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Cetacean Fishery Interaction during operation of major Fishing Systems of India

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Abstract

Cetacean interaction with fishing gear has been reported widely around the globe. This study is aimed at finding out the fishery most prone to cetacean attack along the Indian coast, and to identify the species causing the attacks, the extent of damage to fishing gear, the seasonal variation and catch loss in different fisheries and suggest mitigation measures. This was assessed by conducting face to face interviews with the crew and owners of the fishing vessels from 20 major harbours along Indian coast. The results of the study show that cetacean fishery interactions are frequent in all type of fishing gears operated in the country. Small gillnets that operate near the shore are most prone to cetacean attacks. Gear damage and depredation by cetacean and non-cetacean species cause economic loss to the tune of Rs. 0.5 – 2.0 lakhs per incident in gillnet and purse seine/ ring seine fishery. The study shows that about 15.3% of respondents reported incidental bycatch of cetaceans, mainly in gillnets, purse seines and trawls. The number of interactions are found to be maximum during pre-monsoon season. It has also been observed that gillnets and purse seine/ ring seine are the most economically affected fisheries. Fishers employ mitigation measures like scaring away the animals or delaying fishing. The use of acoustic pingers can be considered as a management option in India.

Keywords: cetacean fishery interactions, dolphin, gear damage, incidental bycatch, mitigation measures

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Introduction

Marine mammal interactions with fisheries have been reported from around the globe and can be categorised as biological (ecological) or operational and are a serious cause of concern (IUCN, 1981; Dawson et al., 2013). Cetacean interactions could be useful for some fisheries like purse seines as the presence of dolphins being is indicator of fish shoals (Allen, 1985). Cetaceans possibly target gear as they can find food directly from gear instead of searching for it (Dalla-Rosa & Secchi, 2007). Cetacean depredation results in gear damage, catch loss and scattering of fish shoal, causing economic losses for fishermen, particularly in areas of serious encounters (Wise et al., 2007; Rocklin et al., 2009; Silva et al., 2011). Interaction occurs mostly in passive gears like gillnets, longlines, traps and other line fisheries (Read et al., 2006; Gilman et al., 2008). However active gears like trolling, trawl and purse seine are also subjected to cetacean interaction (Zollett & Read, 2006). The studies by different researchers highlight the importance of extending analysis of cetacean interactions between important fishing gears to identify the level of interaction and provide more information about the species (Leeney et al., 2015). There are many other aquatic species that can cause interaction with fishing gears like seals, sea lions, sea otters, puffer fish, crabs, squids etc. Interaction is reported in India from nearly all major gears like trawls, gillnet, purse seine, ring seines and longlines (Prajith et al., 2014; Aneesh et al., 2016; Raphael et al., 2017). Mitigation measures to reduce cetacean encounters with fishing gear include the relocation of fishing effort, modification in gear and use of acoustic devices (Goetz et al., 2014; Dawson et al., 2013).

This study is aimed at finding out the fishery most prone to cetacean attack along the Indian coast, to identify the species causing the attacks, the extent

of damage to fishing gear, the seasonal variation and catch loss in different fishers and to suggest mitigation measures. Attempts have also been made to gauge the perception of fishes to these encounters.

Materials and Methods

The present study was conducted during the period November 2018 to October 2019 in major fishing centers in the maritime states of India. In all, crew and owners of about 879 vessels in 20 harbours and coastal areas all along the Indian coast were covered. Nearly 2000 respondents participated in the survey.

The main types of fishing included in the survey during the study are given in the Table 1.

Information was collected using pre-tested interview schedule and included fishery most prone to cetacean interaction, major cetacean and non-cetacean species interacting with gears and level of damage (depredation and gear damage), incidental catch, seasonal variation of interaction viz. post-monsoon (October-January), pre-monsoon (February-May) and monsoon (June-September), economic evaluation of catch and gear loss, mitigation measures, perception of fishers on the factors causing interaction and attitude towards cetacean attack (positive, negative and neutral). Focused group discussions were conducted for validation of cetacean species causing depredation using colour photographs of common cetacean species in the region. Log books maintained on-board were used to cross-check the catch data.

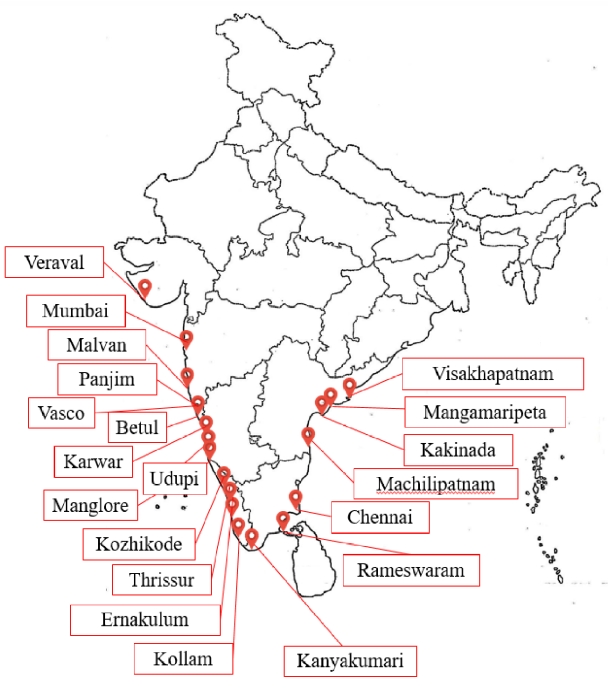

Fig. 1. Study area

Results and Discussion

Fisher respondents were between 30 – 65 years of age and had an average fishing experience of 30 years. Most fishers interviewed were crew members (78%) and the remaining were skippers or owners of fishing vessels (22%). Majority of the cetacean interaction were reported from the gillnets (57.7%) (which includes mechanised, motorised and traditional vessels), followed by ring seine (16.2%), purse

Table 1. State-wise sample of fishing vessels

Type of fishing vessel	Gujarat	Maharashtra	Goa	Karnataka	Kerala	Tamil Nadu	Andhra Pradesh	Total
Mechanised								
Trawler	6	4	7	8	15	10	9	**59**
Large Gillnetter	12	12	0	31	49	22	35	**161**
Purse seine	0	0	56	44	0	0	0	**100**
Longliner cum gillnetter	0	0	0	0	29	40	0	**69**
Motorised								
Small Gillnetter	27	17	41	53	65	62	82	**347**
Ringseine	0	16	0	0	81	21	25	**143**
Total	**45**	**49**	**104**	**136**	**239**	**155**	**151**	**879**

seines (11.3%), longline cum gillnet (7.8%) and trawls (6.7%).

The gear most prone to cetacean interaction is the small gillnet that is operated near shore (39.4%) followed by ring seine (20.5%) and purse seine (16%). The high sea gears like large gillnets, longline cum gillnets, trawl nets had less interaction compared to other gears.

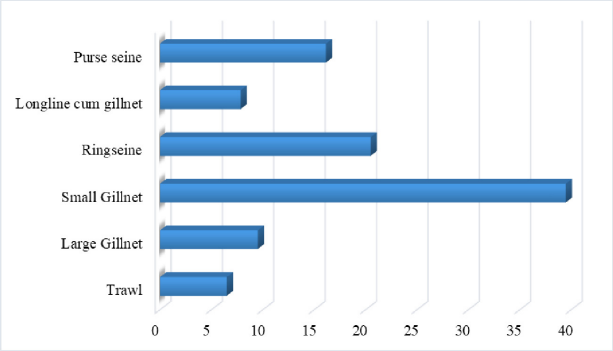

Fig. 2. Cetacean interaction with fishing gear

Almost all the respondents operating small gillnets in near shore waters reported gear damage due to cetacean interaction, almost all of them being artisanal fishers operating at a depth ranging from 10 – 50m. However, interaction with seine nets (purse seine and ring seine) results in more monetary losses due to total loss of catch with major damage to the gear. In majority of cases interaction resulted in loss of catch and gear (87.5%).

The cetacean species most frequently found were Indo-pacific humpback dolphin (*Sousa chinensis)* (27.6%), spinner dolphin (*Stenella longirostris*) (22.5%), long beaked common dolphin (*Delphinus capensis*) (19.7%), Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) (15%), Finless Porpoise (*Neophocaena phocaenoides*) (10.7%) and Risso's Dolphin (*Grampus griseus*) (2.8%). The Short-finned Pilot Whale (*Globicephala macrorhynchu*) and Sperm Whale (*Physeter microcephalus*) were occasionally sighted (< 1%). About 85.6% of fishers were able to correctly identify the cetacean species owing to their experience. Several studies have reported the occurrence of species like humpback dolphins and spinner dolphins (Raphael et al., 2017; Edwin et al., 2017; Koya et al., 2018).

Cetaceans or non-cetacean species were described to prey on catch or bait trapped within the gear (depredation) and respondents have reported damage to catch. Other non-cetacean species like puffer fish and jelly fish also cause depredation, like puffer fish being reported by 27% of respondents, which is almost equal to those who reported damage by the humpback dolphin (30%). Other species reported include Indo-Pacific bottlenose dolphin (12%), common dolphin (12%), spinner dolphin (9%) and crab (6%) (Fig. 3a).

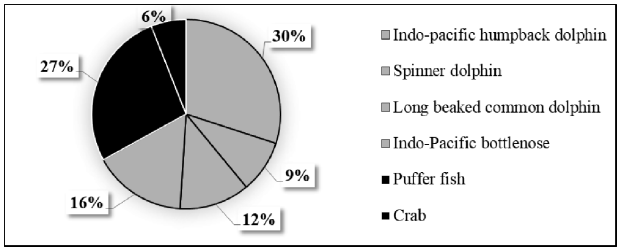

Fig. 3a. Damage by cetacean and non-cetacean species by depredation as reported by interviewees (in %)

Gear damage caused by cetaceans was observed to be more frequent than the non-cetacean species (Fig 3b). Damage to gear is mainly by humpback dolphin (37%) and Indio-Pacific bottlenose dolphin (16%). In majority of cases cetaceans were sighted close to the gear, when depredation and gear damage occurred. Experienced fishers are able to identify the species causing depredation, either through direct observation or based on the character of the damage. Cetaceans usually tear the fish and leave distinctive bite marks, and in some cases leave behind the fish head in the nets, whereas puffer fish and crab bite the fish in half leaving the body parts behind.

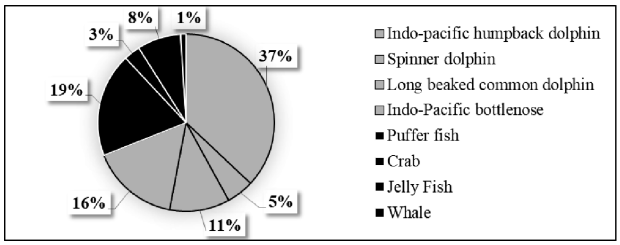

Fig. 3b.Damage by cetacean and non-cetacean species to gear, as reported by interviewees (in %)

The study observed that the humpback dolphin was mostly responsible for gear damage in gillnets, while the humpback dolphin, spinner dolphin, and common dolphin were mostly responsible for the purse seine webbing damage. Trawl cod end damage by cetaceans is reported, but was comparatively very low when compared to other gears because the trawl nets are active gears made of high

strength twines. Dolphins are considered problematic for fishermen who use gillnets and purse seines targeting pelagic species as they tear big holes in the webbing to get fish out of nets (Brotons et al., 2008). Sometimes it gets entangled in the gear and cause damage to large sections of the webbing in order to escape. Repairing the gear is often expensive and loss of working days also occurs exacerbating losses. Gear damage caused by dolphin is more frequent indicating that dolphins depredate on fish and sometimes took fish from nets as an additional food source (Rocklin et al., 2009).

Incidental capture of cetaceans in fisheries has been reported to be a major concern in many countries (Northridge, 1991; Kiszka et al., 2008; Reeves et al., 2013; Temple et al., 2018) and in India cetacean bycatch in tuna and seerfish gillnet catches has been reported (Lal Mohan 1985, 1994; Sathasivam 2004, Kumarran 2012) with estimates being roughly around 1,00,000 small cetaceans yr-1 (Anderson et al., 2020) to 9,000-10,000 ind. yr-1 (Yousuf et al., 2009) in various years for Indian gillnetters. In the present study, about 15.3% of respondents reported incidental bycatch of cetaceans, mostly in gillnets, purse seines and trawls.

Small scale fisheries have been significantly related to humpback dolphins bycatch. Fishers claim that animals encircled in purse-seines usually survived by tearing the net or being helped by fishers to escape and hence bycatch is less. In the case of gillnets and trawls if cetaceans are caught in the gear chances of mortality are higher because of long duration of entangling or dragging of the gear.

The number of interactions of cetaceans with gear are maximum in the pre-monsoon season (54.3%) followed by post-monsoon (37.4%) and monsoon (8.3%) seasons, with the maximum in the month of April (pre-monsoon) and the minimum in August (monsoon). The cetacean interaction is more during the pre-monsoon season probably because the sea water is very clear, whereas in monsoon season the sea water is turbid and visibility poor. There was not much seasonal variability in species composition and distribution with Indo-pacific humpback dolphin and spinner dolphin being the dominant species that were observed in all the seasons.

Catch loss per vessel/interaction was about 15% of total catch. About 40.6% of the fishers reported depredation and 45% of respondents reported high catch loss (ranging from 50 to 100% of the total

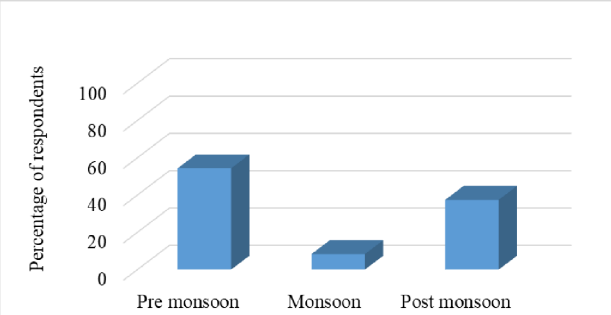

Fig. 5. Seasonal distribution of ceatceans

catch). When cetaceans interfered with fishing operations, there is a very high possibility of losing the entire catch, and this was most common in bulk fishing methods like purse seines and ring seines. The economic losses ranging from Rs. 0.5 – 2.0 lakh per incident have been recorded. The annual economic loss associated with catch damage was <10% of the catch proceeds in 63% of cases and 61% of it was in shoaling species.

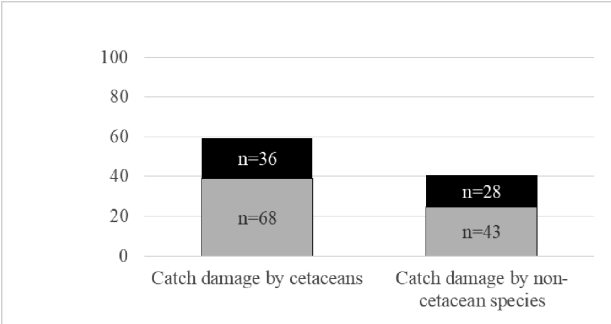

Fig. 6. Percentage of respondents reporting depredation/ loss (n=175)

Gear damage by Indo-pacific humpback dolphins was related to significant economic loss as reported by 35.7% of respondents. There were significant losses in coastal gillnets (90%) than other gears. Other non-cetacean species causing significant catch and gear damage were puffer fish (71.8% of non-cetacean cases), crab (14%), jelly fish (12.5%) and others (1.5%). Studies have reported that the economic loss caused by dolphin, puffer fish, jelly fish ranges from Rs.1,000-3,00,000 (Raphael, 2017).

Mitigation measures are resorted to by fishers especially those who use purse seines and gillnets. In purse seine fishery it is reported that cetacean cause scattering of fish shoal and occasionally cetaceans are encircled with the catch. The cetaceans escape from the net by making tears that can cause

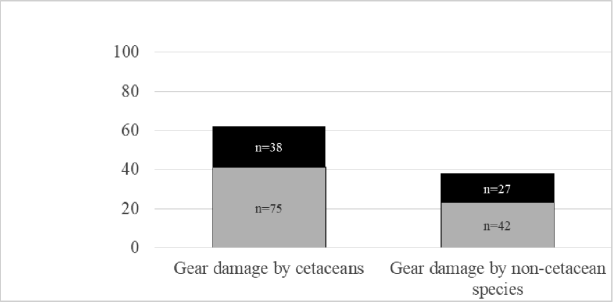

Fig. 7. Percentage of respondents (n=182) reporting gear damage

the entire catch to escape through the hole. One of the main measures resorted to by the fishers is delaying fishing operations until the cetaceans had left the fishing grounds (53.4%). Another approach was to scare the animal away from the vessel by creating noise (32.6%), using fire crackers or throwing stones (Joseph et al., unpublished). Few fishermen reported that they reduced the operation time (15%). Feeding small fishes to cetaceans while they approach the net and the use of dolphin wall net (Prajith et al., 2014) are other measures practised.

About 12.5% of respondents took the presence of cetaceans as a positive sign as their presence indicated fish shoals in the region. Fishers agreed that "interactions are natural and we have to accept them. The most frequently mentioned mitigation strategy for all types of fisheries was to avoid fishing in areas where dolphins were present, as the interactions occurred because of overlap of preferred fishing grounds and cetacean feeding areas, though practical difficulties exist in implementation this strategy. Acoustic deterrent devices could be deployed to keep the cetaceans off (Gazo et al., 2008). Cetaceans interact when there is ready feed available and reduction in use of small meshes and size of gear was another mitigation measure. There is also need for research on cetacean bite resistant materials for fishing gear.

The fishing gear used and target catch were the most important factors determining cetacean attack and gillnets were the most prone to cetacean interaction. Interactions were more frequent during pre-monsoon and towards the shore than in offshore areas. Other factors that determined cetacean interaction were duration of fishing operation/ hauling, climatic change, depth of operation, full moon day and weather. The fishers' ecological knowledge can be used as a reliable source of data for management (Johannes et al., 2000) and these observations can be taken for evolving mitigation strategies. Since small gillnets that operates near shore is considered as the most prone fishery, this can be first targeted for evolving mitigation strategies. Greater cooperation among fishers can also significantly reduce cetacean bycatch (IWC, 1994) and use of acoustic pingers can be considered as a novel management option in India.

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