eastern Gulf of Thailand, finless porpoises eat shrimp and squid, and in other parts of the Gulf their prey is mostly small fish (C. Junchompoo pers. comm.).

3.3.2.3. Bycatch. In the Gulf of Thailand, fishing is the main livelihood for many coastal communities (Junchompoo et al., 2013; Mustika et al., 2017). Thai fisheries are primarily artisanal and use gillnets, small trawls, purse and trap seines (Perrin et al., 2005; FAO, 2009; Junchompoo et al., 2013). Among strandings collected nation-wide from 2002-2012, 683 cetaceans were found stranded from both the Andaman Sea and the Gulf of Thailand; finless porpoises were one of the most frequently recorded species (Hines et al., 2015). Cause of death was determined for 25% of the cases, and in approximately 13% of those cases, fishing gear was determined to be the cause of death (Hines et al., 2015).

3.3.2.4. Other Threats. Thailand's coastline has been developing rapidly (Lunn and Dearden, 2006), and tourism, industrialization, and aquaculture are major concerns (Perrin et al., 2005). Domestic and industrial waste from this development is a significant contributor to pollution discharged into finless porpoise habitats (Janekitkosol et al., 2003; Hines et al., 2015).

Tourism in the southwestern Gulf of Thailand is expanding into these coastal habitats (Hines et al., 2015; Mustika et al., 2017). Tour boats are known to approach small cetaceans, and tourists are encouraged to feed the animals (Hines et al., 2015; Mustika et al., 2017). In addition to tourism, vessel traffic is also increasing from fishery operations, shipping, and other recreational activities (Hines et al., 2015; Senigaglia et al., 2019). Vessel traffic could cause changes in porpoise behavior, for example, the increase in underwater noise from increased marine traffic could cause them to move from their key habitats (Hines et al., 2015).

3.3.3. Cambodia

3.3.3.1. Historic Distribution and Habitats. Cambodia's coastal waters are generally shallow with substantial areas of mangroves (Beasley and Davidson, 2007). Research on marine mammals is limited and the first dedicated boat-based surveys on cetaceans were conducted in 2001 (Beasley et al., 2001). The Indo-Pacific finless porpoise was one of the first cetacean species to have its presence confirmed in Cambodia's coastal waters (Beasley and Davidson, 2007). In 2004, aerial surveys sighted groups of finless porpoises along the western coast near Koh Kong (Hines et al., 2004).

3.3.3.2. Current Research. No recent dedicated finless porpoise surveys have been conducted, and currently, cetacean research is focused on other species (S. Phay pers. comm). In 2017, the Cambodian Marine Mammal Conservation Project (CCMP), initiated by Marine Conservation Cambodia, a local NGO, was established to conduct land- and boat-based surveys on marine mammals in coastal waters and highlight the need for conservation planning (Tubbs, 2018; Tubbs et al., 2019).

3.3.3.3. Bycatch. Diverse fishing gear used in Cambodian waters include Spanish mackerel nets (nylon), other gillnets, set nets, purse seine nets and single and pair trawl nets (Beasley et al., 2001; Beasley and Davidson, 2007; Hines et al., 2015). In Cambodian waters, fishing is prohibited in waters shallower than 20 m, yet nearly all fishing operations are conducted nearshore, even in water as shallow as 1–2 m deep (Beasley

et al., 2001; Beasley and Davidson, 2007).

Fishers report occasionally seeing small cetaceans bycaught in gillnets (Beasley et al., 2001). In addition, artisanal fisheries using trawl nets in nearshore waters is destructive to finless porpoise habitats as their nets are pulled along the seabed (Beasley and Davidson, 2007; Smith et al., 2014). Although there are no reports of finless porpoises specifically being caught in the nearshore waters, given what is known about the susceptibility of finless porpoises to fisheries bycatch, it is almost certain that at least some individuals are caught or killed. Unfortunately, the extent of bycatch is unknown, but approximately 50 small cetaceans were reported to be bycaught annually within inshore waters by Beasley et al. (2001).

3.3.3.4. Other Threats. Habitat degradation is a major issue. There has been a significant increase in the human population along Cambodia's coastline (Smith et al., 2014). This increase has placed demands on natural resources and threatens biodiversity. The lack of enforcement of existing fishery regulations, especially those banning trawling in shallow waters, means that negative effects on sea beds and finless porpoise habitats continue unabated (Beasley et al., 2001; Hines et al., 2015). Although some of these fisheries provide resources (food and employment) for the rising population, current levels of overfishing and habitat destruction are not sustainable (Smith et al., 2014).

Cambodia is one of the top ten sand exporters globally. Sand is extracted from the nation's rivers and beaches and is used domestically as well as exported to support Asia's development (Lamb et al., 2019). In 2013, a cetacean survey conducted by Smith et al. (2014) found 106 sand mining dredges and barges in clusters along the coast. In 2014, a second survey was conducted, where 37 sand-mining dredges and barges were documented within coastal waters (Smith et al., 2014). Intensive sand mining contributes to the degradation of key habitats for finless porpoises and their prey and also affects fishery operations (Smith et al., 2014; Lamb et al., 2019).

3.3.4. Vietnam

3.3.4.1. Historic Distribution and Habitats. In Vietnam, the Indo-Pacific finless porpoise is known to occur in coastal waters throughout the country, especially the Beibu Gulf, Southeast and Southwest Vietnam (Smith et al., 1995, 1997; Hines et al., 2015). Few surveys were conducted prior to 1995 (Hines et al., 2015) when Smith et al. (1997), surveyed Vietnamese waters. Additionally, photographs of strandings and skulls found in various temples were determined to be finless porpoises (Smith et al., 1995, 1997).

3.3.4.2. Current Research. In Vietnam, data on finless porpoises are limited, so the status of this species is largely unknown (L. Vu pers. comm.). While there have been few sightings of live finless porpoises, there are several records of strandings and specimens in local whale temples (Smith et al., 1997, 2003). Whale temples are recognized as archives of natural history regarding marine mammals and are found near fishing communities along the central and southern coast (Vu et al., 2020; McGowen et al., 2021). These temples have a long history of traditional practices including festivals and the collection of bones from marine mammals that were either stranded or bycaught (Vu et al., 2020; McGowen et al., 2021). Thus, they provide a source of vital information on cetaceans found in Vietnamese (and nearby) waters and are a tool that can be used in conservation planning (Hines et al., 2015). Among 140 skulls identified in whale temples in central Vietnam in 2019, those of finless porpoises were the most common ($n = 41$, McGowen et al., 2021)

3.3.4.3. Bycatch. Fisheries in Vietnam's waters are extensive and rapidly expanding (Pham et al., 2014). Coastal fisheries make up approximately 83% of Vietnam's total fishing fleet and consist of non-motorized and motorized vessels primarily using gillnet, trawl, longline, lift and push nets, and trap gear (FAO, 2005; Pham et al., 2014). The number of motorized vessels increased from 44,000 in 1991 to 95,000 in 2006, and by 2010 the overall total fleet size was approximately 127,000 vessels (Pham et al., 2014).

The magnitude of bycatch in Vietnam is unknown (Perrin et al., 2005; Hines et al., 2015). In observations recorded by Smith et al. (1997), fishers reported that bycatch of small cetaceans in gillnets would occasionally occur, and fishers consistently reported that individuals were released when found alive. Interviews with fishers indicated gillnets are a major fishing gear threatening small cetaceans, but the extent of bycatch is unknown (Smith et al., 2003; Perrin et al., 2005).

3.3.4.4. Other Threats. Vietnam's coastal zones are developing rapidly and deforestation of mangroves, pollution, mining and construction of dams in rivers are among the major issues (Thanh et al., 2003). Mining has become a significant issue with companies gaining permits to dredge estuaries, waterways and canals, as well as exploiting shoals and mineral deposits (coal, sand, gravel and other heavy minerals) in coastal regions (Thanh et al., 2003). Industrial (production of fertilizers and pesticides) and domestic pollution are transported by rivers into coastal areas where the chemicals accumulate in the sediments to high concentrations (Thanh et al., 2003). Dams were also constructed in these rivers to create reservoirs for irrigation during the dry seasons and for hydroelectric power, affecting freshwater, nutrient, and sediment flow to the coast (Thanh et al., 2003; Campbell and Barlow, 2020).

3.3.5. Indonesia

3.3.5.1. Historic Distribution and Habitats. Historic sightings of the Indo-Pacific finless porpoise have been reported in coastal waters near the southeastern coasts of Sumatra and Java, between the Belitung and Bangka Islands (Rudolph et al., 1997). The Indonesian Archipelago is extensive and consists of approximately 5 million km^2 of territory overall, including land and sea (Kreb and Budiono, 2005; Kreb and Budiono, 2014). A few dedicated studies have been conducted on cetaceans in limited areas, including East Kalimantan, North Sulawesi, Lesser Sunda Islands, West Sumatra and Papua (Kreb and Budiono, 2005; Ender et al., 2014; Hines et al., 2015; Sahri et al., 2021). Finless porpoises were also found to inhabit waters of the entire coastal shelf of west, south and east Kalimantan (Kreb et al., 2005).

3.3.5.2. Current Research. Information on finless porpoises in Indonesia is lacking as only recently have surveys been conducted on cetaceans throughout the archipelago (Kreb, 2019; Sahri et al., 2021). Most of the information regarding finless porpoises comes from opportunistic sightings and strandings data (Kreb, 2019). In East Kalimantan between 2008-2019, nine stranded finless porpoises were examined, however because of the state of decomposition, cause of death could not be determined (Kreb, 2019).

3.3.5.3. Bycatch. Indonesia's marine fisheries consisted of 620,830 vessels in 2012 and artisanal fisheries accounted for approximately 95% of overall fishing activities within the nation's waters (FAO, 2014). Current regulations require fishing vessels to take conservation actions to reduce bycatch of cetaceans. However, with expanded national and foreign fisheries operating in Indonesian waters, the magnitude of bycatch is not well known (Hines et al., 2015; Sahri et al., 2020). In Indonesia's coastal and marine fisheries, gillnets, lift nets, purse seines, seine nets and trawl nets are among the most commonly used gear (Perrin et al., 2005; Hines et al., 2015; Mustika et al., 2021).

3.3.5.4. Other Threats. Throughout Indonesia, oil-gas exploration is rapidly expanding into areas that were previously undisturbed by development (Ender et al., 2014). In East Kalimantan and northwest Papua, significant hydrocarbon reserves overlap with essential small

cetacean habitats (Sahri et al., 2021). Oil spills (and the dispersants used to try to control them) have been known to cause substantial pollution to the marine environment and greatly affect cetaceans through direct (e.g., skin burns, inhalation) and indirect (e.g., loss of prey) exposure (Sahri et al., 2021). These areas are also subject to seismic exploration, which is a significant contributor to anthropogenic noise in the ocean (Sahri et al., 2020). Cetaceans are also exposed to noise produced by vessels (e.g., shipping, recreational, and naval) (Sahri et al., 2021). In Indonesia, there are no regulations on underwater noise, which can lead to strandings and displacement of cetaceans and their prey (Ender et al., 2014; Sahri et al., 2020, 2021).

Areas of high vessel traffic shipping lanes overlap with key small cetacean habitats (Ender et al., 2014; Sahri et al., 2021), which can possibly lead to cetacean displacement (Mustika, 2006). Additionally, vessel traffic is not all concentrated within these shipping lanes as passenger, recreational and fishing vessels occur in other areas (Mustika, 2006; Sahri et al., 2020, 2021).

3.3.6. Malaysia

3.3.6.1. Historic Distribution and Habitats. Indo-Pacific finless porpoises are frequently encountered in coastal waters in Malaysia (Jaaman et al., 2002; Minton et al., 2013). In the waters of Peninsular Malaysia, finless porpoises are found on both the west and east coasts, including the Langkawi Archipelago, Penang Island, and Matang coastline where they are found year-round (Ponnampalam, 2012; Hines et al., 2015; Kimura et al., 2022; Kuit et al., 2019; Rajamani et al., 2023). This species is also found in the coastal waters of Sarawak and Sabah of East Malaysia (Jaaman et al., 2009; Minton et al., 2013, 2016).

3.3.6.2. Current Research. In the waters of Peninsular and East Malaysia, research on finless porpoises has largely focused on collecting data on its distribution, habitat use and preferences, and abundance through distance sampling and boat-based surveys (Minton et al., 2011, 2013; Kuit et al., 2019,2021; Kimura et al., 2022). In 2010, a dedicated research team from the Centre for Marine and Coastal Studies in Penang conducted approximately 30 informal interviews with local fishers to gain baseline knowledge (Rajamani et al., 2018). Between 2012-2014, four boat-based surveys were completed off northern and western Penang coasts. Finless porpoises were observed off western Penang and 16 strandings were documented in both western and northern waters. Several stranded individuals were found missing their flukes which potentially indicates that they may have been entangled in fishing gear and were cut out during distentanglement by fishers (Rajamani et al., 2018). The Department of Fisheries established a National Marine Mammal Stranding Response Network in 2012, but it was not put into operation. However, there are regional networks in Peninsular Malaysia, Sarawak and Sabah, that rely on the public to report events. Most strandings are difficult to reach and individuals are usually badly decomposed by the time researchers arrive, which makes cause of death difficult to determine. Researchers endeavor to obtain as many samples as they can from each case including skin and stomach contents (Regional Marine Mammal Stranding Workshop, 2021; L. Ponnampalam pers. comm.). In 2018–2019, stomach contents that were collected from stranded finless porpoises by the MareCet team in Peninsular Malaysia provided some preliminary information regarding their diet which was comprised mostly of squid and prawn species (Ponnampalam, unpublished data).

Rajamani et al. (2023) completed 240 interviews with the local community along the north-western and western coasts of Penang in 2013. Most sightings of cetaceans came from fishers actively fishing and during boat tours, with sightings of finless porpoises being the least common. A total of only five live sightings and one dead sighting of a floating finless porpoise observed while fishing were recorded. In 2019, researchers conducted a total of 23 boat surveys and observed a total of 39 finless porpoises exhibiting avoidance behaviors, traveling, milling, and others that were undetermined (Rajamani et al., 2023). Another study was conducted with a total of 39 boat-based surveys from 2019-2021 off the west coast of Penang Island. This research was used to study finless porpoise behaviors and how they correlate to their habitat to better understand cetacean occurrence and their interaction with anthropogenic activities (Ali et al., 2023). A total of 35 finless porpoises were sighted, either individually or in groups, in depths less than 15 m along the coast, and these were exhibiting mostly milling behaviors followed by traveling and avoidance behaviors (Ali et al., 2023). The avoidance behaviors were observed when finless porpoises were surrounded other fishing vessels.

3.3.6.3. Bycatch. Artisanal and commercial fisheries are found throughout Malaysian waters (Peter et al., 2015). In Peninsular Malaysia, the magnitude of bycatch is unknown (Hines et al., 2015). However, in Penang and Matang, common gear types that are strongly suspected to affect finless porpoises are gillnets, driftnets, purse seines, trammel, and trawl nets (Kuit and Ponnampalam, 2021; Rajamani et al., 2018; Ali et al., 2023). Kuit and Ponnampalam (2021), conducted 198 interviews with fishers on their perceptions, fishing operations, sightings of small cetaceans, and bycatch. From the interviews, most fishers had a positive perception of small cetaceans and stated that they felt abundances have decreased. During the interviews, however, fishers had difficulty distinguishing finless porpoises from Irrawaddy dolphins during brief encounters due to their small physical differences. Many thought that the decrease in abundance could be from there being fewer cetaceans overall, from the increase in fishery operations, or due to the size of the deployed nets (Kuit and Ponnampalam, 2021). From these interviews, researchers used the Bycatch Risk Assessment (ByRA) toolkit to assess the main bycatch gear types along with areas of high risk of bycatch as a guide for bycatch mitigation planning.

In East Malaysia, artisanal fisheries are mostly gillnets, trawlers, kelongs (fish corrals), trammel nets and fish stakes within finless porpoise habitats (Perrin et al., 2005; Peter et al., 2015; Hines et al., 2015). In this region, gillnets are commonly set at night, with a high likelihood of small cetaceans becoming entangled (Hines et al., 2015). Since the late 1990s, numerous cases of entanglements of small cetaceans have been reported and generally the bycaught cetaceans are deceased (Perrin et al., 2005; Hines et al., 2015).

3.3.6.4. Other Threats. Oil and gas exploration, including seismic surveys, has been increasing within the nation's waters, as have offshore development projects. Companies are moving into previously undeveloped coastal areas in East Malaysia to explore for oil and gas (Hines et al., 2015). Impacts of exploration and development activities include an increase in underwater noise and the discharge of waste during operations into the surrounding waters affecting cetacean populations, their habitat and their prey (Hines et al., 2015).

In East Malaysia, overfishing coupled with destructive fishing gear and development are putting important coastal areas at risk (Teh et al., 2013). In Sabah, many riparian areas have been converted to either urban or agricultural areas causing degradation of coastal marine habitats from pollution, eutrophication and sedimentation, and effluent discharge (Hines et al., 2015).

3.3.7. Brunei

3.3.7.1. Historic Distribution and Habitats. Live sightings and strandings of the Indo-Pacific finless porpoise have been recorded along the coast (Hines et al., 2015). The first known record for this species was a stranding case in 1990, followed by live sightings of two individuals in coastal waters near the previous stranding site (Elkin, 1992). From

1990-2020, there have been 11 confirmed records (live sightings and strandings) of finless porpoises along the western coast of Brunei (Hines et al., 2015; G.S. Ham pers. comm.).

3.3.7.2. Current Research. There have never been systematic surveys of cetaceans and unfortunately this is still the case (G.S. Ham pers. comm.). All records of finless porpoises (sightings and strandings) have been opportunistic and reported by the public. Local researchers are currently working on a survey design and a research proposal to complete boat-based surveys to collect baseline data on the distribution and species composition of cetaceans in Bruneian waters (G.S. Ham pers. comm.).

3.3.7.3. Bycatch. Brunei's fishing area can be divided into four zones from 0 to 200 nautical miles with zone 1 (extending from 0 to 3 nautical miles offshore) exclusively for artisanal fishers using gillnets, trammel nets, ring nets, traps, hook and lines and set bottom nets (Ruangsivakul et al., 2007). Due to gaps in data on fishery activities, estimates of bycatch are not available (Beales, 1982; Ruangsivakul et al., 2007; Brunei Darussalam Fisheries Statistic in Brief, 2018).

3.3.7.4. Other Threats. There are extensive hydrocarbon reservoirs within the nation's waters (Zaini et al., 2020). Petroleum exploration began in 1899 and was concentrated onshore for the first 50 years, followed by an increase in offshore exploration and drilling. The first offshore well was drilled in the late 1950s, and by 1999 there were approximately 75 onshore and 129 offshore wells (Curiale et al., 2000). Oil spills from exploration activities are a major cause of pollution affecting cetaceans, their prey and their habitat (Sahri et al., 2021). Finless porpoises are also subject to seismic exploration activities. Since 1965, seismic exploration has been conducted in the offshore, continental shelf and slope regions (Curiale et al., 2000). These activities contribute to the increase in anthropogenic noise that can lead to cetacean displacement, strandings and injuries (Ender et al., 2014; Erbe et al., 2019; Sahri et al., 2020, 2021).

3.4. East Asia

3.4.1. China

Separate accounts are given within this section for the Mainland, Hong Kong, and Taiwan (Perrin et al., 2005).

3.4.1.1. Mainland

3.4.1.1.1. Historic Distribution and Habitats. From the East China Sea, north to the Yellow Sea and Bohai, the East Asian finless porpoise occurs in coastal waters with a region of overlap with the Indo-Pacific finless porpoise in the Taiwan Strait. The South China Sea is relatively shallow and has important mangrove and coastal wetland habitats for Indo-Pacific finless porpoises (Barros and Jefferson, 2002; Vo et al., 2013). The East China Sea and the Yellow Sea have shallow waters with a large, wide continental shelf. The Bohai Sea has a semi-enclosed continental shelf with a densely industrialized and urbanized coast; these regions are inhabited by the East Asian finless porpoise (Zhao et al., 2018).

In central China, the Yangtze finless porpoise subspecies is found in the middle and lower reaches of the Yangtze River and its two adjoining lakes, Poyang and Dongting. Historically, this subspecies inhabited upstream portions of the Yangtze River to Yichang in Hubei Province and in the Gan Jiang and Xiang Jiang, both respectively leading to Poyang and Dongting lakes (Reeves et al., 1997; Perrin et al., 2005; Zhao et al., 2008; Wang et al., 2013).

3.4.1.1.2. Current Research. Since the early 1980s, abundance surveys have been conducted within the Yangtze River system (Wang et al., 2013; Zhang et al., 2014). Over the years, estimates from the surveys have shown drastic declines in abundance with approximately 1012 individuals within the Yangtze River, Poyang and Dongting Lakes in 2017 (Mei et al., 2014; Huang et al., 2020; Mei et al., 2020; Hao et al., 2023). Due to these declines in abundance, the focus has shifted from research to urgent conservation planning and actions (Mei et al., 2020). Since the 1990s, various *in situ* and *ex situ* reserves have been pursued in an effort to conserve the subspecies. *In situ* reserves are effective when anthropogenic activities on the species and its habitat are simultaneously mitigated and have focused on restoring the Yangtze River, whereas *ex situ* reserves can enhance local populations by reintroducing captive-bred individuals back into their natural habitat using semi-natural reserves (Huang et al., 2017; Wang et al., 2021). In 1990, the Tian-e-Zhou oxbow was the first established *ex situ* reserve, where additional translocations of wild captured finless porpoises along with reproductions increased the population in this reserve from five individuals to 100 by 2021 (Wang et al., 2021; Hao et al., 2023). Because of the success in Tian-e-Zhou, an additional three oxbow reserves were established in 2006, 2015, and 2016, with approximately 150 individuals. In addition to the reserves, there have been spatial-temporal fisheries closures within the Yangtze River (Wang, 2009; Huang et al., 2017; Mei et al., 2020; Wang et al., 2021; Hao et al., 2023). In 2002, an annual three-month closure on all commercial fishing activities by multiple government agencies was initiated, and in 2016 the closure was increased to four months until 2018, when all fishing was banned in China's aquatic biological reserves (Wang, 2009; Huang et al., 2020; Mei et al., 2020). In January 2021, a ten-year ban was implemented on all fishing activities throughout the Yangtze River, its lakes and tributaries (Mei et al., 2020; Wang et al., 2021). Unfortunately, due to the fishing ban, fishers needed to find new livelihoods. Both central and local governments have provided funds that will be used to retrain fishers in different occupations. The governments are also partnering with NGOs to train fishers to become fishery wardens where they will assist law-enforcement agencies in regulating fishing activities (Hao et al., 2023). From 2020-2022, a passive acoustic monitoring study was conducted using C-PODs, autonomous acoustic devices which were deployed at the junction of the Yangtze River and Poyang Lake. C-PODs are used to detect finless porpoise biosonar and collect data on anthropogenic activities and environmental variables (Duan et al., 2023). A total of 834 days of data were extracted from the C-PODs, of which 773 days were found where finless porpoise biosonar signals were detected. Even though detection during those days were in short periods, this showcased that there was still a river to lake migration (Duan et al., 2023). During the COVID-19 lockdown, vessel traffic and noise pollution levels dramatically decreased due to reduced anthropogenic activities, which showed an increase in finless porpoise biosonar behaviors (Duan et al., 2023). A similar study was conducted in Wuhan, China, one of the largest urbanized cities in the region (Wang et al., 2024). but the region is considered data deficient. In 2020–2022, researchers conducted a passive acoustic monitoring study at the Wuhan Marine Affairs Wharf where they deployed a F-POD to detect the presence of finless porpoises and to analyze anthropogenic factors. Data collected from the F-POD had a total of 603 effective monitoring days, of which 257 days were found to have detected finless porpoise biosonar (Wang et al., 2024). Within this study, findings were consistent with Duan et al. (2023), where a decrease in vessel traffic showed an increase in finless porpoise biosonar detections. The ten-year fishing ban, along with the COVID-19 lockdown, may have resulted in an increase in finless porpoise presence in the region, but more studies are needed (Duan et al., 2023; Wang et al., 2024). In the region's marine waters East Asian finless porpoises are data deficient and accurate baseline data about their abundance, population, and ecology are needed (Li et al., 2023). In 2018–2020, boat-based surveys were conducted along the coastline of Shandong Peninsula in the Yellow Sea and researchers recorded a total of 117 sightings. After analyzing the data, researchers estimated the abundance of finless porpoises along the peninsula to be 3978 individuals (Li et al., 2023).

3.4.1.1.3. Bycatch. Within coastal regions, gillnets (fixed and drift), trawl nets, stow nets, purse nets and long lines were reported to be the main gear types used by fishers, with gillnets (fixed and drifting) and trawl nets reported to cause the most entanglements (Zhou and Wang, 1994; FAO, 2017; Cheng et al., 2021). Of the nine small cetacean species

in China, finless porpoises have the highest bycatch rate (Hines et al., 2015).

Prior to the fisheries ban in the Yangtze River, finless porpoises were killed by electrofishing, and entangled in gillnets, set nets, seine nets, and rolling hook longlines (Turvey et al., 2013; Wang et al., 2013; Mei et al., 2019). In Poyang Lake, from 2008-2013, 60 deceased porpoises were collected: 11 of these individuals were killed by illegal fishing (seven by electrofishing, three from set nets, and one from rolling hook longlines) (Mei et al., 2019). In Dongting Lake, from 2008-2012, four of 22 individuals were killed by fishing gear (two by electrofishing, one from set nets, and one from rolling hooks longline) (Mei et al., 2019).

3.4.1.1.4. Other Threats. Besides incidental bycatch, an additional threat is increasing water pollution from multiple sources including the discharge of heavy and trace elements from rapid industrialization and urbanization along the coast and rivers, oil and gas spills (from transportation and exploration), agricultural and domestic wastes, organochlorine pesticides, organophosphate esters (OPEs) and phthalate esters (PAEs), and aquaculture (Song and Duan, 2019; Tian et al., 2020; Cheng et al., 2021; Xie et al., 2024). Chemicals from these activities accumulate in coastal and riverine sediments. As dredging and development projects occur, these pollutants are resuspended within the water column each time increasing the uptake by fish which in turn exposes finless porpoises as they consume their prey (Liu et al., 2015; Hao et al., 2023).

In shallow coastal waters, offshore wind farms are being constructed rapidly in important cetacean habitats (Fang et al., 2023). As these infrastructures are built there is a massive injection of underwater noise from dredging, pile driving, and vibrations (Fang et al., 2023). There is also rapid development surrounding the Yangtze River which has been caused by an increase in shipping demands. Preliminary studies with passive acoustic monitoring in both areas found a correlation between underwater noise and vessel presence in the areas where finless porpoises are present (Zhou et al., 2021; Fang et al., 2023). Porpoises showed avoidance behaviors, and there are potential strandings and negative impacts on hearing from increasing underwater noise (Kimura et al., 2012; Ender et al., 2014; Wang et al., 2015a, 2015b; Zhou et al., 2021; Fang et al., 2023). The overall development within the Yangtze System has also degraded finless porpoise habitat with a series of dams affecting prey species' migrations and blocking porpoise movements within the entire system (Liu et al., 2020; Reeves et al., 2003; Zhang et al., 2014). The construction of the Three Gorges Dam in China has altered, and will continue to change, hydrological conditions within the Yangtze River and its adjoining lakes, especially Poyang Lake (Tong et al., 2008; Zhao et al., 2008; de Leeuw et al., 2010; Zhang et al., 2014). In the 1990s, dredging occurred in the lower Yangtze River to supply sand for the increase in construction development, however, having hundreds of dredging vessels in the channel caused multiple accidents (de Leeuw et al., 2010), which resulted in a ban on sand mining activities in the Yangtze River in 2000. Unfortunately, this ban resulted in an increase in dredging, starting in 2001 within Poyang Lake, that developed into an industry involving numerous large vessels (de Leeuw et al., 2010; Lai et al., 2014; Qi et al., 2014; Lu et al., 2019). During dry seasons, the water level and surface area of Poyang Lake have been declining due to sand mining altering the water flow between the Yangtze River and Poyang Lake (Lai et al., 2014). These low water levels can cause the bottom of the lake to turn into sand pits in some areas. This creates isolated pools of water where both prey and finless porpoises can become trapped, increasing the risk of strandings and vessel strikes (Dong et al., 2015; Li et al., 2021, 2022a, 2022b).

3.4.1.2. Hong Kong. Hong Kong is a Special Administrative Region (SAR) of the People's Republic of China.

3.4.1.2.1. Historic Distribution and Habitats. Indo-Pacific finless porpoises occur year-round in the waters of Hong Kong (Parsons and Wang, 1998; Jefferson et al., 2009), with the abundance appearing to peak during the winter to spring months (Jefferson et al., 2002a, 2002b), which is also the dry season for the region. The waters of Hong Kong are relatively shallow, with an average depth of 10–20m deep. The eastern and southern waters are influenced by oceanic currents while the western waters are more estuarine and heavily influenced by freshwater output from the Pearl River. Finless porpoises occur primarily in the eastern, central and southern waters where salinity is higher (Jefferson et al., 2002a; Jefferson et al., 2009).

3.4.1.2.2. Current Research. Since the 1990s, there have been intensive studies conducted on small cetacean populations, including finless porpoises (Parsons, 1998; Jefferson et al., 2009). In 1973, a stranding network was initiated by the Agriculture, Fisheries and Conservation Department. This dedicated program was introduced to record and examine stranding cases (Parsons and Jefferson, 2000; Jefferson and Hung, 2007). Also, during that time, a longitudinal study on finless porpoises was started to provide information on overall population, distribution, abundance and habitat to the local government for marine spatial and conservation management (Parsons and Jefferson, 2000; Hines et al., 2015).

Finless porpoises are the most commonly stranded species in Hong Kong (Jefferson et al., 2002a; Jefferson and Hung, 2007; Kot, 2019). In most cases, the causes of death are unknown, but researchers are increasing efforts to determine the differences between natural causes and human activities (i.e., bycatch, vessel strikes, pollution, habitat reduction, etc.) (Kot, 2019). Between 1993-1998, 32 finless porpoise carcasses were examined (Parsons and Jefferson, 2000). Cause of death for three individuals was blunt force trauma consistent with a boat strike, two exhibited wounds suggestive of bycatch and five presented pathological findings (Parsons and Jefferson, 2000). For every stranding case, attempts were made to examine the carcass and, since 2014, computed tomography (CT) and magnetic resonance imagining (MRI) have been used routinely to supplement necropsy findings to better understand the causes of cetacean strandings (Kot, 2019). Since the beginning of the stranding program, there have been 235 stranding cases, most of which were finless porpoises (Kot, 2019).

3.4.1.2.3. Bycatch. Hong Kong's fishing fleet consists of trawlers, purse seiners, gillnetters, traps, and hook and lines (Parsons and Jefferson, 2000; Cheung and Sadovy, 2004). Finless porpoises have been observed following trawlers and preying on fish that were stirred up by the nets, thereby increasing their risk of entanglement (Parsons and Jefferson, 2000). There are very few reports of bycatch recorded. In 2019, there was a substantial increase in finless porpoise strandings with no cause for the increase determined (Phelps Bondaroff, 2020).

3.4.1.2.4. Other Threats. Since the 1990s, Hong Kong has developed rapidly, including large infrastructure projects, resulting in major dredging and land reclamation of coastal waters (Parsons and Wang, 1998; Jefferson et al., 2009; Hines et al., 2015). During these operations, pollutants (polychlorinated biphenyls (PCBs), other organohalogens, heavy metals, etc.) were resuspended into the water column along with ongoing discharge from domestic and industrial treatment plants, and vessel and fishery activities. These pollutants can bioaccumulate in finless porpoises as they forage, and have been found in their blubber and other organs, causing negative impacts on their health (Perrin et al., 2005; Hung et al., 2006; Jefferson et al., 2009; Moon et al., 2010). Another significant threat is vessel traffic. High-speed ferry and other vessel traffic have grown at a rapid pace with trade and transportation increasing annually with mainland of China, thus increasing the likelihood of cetacean collisions (Jefferson et al., 2009).

3.4.1.3. Taiwan

3.4.1.3.1. Historic Distribution and Habitats. Along western Taiwan, both the Indo-Pacific finless porpoise and the Narrow-ridged finless porpoise are known to inhabit coastal waters, and the Indo-Pacific finless porpoise appears to be the predominant species (Wang et al., 2008; Hines et al., 2015; Ekelund et al., 2021). The two species overlap in the Taiwan Strait; however, the extent of sympatry is unclear (Wang et al., 2008).

The waters of the Taiwan Strait are shallow and include suitable habitat for finless porpoises (Wang et al., 2008; Hines et al., 2015; Ekelund et al., 2021).

3.4.1.3.2. Current Research. Stranding surveys have been conducted since 2000 (Yang, 2019). Stranded individuals are reported and, when they can be recovered, they are sent to research centers or universities for a necropsy. Unfortunately, the cause of most strandings is unknown (Yang, 2019; Ekelund et al., 2021).

3.4.1.3.3. Bycatch. In the coastal waters of southwestern Taiwan, bottom trawling and pair trawls (trawling by tandem vessels) are commonly seen inshore along with gill and trammel nets (Hines et al., 2015; Wang et al., 2016). Although banned within 3 nmi by the local government in 1999, this type of gear is still widely (and legally) used in nearshore waters beyond 3 nmi from shore (Perrin et al., 2005; Slooten et al., 2013; Hines et al., 2015; Wang et al., 2016). However, illegal trawling within 3 nmi still occurs as well. Purse seines, stow nets and various gillnets (drifting and bottom-set, trammel, etc.) are also commonly found in waters of Taiwan (Slooten et al., 2013; Hines et al., 2015; Wang et al., 2016). Incidental catch and mortality in these various gear types have been recorded frequently and are a major concern for both finless porpoise species (Hines et al., 2015; Wang and Reeves, 2017a; 2017b). Between 2016-2020, out of 161 stranding cases, 41 individuals were identified as Indo-Pacific finless porpoise and 21 were identified as narrow-ridged finless porpoise. Cause of death was determined for 89 finless porpoises stranded between 2019-2020 in which 21 individuals showed signs of possible bycatch (Ekelund et al., 2021).

3.4.1.3.4. Other Threats. On the western coast, coastal development continues at a rapid pace, with several projects proposed for new industrial sites and for the expansion of existing industrial sites. Since 2007, 59 large-scale projects are either in progress or have been completed with approximately 80 projects still waiting for government approval (Perrin et al., 2005; Hines et al., 2015; Wang et al., 2016). All major rivers that drain into the eastern Taiwan Strait have either been dammed or redirected for industrial infrastructure with more proposed projects for additional river alteration primarily for development, which reduces the freshwater flow into estuarine ecosystems (Wang et al., 2004, 2016). Pollutants from these facilities are released into the freshwater systems and affect small cetacean habitats and their prey, with ingestion of contaminated prey the primary route of exposure (Perrin et al., 2005; Ross et al., 2010; Hines et al., 2015; Wang et al., 2016). The heavy metals and persistent organic pollutants that are produced by these facilities can accumulate in the body tissues of cetaceans and can compromise their health overtime (Simmonds et al., 2002; Wang et al., 2016).

Transit-passage merchant vessels carrying commercial goods and passengers have increased in volume throughout the Taiwan Strait (Waerebeek et al., 2007; Chen et al., 2015). Vessel strikes in Taiwan were classified as low to medium impact for finless porpoises prior to the increase in vessel traffic, fishing activities, and the increasing coastal human populations fronting the Taiwan Strait (Waerebeek et al., 2007; Wang et al., 2016; Ekelund et al., 2021). Fishing and commercial vessel activities can potentially increase the likelihood of vessel strikes, deplete prey resources, and increase noise pollution resulting in physical and physiologic stress (Slooten et al., 2013; Wang et al., 2016).

3.4.2. Republic of Korea

3.4.2.1. Historic Distribution and Habitats. Narrow-ridged finless porpoises and the subspecies, East Asian finless porpoises, are both found in the coastal waters of the Korean Peninsula, primarily along the west, south and southeast coasts (Lee et al., 2013; Park et al., 2015). We focus on the Republic of Korea because no data were available from the Democratic People's Republic of Korea.

3.4.2.2. Current Research. Recently, the Korean government has concentrated on addressing data gaps in finless porpoise ecology by conducting acoustic surveys (Lee et al., 2013; Park et al., 2017, 2018; Oh et al., 2018; Yoon et al., 2020). A research effort started in 2020 is using unmanned aerial systems (or drones) to estimate finless porpoise distribution and population size more accurately (M.Y. Kim pers comm.).

Other research and conservation measures are focused on reducing bycatch. When jellyfish blooms occur, fishers use a modified stow net with a jellyfish-excluding device to allow jellyfish to escape from the net. The National Institute of Fisheries Science developed a new version of this modified stow net to decrease bycatch of finless porpoises with a similar exclusion device (Lee, 2019). Fishers are incentivized by the government to use this new stow net on a regular basis. In previous studies, there had been some catch loss where fish escaped through the exit that was intended for marine mammals. More research is needed to understand the effectiveness of the modified net in reducing finless porpoise bycatch (Lee, 2019).

3.4.2.3. Bycatch. Throughout the Yellow Sea and within the Korean Strait, gillnets, set nets (which can be left unattended for 4–5 h to overnight), trawling, and stow nets are used (FAO, 2003; Lee et al., 2013). Finless porpoises are one of the most bycaught marine mammals in Korean waters (Altherr and Hodgins, 2018), where many artisanal fisheries use stow nets on anchors. Stow nets are stationary gear designed in the shape of a cone or a funnel and are fixed on anchors or stakes (FAO, 2001). These nets are positioned according to the direction of the tide, and are used in rivers, estuaries, or shallow coastal waters with strong currents and tides. Finless porpoises that are bycaught by these nets do not usually have external signs of injury, but signs of asphyxiation have been observed internally (e.g., foam and bleeding in the airways) (Lee, 2019). Lee et al. (2024) conducted a study on a beached Indo-Pacific finless porpoise found on the coast of Jeju Island. The indivdual had ingested four fishing hooks with nylon and steel lines with three ring connectors; the line was measured to be 71 inches long. Researchers inferred that the gear was for angler fishing designed for Jeju haritail (*Trichiurus lepturus*). Along with ingesting the gear, there were a multitude of nematodes found within the mouth, esophagus, forestomach, and digestive tract but there was nothing within the intestines. These findings, along with pulmonary effusion, caused researchers to suggest that the individual suffered from a wet drowning (Lee et al., 2024). Bycaught cetaceans can potentially suffocate to death from fishing gear, a common cause of death. Along with the ingestion of foreign bodies which can cause finless porpoises to suffer from malnutrition, long-term pain, and other life threatening symptoms, these findings highlight the importance of addressing anthropogenic effects from fisheries (Lee et al., 2024).

The Republic of Korea banned the hunting of whales, dolphins and porpoises in 1986 when the International Whaling Commission (IWC) moratorium went into effect. However, legislation allowed the domestic sale and consumption of cetaceans that were obtained through incidental catch (Kang and Phipps, 2000; MacMillan and Han, 2011; Lee, 2019; Lee et al., 2019b; Kim et al., 2020). Within the Yellow Sea, west of Korea, a cetacean abundance survey estimated approximately 36,000 individuals in 2004, however, by 2011 there was an estimated population of only 13,000 individuals, which represented a decline of over 60% (Park et al., 2015). Directed catch (which supplied the continued demand for cetacean meat) was the most likely cause of this decline (Lee et al., 2013; Park et al., 2015; Kim et al., 2020). In January 2011, Korea enacted the "Notice of conservation and management of cetacean resources" to regulate bycaught and stranded species (Tatar, 2014; Park et al., 2015, pg. 415). With this management system in place, incidents of bycatch were collected and recorded. Fishers who caught cetaceans were required to report to the maritime police or coast guard of Korea, who then determined whether the cetaceans were caught intentionally or unintentionally. Unintentionally caught porpoises were permitted to be traded for food (Lee, 2019; Lee et al., 2019b). Finless porpoise bycatch has been reported mainly in large harbors; mortality is seldom reported in smaller ports where some bycatch likely goes unreported (Park et al.,

2015). Since the summer of 2016, finless porpoises have been classified as a "protected marine organism". In 2017, the Korean government implemented the Marine Protection Law, which banned the trade and consumption of the species. With the ban, finless porpoise bycatch is not expected to be voluntarily reported and carcasses may be discarded at sea (Lee, 2019).

In some areas of Korea, there continues to be a demand for cetacean meat (Lee et al., 2013; Kim et al., 2020). Along the southeastern coast of Korea, cetacean meat, either by legal catch or bycatch, is readily available even with the ban (Kang and Phipps, 2000; Kim et al., 2020).

3.4.2.4. Other Threats. A variety of pollutants are found throughout the region's marine ecosystems. Toxic chemicals (e.g., POPs, PCBs, polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans (PCDD/Fs), per- and polyfluoroalkyl substances (PFASs), etc.) have been detected in the blubber and liver of finless porpoises and have been shown to impact their health (Moon et al., 2010; Jeong et al., 2016, 2020, 2024). In juveniles, there are higher concentrations of some pollutants than there are in mature adults inferring that there is significant transfer from the mother along with bioaccumulation (Jeong et al., 2024). Korea has a very industrially developed coastline and a major contributor of these pollutants into this region's waters are from the municipal solid waster incinerators, the steel industry, and wastewater treatment plants (Moon et al., 2010).

Vessel traffic in Korean waters may be a threat, but the data are difficult to acquire. There are few known vessel collisions with finless porpoises (M.Y. Kim pers comm). Noise pollution and habitat degradation due to large infrastructure developments may potentially affect foraging and breeding behaviors of finless porpoises (Kim et al., 2018).

3.4.3. Japan

3.4.3.1. Historic Distribution and Habitats. The Narrow-ridged finless porpoise and its subspecies, the East Asian finless porpoise, inhabit the coastal waters of Japan. There are frequent sightings of finless porpoises in five geographical locations: Sendai Bay–Tokyo Bay, Ise–Mikawa Bays, Seto Inland Sea–Hibiki Nada, Omura Bay and Ariake Sound–Tachibana Bay (Shirakihara et al., 1992; Yoshida et al., 2001). Coastal waters of these five locations are favorable to finless porpoises with waters less than 50 m in depth and predominantly non-rocky bottoms (Shirakihara et al., 1992; Hashimoto et al., 2015).

3.4.3.2. Current Research. Bycatch and stranding data are gathered by regional governments. From 2009-2017, 220 stranding cases (stranded/drift and bycaught) were reported. Carcasses are collected by the local government and then sent to various institutions such as Nagasaki University for a necropsy (Shiozaki, 2019). During the necropsy, researchers collect a series of samples (i.e., skull/skeleton, teeth, organs, skin, muscles, blood) for research, education and exhibition purposes (Kurihara, 2019; Shiozaki, 2019). Between 2017-2018, a drone was used to conduct multiple aerial surveys to observe finless porpoises within the waters of Misumi West Port. Finless porpoises were observed to dive when near vessels to potentially avoid disturbances (Morimura et al., 2019). Another drone survey was conducted in 2022–2023 in the coastal waters of Ariake Sound to observe finless porpoise social aggregation patterns. Researchers found that finless porpoises formed aggregations that varied between one and nine individuals, however, ocassionally researchers would observe groups up to 30 individuals (Morimura et al., 2023).

In Seto Island Sea and Mikawa Bay, passive acoustic monitoring was conducted in 2021 and 2022 to study the interaction between both day and night activities of finless porpoises and the presence and absence of vessel noise in both areas. Researchers noticed that finless porpoises exhibited a decrease in their vocalizations in response to vessel noise in both their day and nightime activities (Ogawa and Kimura, 2023).

3.4.3.3. Bycatch. Incidental catch takes place in all areas of finless porpoise distribution. Some of the common gear used within coastal waters are gillnets (surface, drift and bottom-set), set nets, and trawl nets (Kasuya et al., 2002; Shirakihara and Shirakihara, 2013). The commercial capture of finless porpoises is illegal (Shirakihara et al., 2008). From 1987-1992, a total of 67 finless porpoises were found caught in nets in Ariake Sound and Tachibana Bay. Of those, 49 were bycaught in bottom-set gillnets, 12 in drift gillnets, five in set nets and one unknown (Shirakihara and Shirakihara, 2013).

In 2007 and 2008, surveyed fishers reported that approximately 250 finless porpoises per year were found caught in gillnets (Shirakihara and Shirakihara, 2013). Within the Inland Sea, from 1970-1998, the cause of death for 76 deceased finless porpoises resulted from fishery operations (Kasuya et al., 2002). In western Kyushu from 1987-1992, 76 out of 97 carcasses were incidental takes, of which 56 showed signs of ground gillnets, 12 showed signs of surface gillnets, seven were from set nets, and one from a drifting net (Shirakihara et al., 1993).

3.4.3.4. Other Threats. Throughout Japan's history, coastal development has steadily been increasing (Sakiyama, 1979). As the human population moved from inland areas to coastal areas, industrial and urban development increased, especially for international trade of industrial and commercial goods, agriculture, and land reclamation for recreational facilities and activities (Sakiyama, 1979; Kasuya et al., 2002). As a result of these activities, a high percentage of Japan's natural coastline was transformed (Sakiyama, 1979). Based on this intensive development, other threats that might affect finless porpoises include vessel traffic, pollution, habitat degradation and sand dredging (Hashimoto et al., 2013; Hines et al., 2015; Morimura and Mori, 2019).

4. Discussion

The 2019 Neophocaena workshop discussions highlighted data gaps and prioritized research and management needs. High priority research topics for finless porpoises included population structure, ecology, fisheries-related mortality, and solutions to mitigate bycatch. Participants also recommended standardizing research protocols and approaching conservation and management creatively with public and educational outreach programs. Throughout finless porpoise distribution there are still areas with no data. Within the Persian Gulf, data from Bahrain, Iraq, Kuwait, Oman, Qatar, or Saudi Arabia were not available. In Southeast and East Asia, no data on finless porpoises were available from the waters of Macao, North Korea, Philippines, Singapore and Timor-Leste. Overall, more research is needed to better determine the factors that affect finless porpoises.

4.1. Bycatch: Issues and Solutions

The issue of bycatch in small-scale and commercial fisheries is a major threat to finless porpoises throughout their range (Jefferson and Hung, 2004; Reeves et al., 2013). Information is lacking on the magnitude and extent of bycatch numbers, status of fisheries, the spatial and seasonal use of fishing gear, and how these topics relate to fishers' livelihoods and culture. Previous efforts involved in assessing bycatch in fisheries usually focused on gillnet fisheries, commonly considered to be the greatest threat (Reeves et al., 2003; Brownell et al., 2019). Along with gillnets, purse seine and nearshore nets that are left unattended for hours were also found to be a major threat to finless porpoises in Myanmar and Malaysia by local researchers. Increased monitoring and new information largely showed a lack of awareness about finless porpoises by communities and fishers. People believe finless porpoises are large fish rather than marine mammals or are uninterested in the animals because they offer no direct benefits to them (Hines et al., 2015). Research also showed the continued consumption of finless porpoises in some regions (Altherr and Hodgins, 2018; Sutaria, 2019). Individuals that were

incidentally bycaught were, in some places, sold and consumed. In some areas, this activity has ceased due to enforcement of laws and regulations, while in others, demand is causing the market to grow (Kang and Phipps, 2000; Robards and Reeves, 2011; Altherr and Hodgins, 2018).

Given the acute threat of bycatch, solutions and recommendations were identified to try to mitigate bycatch. The consensus was to focus on continuing research on finless porpoise populations with the following priorities: (i) population assessments and ecology, (ii) quantifying fishery-related mortality, (iii) bycatch risk assessments, and (iv) alternative fishing solutions to reduce bycatch. Unfortunately, the overarching concern was the lack of funding and resources available. To effectively mitigate bycatch, there needs to be a better understanding of porpoise distribution, abundance and habitat use, fishery operations, management, fishing gear usage, and fishing gear alternatives. Some bycatch reduction solutions were: (i) applying observer programs, (ii) implementing and enforcing regulations (where they exist), (iii) incentives to use alternative gear, report bycatch, and decrease consumption, (iv) no penalties or fines for reporting bycatch, and (v) replacing high risk gear with low-risk gear types.

Within some areas across the range of the finless porpoise, there have been new developments in efforts to reduce bycatch. Acoustical deterrents (e.g., "pingers") are being used experimentally to reduce marine mammal bycatch (Amano et al., 2017; Nelms et al., 2021). "Pingers" have been shown to be effective depending on the type of fishery involved. Experimental research suggests constant usage can lead to habituation or displacement that could lead to an increase in bycatch (Amano et al., 2017; Omeyer et al., 2020). In gillnet fisheries, however, habituation has not been reported for large-scale applications (Amano et al., 2017). The effectiveness of "pingers" for finless porpoises is not completely known and could take a significant period of time to develop fully; however, smaller finless porpoise populations may not have such time (Amano et al., 2017; Omeyer et al., 2020; Nelms et al., 2021). Acoustical monitoring can be used to determine distribution and seasonal movements and as a tool for long-term monitoring. This tool can increase survey efforts where boats are unable to navigate (Morimura and Mori, 2019).

4.2. Standardizing Research and Stranding Response

Standardized research protocols need to be developed to effectively assess finless porpoises over a more global scale. Because finless porpoises inhabit coastal waters throughout a wide geographic range and are not easily observed, their abundance and distribution are difficult to ascertain. Standardizing methodology begins with coordinating the efforts of researchers to address the issue from an international perspective. First, an international committee compiling national protocols to develop standardized survey, sampling, and data collection methods should be established. This committee would then train national networks once the methodology was approved.

The standardization of stranding network protocols, in particular, was identified as a priority by workshop participants. Participants were concerned that cases of strandings have increased significantly due to anthropogenic impacts (Wang et al., 2015a, 2015b; Hines et al., 2015). Numbers and distribution of stranded individuals could indicate a change in the ecosystem, disease, pollution, or fishing pressures. Standardizing protocols for a stranding program begin with training personnel on the importance of increasing stranding response effort, and the collection of information on (i) animal condition and size, (ii) environment, (iii) species, (iv) metadata, (v) GPS coordinates, and (vi) photos. In necropsies, taking samples of the animal (e.g., skin, stomach contents, bones) along with examining the carcass for signs of fishery interaction should be prioritized. Unfortunately, the main concern is insufficient funding and resources to fully establish a stranding response network with access to equipment, facilities and training materials. To effectively establish a stranding response network, nations with established networks should make their protocols accessible. A recommendation from the workshop was to create an open access online platform for stranding network methodology and protocols as a dedicated forum for scientists, personnel and marine mammal veterinarians to share information. A parallel workshop held at the same time as ours reached similar conclusions and has developed a website for sharing protocols online: https://globalstrandingnetwork.com/.

4.3. Management and Conservation

The diversity of threats affecting finless porpoise populations requires creative tools to address management and conservation issues. Practical management opportunities begin with bycatch mitigation and testing alternative proposed methods to understand their effectiveness. A straightforward management action is spatial-temporal closures (seasonal or permanent) to reduce the overlap of fishery activities and finless porpoise populations (Amano et al., 2017; Nelms et al., 2021).

Fishing is the main livelihood in many local communities. Nets (gillnets, purse seine, stow nets, still nets, etc.) which are highly threatening to cetaceans are perceived to be essential to livelihoods within these communities. They are cost effective, easy to maintain and can be set for hours at a time. There are regulations on fishing gear in some countries, but they are not always enforced. Managers, stakeholders and policymakers need to take into consideration how essential particular gear types are for communities and livelihoods. Possible solutions are government buy-back programs for fishing gear and gear modifications (Lee, 2019; Lee and Midani, 2015).

Approaches to conservation should be multifaceted. No single strategy will help facilitate the recovery of finless porpoise populations. Local community support is essential in creating and enforcing conservation measures along with raising public awareness with programs and printed materials (e.g., talks, workshops, pamphlets, posters, etc.) for fishers, stakeholders and communities (Sule et al., 2016). These programs should include basic information on finless porpoises, their interactions with fisheries and vessels, and information on current local research. These are an effective means to distribute information widely and can be used for targeting specific audiences. Documentaries and videos are known to be an effective way of increasing awareness by providing customized information on specific issues critical for conservation. Scientists, government agencies, stakeholders, the fishing industry, fishers and communities need to collaborate to develop innovative solutions to assure conservation efforts are effective.

Implementing these recommendations will be challenging, especially since the lack of funding and resources is an issue. Hands-on workshops with local and national organizations for domestic and international researchers throughout the range of the finless porpoise would be a good place to begin. These workshops could cover a wide array of training activities led by local researchers, from conducting boat and shore surveys, to data collection and analysis, stranding response, and necropsies. With these workshops, international standardized research protocols could be developed for researchers to use in future studies.

CRediT authorship contribution statement

Tishma Patel: Writing – review & editing, Writing – original draft, Software, Resources, Methodology, Investigation, Formal analysis, Data curation. **John Y. Wang:** Writing – review & editing. **Denise Greig:** Writing – review & editing. **Ellen Hines:** Writing – review & editing, Validation, Supervision, Project administration, Methodology, Conceptualization.

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Declaration of competing interest

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