

SHORT COMMUNICATION

# Bottlenose dolphin detection and approach to distant trawlers in the northwestern Adriatic Sea

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**Abstract:** Common bottlenose dolphins *Tursiops truncatus* have adapted to foraging and scavenging behind fishing trawlers in many areas around the world. This opportunistic behaviour is widespread in Adriatic Sea waters off the region of Veneto, Italy. On October 1<sup>st</sup>, 2020, we tracked a group of bottlenose dolphins from a 6 m boat, north-east of the Po River Delta. The dolphins foraged behind midwater pair trawlers, then four individuals abandoned the vessels and engaged in fast, highly-directional movement toward another distant pair of midwater trawlers, at speeds of 8-14 km/h, as the trawlers moved away from the dolphins. After 29 min of fast directional travelling, the dolphins reached the midwater trawlers and immediately started foraging in their wake. GPS tracking of dolphin positions, combined with trawler positions obtained from AIS data matching vessel name/plate, revealed that the trawlers were 2.6 km away from the dolphins when the animals first appeared to have detected them – consistent with reports of detection-and-approach in other seas. While bottlenose dolphins in our 3,000 km<sup>2</sup> study area frequently moved from one fishing trawler (or pair of trawlers) to the next, the trawlers' detection-and-approach event reported here was the longest observed during our 7-year study, totalling 721 encounters with fishing trawlers and 17,432 km of survey effort during 129 days of monitoring trawling activities. Long-distance detection can theoretically enhance foraging opportunities, though the substantial negative effects of trawling on marine ecosystems make it difficult to disentangle causes and effects, and determine whether there may be net demographic benefits to the dolphins.

**Keywords:** Adriatic Sea; detection distance; fisheries; foraging; trawling; *Tursiops truncatus*

**Sažetak:** DETEKTIRANJE I PRILAŽENJE DOBROG DUPINA (*TURSIOPS TRUNCATUS*) UDALJENIM KOČARICAMA U SJEVERO-ZAPADNOM DIJELU JADRANA. Dobri dupini (*Tursiops truncatus*) u mnogim su dijelovima svijeta razvili prilagodbu koja uključuje traženje hrane i strvinarenje u blizini ribarskih kočarica. Ovakvo oportunističko ponašanje široko je rasprostranjeno i u vodama Jadranskog mora uz obalu regije Veneto u Italiji. Dana 1. listopada 2020. godine pratili smo skupinu dobrih dupina s istraživačkog broda duljine 6 m, sjeveroistočno od delte rijeke Po. Dupini su u početku tražili hranu iza lebdećih kočarica, nakon čega su se četiri jedinke udaljile od plovila te su se započele brzo kretati prema drugom paru udaljenih lebdećih kočarica brzinama od 8 do 14 km/h, dok su se kočarice udaljavale od njih. Nakon 29 minuta brzog kretanja, dupini su dostigli ciljane kočarice te su odmah započeli hranjenje u brazdi iza kočarica. Analiza GPS podataka o položaju dupina, u kombinaciji s podacima o položaju kočarica dobivenima iz AIS sustava prema nazivu dotičnih plovila i njihovim registracijskim oznakama, pokazala je da su kočarice bile udaljene približno 2,6 km od dupina u trenutku kada se pretpostavlja da su ih životinje prvi put detektirale. Ova udaljenost u skladu je s ranije zabilježenim primjerima detekcije i pristupa ribarskim plovilima u drugim morima. Iako su se dobri dupini unutar našeg istraživanog područja površine 3000 km<sup>2</sup> često premještali od jedne ribarske kočarice (ili para kočarica) do druge, detekcija i pristup kočaricama opisani u ovom radu ostvareni su s najveće udaljenosti tijekom sedmogodišnjeg istraživanja. Tijekom sedam godina istraživanja zabilježen je ukupno 721 slučaj prilaznja dupina kočaricama i kroz 129 dana promatranja kočarskih aktivnosti obuhvaćeno je 17 432 km. Iako detekcija ribarskih plovila na velikim udaljenostima potencijalno može povećati dostupnost hrane za dobre dupine, značajni negativni učinci kočarenja na morske ekosustave otežavaju razlučivanje uzročno-posljedičnih odnosa, stoga ostaje nejasno mogu li takve vještine dugoročno rezultirati demografskim koristima za populacije dupina.

**Ključne riječi:** Jadransko more; domet detekcije; ribarstvo; traženje hrane; kočarenje; *Tursiops truncatus*

## INTRODUCTION

The Adriatic Sea is one of the areas most exposed to bottom trawling, worldwide, and one with the worst seabed status (Pitcher *et al.*, 2022). Trawling has been an important driver of change in Adriatic ecosystems (Coll *et al.*, 2009), resulting in a major regime shift (Fortibuoni *et al.*, 2017; Sguotti *et al.*, 2022) and rich three-dimensional

habitats turned into flattened plains that trawlers continue to exploit (Bearzi *et al.*, 2024a). Marine communities experienced alterations and declines (Barausse *et al.*, 2011; Lotze *et al.*, 2011; Fortibuoni *et al.*, 2017; Sguotti *et al.*, 2022) and vulnerable high-order predators have declined dramatically (Ferretti *et al.*, 2013; Bearzi *et al.*, 2024b).

Foraging and scavenging in the wake of fishing trawlers is an important component of the behaviour of

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several species of odontocete cetaceans in many areas around the world (Bonizzoni *et al.*, 2022). Specifically, common bottlenose dolphins *Tursiops truncatus* (hereafter “bottlenose dolphins”) have adapted to foraging behind various types of trawlers (Bearzi *et al.*, 2019; Bonizzoni *et al.*, 2022). In the northwestern Adriatic Sea, the distribution and behaviour of bottlenose dolphins is strongly driven by trawling (Bonizzoni *et al.*, 2023).

Jefferson and Leatherwood (1997) noted that trawlers may “act as ‘magnets’, collecting dolphins as they move through an area”. While vision might play a role in some cases, to our knowledge there is no published information documenting the dolphins’ use of visual cues to detect distant trawlers: odontocete cetaceans appear to locate the trawlers and other fishing vessels acoustically, because of the noise produced by their engines, running winches and fishing gear (Gunter, 1954; Svane, 2005; Bayless *et al.*, 2017; Anderson *et al.*, 2020). In the case of trawl nets, acoustic cues are likely to include the noise caused by water friction and groundgear contact with the seabed (Bearzi *et al.*, 2024a).

Only scant information exists on the distance at which bottlenose dolphins are not only capable of detecting navigating or fishing trawlers, but also react to their presence and direct towards them to forage in their wake. Here, we report an estimate of the distance at which bottlenose dolphins can detect and actively react to the presence of fishing trawlers.

## MATERIAL AND METHODS

The reported observation occurred during a 7-year-long study (2018–2024) in a 3,000 km<sup>2</sup> area off the region of Veneto, Italy, with survey effort encompassing waters up to approximately 22 km from the coast (Fig. 1). Boat-based visual surveys following the methods described by Bonizzoni *et al.* (2023) were conducted from 6–7 m craft with rigid hull powered by four-stroke outboard engines between April and October, for a total of 129 days of trawling, 17,432 km of survey effort, and 721 encounters with fishing trawlers.

In the study area, waters are shallow (maximum depth 33 m), with gradual bathymetric gradients, and exposed to strong river runoff and wide oceanographic and trophic fluctuations, in part caused by human activities. These wide fluctuations have involved variations in prey availability that, in turn, can influence the abundance and local distribution of cetaceans (Bearzi *et al.*, 2024b).

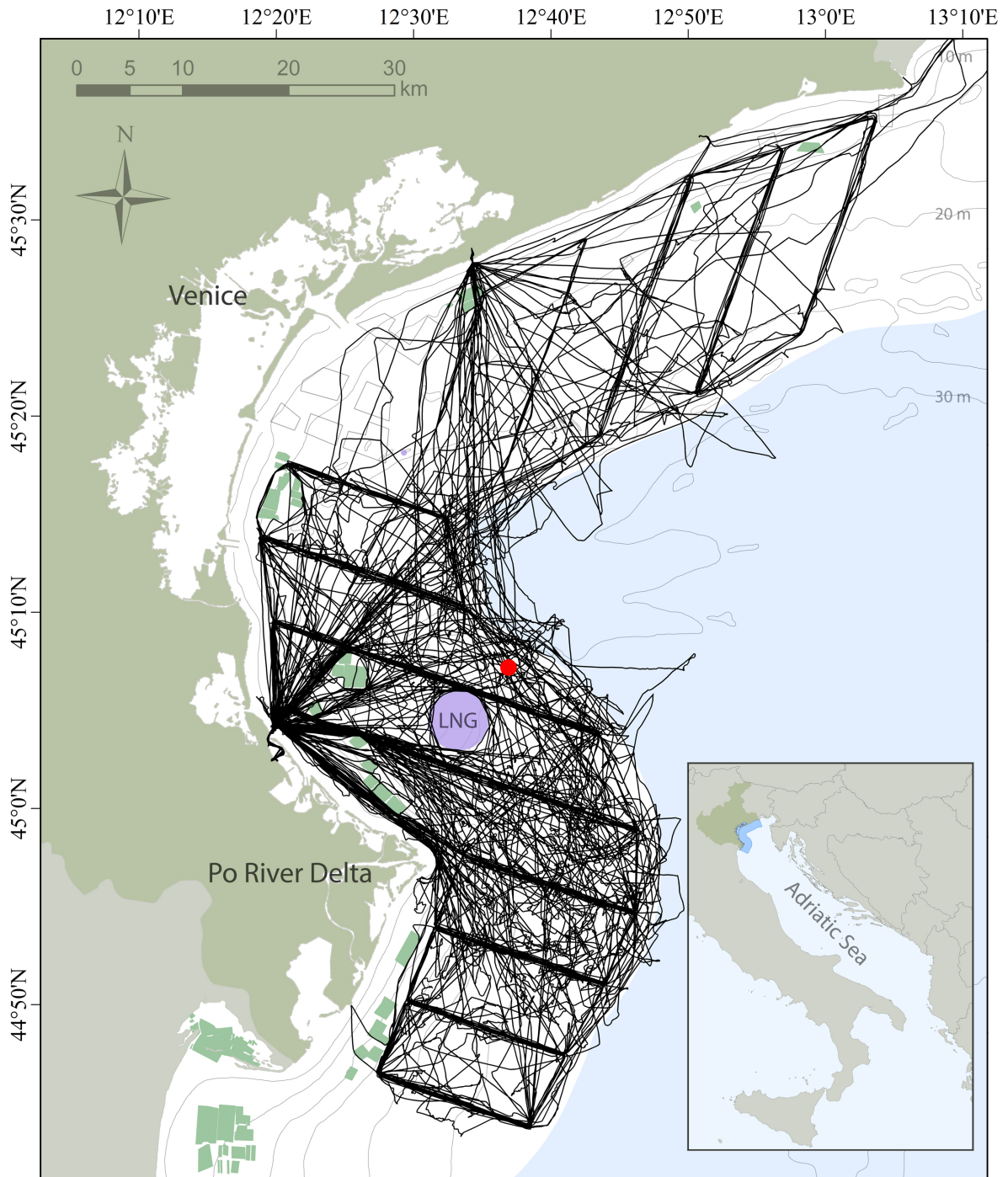
Bottlenose dolphins in the study area were frequently observed foraging in the proximity of fishing trawlers (Bonizzoni *et al.*, 2023; Fig. 2) and moving from one trawler to the next. These trawlers include midwater pair trawlers (i.e., two vessels towing a single trawl net), bottom otter trawlers (one vessel towing a single trawl net kept open by two large boards), and beam trawlers (one vessel with outriggers normally towing four nets simultaneously). The observation reported here was the long-

est and most striking in terms of i) the distance covered to approach distant trawlers, and ii) the extent of fast, highly directional travelling toward the target. The position of the research boat was recorded *via* GPS at 1-min intervals throughout navigation and tracking, and was used as a proxy for dolphin position, considering that the boat kept a distance of less than 50 m from the dolphins throughout the reported observation. GPS positions of trawlers were derived from Automatic Identification System (AIS). AIS data matching the identity (name and plate) of trawlers were obtained from VesselFinder (2026), and analysed with ArcMap 10.4 (ESRI, Redlands, CA, USA).

## RESULTS AND DISCUSSION

On October 1<sup>st</sup>, 2020, at 09:16 we were tracking a group of three bottlenose dolphins that were foraging in the wake of midwater pair trawlers (Table 1), approximately 20 km north-east of the Po River Delta (Fig. 1). At 09:19 four other dolphins joined the group, as the trawlers started converging and hauling their net, with hauling being completed and the trawl net completely retrieved by 09:31. Until then, the dolphins had kept following the trawlers and diving on the net. At 09:36, the group abandoned the midwater trawlers and split into two subgroups. Four individuals were stationed in the same area, and three moved toward a bottom otter trawler that was fishing nearby. We remained with the group of four. At 09:49, the dolphins started moving slowly and erratically, possibly towards distant midwater pair trawlers (not those that were followed previously). At 10:01, one of the four dolphins performed a single high vertical jump (‘high bow’, Bearzi *et al.*, 1999).

At that moment, with the aid of binoculars, we noticed that the distant midwater pair trawlers had begun to set their net and start fishing. Immediately after the jump, the behaviour of the dolphin group suddenly changed from slow to high-speed directional travel (‘Travel-fast’; Bearzi *et al.*, 1999), seemingly heading towards the distant pair of midwater trawlers that had just engaged in fishing. The dolphins travelled straight towards those trawlers at speeds of 8–14 km/h for 29 min. Meanwhile, the trawlers moved away in approximately the same direction as the dolphins, towing their net at speeds of about 8 km/h. The four dolphins reached the pair of midwater trawlers at 10:30, after 5.8 km of high-speed directional travel. As soon as they were in the wake of midwater pair trawlers, their behaviour changed from ‘Travel-fast’ to ‘Dive/Following-trawler’ (Bearzi *et al.*, 1999), with the animals positioned in the wake of the trawlers, about 100–150 m from the stern, while presumably foraging behind, around, and/or within the trawl net (Bonizzoni *et al.*, 2022). GPS tracking of dolphin positions, combined with vessel positions obtained from AIS data matching vessel name/plate, revealed that the midwater trawlers were 2.6 km away from the dolphins when the animals first appeared to have detected them. The midwater pair trawlers detected and



**Fig. 1.** The study area off the Italian region of Veneto, in the northwestern Adriatic Sea, showing 17,432 km of survey effort in days of monitoring trawling activities. LNG indicates the circular area surrounding a liquified natural gas terminal where fishing and navigation are prohibited. Solid green polygons indicate offshore mussel farms. The area in light blue indicates waters beyond 22 km from the coast. The red dot shows the position of dolphins at the time of detection of distant midwater pair trawlers. The inset shows the position of the study area (darker blue) relative to the entire Adriatic Sea and the region of Veneto (darker green).

approached by dolphins were twin vessels 21.3 m long (Fig. 3), with an engine power of 379 kW and gross tonnage 59.0, based on information in the EC Fleet Register (2026) and in the FAO Regional Fleet Register (2026).

It has long been reported that dolphins are capable of locating trawlers from a distance. In one of the earli-

est reports, Norris and Prescott (1961) noted that “It is a common sight just before a net comes on board to see bottlenose porpoises [= common bottlenose dolphins], who were nowhere in sight while the net was out, leaping out of the water as they race toward the vessel. In one instance, the senior author estimated the animals as



**Fig. 2.** Two bottlenose dolphins foraging in the wake of midwater pair trawlers (only one of the two vessels is visible in the photo) off the Italian region of Veneto, in the northwestern Adriatic Sea.

starting their dash toward the boat from 2 miles away”. As it is unclear whether the authors referred to the nautical mile (1852 m) or the statute mile (1609 m; see Wikipedia, 2026), the reported distance may be assumed to be between 3 and 4 km. Indo-Pacific bottlenose dolphins *Tursiops aduncus* were observed ‘porpoising’ towards bottom otter trawlers from well over one nautical mile away as the boats started hauling their nets (L. Chilvers and P. Corkeron, personal communication).

Odontocete species other than *Tursiops* can detect changes in the noise produced by engines of fishing vessels, and appear capable of associating them with fishing activity. Indo-Pacific humpback dolphins *Sousa chinensis* in Hong Kong waters reportedly changed their course and increased their speed to approach bottom otter trawlers and midwater hang trawlers (Piwetz *et al.*, 2012), but distances were not reported. Referring to Indo-Pacific humpback dolphins and bottom pair trawlers, Jefferson (2000) noted that “in one instance dolphins were observed swimming at high speed from well over 1 km away to follow a set of pair trawlers”. Sperm whales interacting with a longline fishery in the Gulf of Alaska reportedly could detect operating longliners from distances of at least 5 km, approaching them when engine noise was indicative of fishing (Thode *et al.*, 2007).

The longest-distance detection was reported by Anderson *et al.* (2020) for satellite-tagged false killer whales *Pseudorca crassidens* in Hawaiian waters: the animals appeared to detect a hauling longliner that was nearly 100 km away, and reached it after 7 h. A caveat is that false killer whale groups are often spread out over 20+ km, up to a maximum distance of 35 km (Bradford *et al.*, 2014), and sub-groups regularly converge when

prey is encountered: a closer group might have heard the longliner, and the response would have been a larger group-level coordination (R.W. Baird, personal communication).

In the northern Adriatic Sea, bottlenose dolphins have long been known to forage and scavenge behind bottom and midwater trawlers (Bearzi *et al.*, 1999; Genov *et al.*, 2008; Rako-Gospic *et al.*, 2017; Bonizzoni *et al.*, 2023). Genov *et al.* (2008) reported bottlenose dolphins heading towards midwater pair trawlers in the Gulf of Trieste, and waiting for these fishing boats to start or resume trawling, sometimes following the vessels at distances of more than 1 km.

The case reported here was the longest-distance observation of detection-and-approach of trawlers during our 7-year study in the northwestern Adriatic Sea – an area where bottlenose dolphins routinely forage and scavenge behind three types of trawlers (particularly midwater pair trawlers and bottom otter trawlers, but occasionally also beam trawlers; Bonizzoni *et al.*, 2023). In this area, the ability to detect distant trawlers and actively react to their presence can represent an important survival skill, considering that in days of trawling (i.e., Monday to Thursday) bottlenose dolphins were observed foraging and scavenging behind fishing trawlers for 39% of total observation time (109 h) – with dramatic differences in dolphin distribution between days with and without trawling (Bonizzoni *et al.*, 2023).

Detection-and-approach of distant fishing vessels can enhance foraging opportunities at least theoretically. In other areas and for other species, foraging on fishing gear other than trawl nets reportedly resulted in increased fitness. For instance, killer whales *Orcinus orca*

**Table 1.** Time table of the observed dolphin detection-and-approach of trawlers (October 1<sup>st</sup>, 2020). MPT = midwater pair trawlers; D = dolphin.

Time	Activity of midwater pair trawlers	D distance to MPT (m)	Dolphin behaviour	D group size
09:16	Towing net	50-100	Approach trawlers and position themselves in their wake, presumably above the net	3
09:18	Towing net	50-100	Following trawlers, distant dolphins approaching the group of 3	3
09:19	Converge and start hauling net	50-100	Following trawlers, 4 new dolphins have joined the group	7
09:20	40 m apart, hauling net	50-100	Surfacing and diving above the net	7
09:22	Side by side, hauling net, net floaters visible at surface	50-100	Surfacing and diving above the net	7
09:27	Side by side, hauling net, first codend (with fish catch) retrieved	50	Surfacing and diving above the net	7
09:29	Side by side, hauling net	50-100	Surfacing and diving close to where the net is being hauled, but a bit farther away	7
09:31	Side by side, hauling net, second codend (with fish catch) retrieved	100	Surfacing 100 m from trawlers	7
09:33		300	Moving away from trawlers	7
09:36			Group splits in two: 4 dolphins stay in the area; 3 move away, approach a bottom otter trawler and start following it 100 m from its stern	4+3
09:45			Remaining group stationary, not following any trawler	4
09:49			Start moving slowly, erratically, possibly towards another pair of distant midwater trawlers	4
10:01	Finished to set the net and started to fish	2,600	One of the 4 dolphins performs a single high vertical jump ('high bow', Bearzi <i>et al.</i> , 1999); behaviour changes from slow/erratic to directional travel ('Travel'; Bearzi <i>et al.</i> , 1999) at speeds of 8 km/h	4
10:02	Fishing	2,500	Sudden change to high-speed directional travel ('Travel-fast'; Bearzi <i>et al.</i> , 1999); moving straight towards distant trawlers at speeds of 10-12 km/h	4
10:24	Fishing	1,000	Moving straight towards distant trawlers at even higher speeds of 12-14 km/h	4
10:30	Fishing	100–150	Approaching midwater pair trawlers; group behaviour changes from 'Travel-fast' to 'Dive/Following-trawler' (Bearzi <i>et al.</i> , 1999); animals position themselves in the wake of trawlers, 100–150 m from stern, while presumably foraging behind, around, and/or within the trawl net	4

interacting with longliners can have higher rates of adult survival (Esteban *et al.*, 2016) and higher calving rates (Tixier *et al.*, 2014; Esteban *et al.*, 2016) than those that do not interact. In the specific case of trawling, however, the well-known negative effects on marine food webs

and marine ecosystems generally (Bearzi *et al.*, 2024a) make it difficult to disentangle causes and effects, thus determining whether there may be net demographic benefits to the dolphins. Any advantage gained through opportunistic foraging may be ultimately offset by



**Fig. 3.** The midwater pair trawlers that were detected by bottlenose dolphins from 2.6 km away, and approached after 29 min and 5.8 km of high-speed directional travelling, as the trawlers moved in approximately the same direction and away from the dolphins (October 1<sup>st</sup>, 2020).

i) the widespread ecosystem damage and prey depletion caused by trawling, ii) the risk of dolphin injury and death resulting from proximity to trawl gear, and iii) the detrimental side effects to the dolphins, resulting *inter alia* from exposure to the noise of trawlers and exposure to trawl-related pollutants (Bonizzoni *et al.*, 2022; Bearzi *et al.*, 2024a). Reported effects of trawling on odontocete species, including bottlenose dolphins, have included changes in movements and distribution, diet, group size, behaviour and social organization (Bonizzoni *et al.*, 2022, 2023).

## CONCLUSIONS

The observation reported here indicates that, under certain conditions, bottlenose dolphins can detect and react to fishing trawlers at a distance of 2.6 km, travelling at high speeds for up to 5.8 km and 29 min (indicative of high energy expenditure) before reaching the vessels to forage and scavenge in their wake. Our estimate – relying on GPS tracking combined with AIS information from vessels – appears more precise than the scant earlier information relying on visual estimates by onboard observers (because visual assessment of distances at sea is often inaccurate). Our estimate, however, should be viewed as minimum estimate of detection-and-approach distance, considering that i) dolphins may move toward even more distant trawlers at ‘normal’ travel speeds, in ways that are less conspicuous and may not be interpreted by onboard observers as indicative of a vessel detection-and-approach; and ii) odontocetes other than *Tursiops* sp. have been found to detect and react to vessels at much greater distances (Thode *et al.*, 2007; Anderson *et al.*, 2020), indicating a potential for

acoustic detection-and-approach that may exceed that found in our study. Finally, it should be considered that the detection distance of any underwater sound depends on factors including ambient noise, bottom depth, type of seabed, and several other oceanographic and physiographic factors (Bass and Clark, 2003), making it difficult to compare the acoustic capabilities of different odontocetes in different environments and under different conditions.

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