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Stranding events in the Philippines provide evidence for impacts of human interactions on cetaceans

Marie Christine M. Obusan [a, c, *], Windell L. Rivera [a, b], Maria Auxilia T. Siringan [b], Lemnuel V. Aragones [c]

[a] Institute of Biology, College of Science, University of the Philippines, Diliman, Quezon City, 1101, Philippines
[b] Natural Sciences Research Institute, University of the Philippines, Diliman, Quezon City, 1101, Philippines
[c] Institute of Environmental Science and Meteorology, College of Science, University of the Philippines, Diliman, Quezon City, 1101, Philippines

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ABSTRACT

Human interactions continue to affect cetacean populations worldwide. In particular, fisheries are some of the serious threats which can take the form of direct fishery interactions (e.g. mortalities or injuries from fishing gear) or indirect fishery interactions (e.g. prey availability). In this study, cetacean stranding events (n = 354) that occurred in the Philippines from July 1998–March 2013 were analyzed for different forms of human interaction (HI). A subset of these strandings (i.e. 27 events with 28 individuals) was attended from January 2012–March 2013 using a protocol to examine stranded cetaceans for signs of HI. Based on HI categories, stranding events were classified as: (1) *Non-HI Strandings* or strandings not caused by HI (n = 21); (2) *HI-Strandings* or strandings caused by HI (n = 47); and (3) *CBD* (Could not Be Determined) or strandings (n = 286 in total) in which the contribution of HI was neither assessed (n = 278) nor confirmed (n = 8). Most stranding events had northeast monsoon seasonality. The findings from the protocol used for investigating HI in the representative subset of strandings demonstrated what could have been possibly missed in the larger dataset that included all other stranding events recorded from July 1998. Thirty-three percent of the assessed strandings in the subset were confirmed as *HI-Strandings*, and this proportion translates to at least 92 stranding events under *CBD* that were not assessed at all. In general, HI negatively affected stranded cetaceans by inflicting physical injuries (and often resulting to mortalities), eventually increasing their likelihood to strand. The regions with higher proportions of *HI-Strandings* were those previously identified as regional stranding hotspots: Region III (Central Luzon), Region VII (Central Visayas), Region V (Bicol Region), and Region I (Ilocos Region). The implicated forms of HI in the case of direct fishery interactions included entanglement in fishing nets, entrapment in fish cages, collisions with fishing vessels, and fishing gear-associated injuries; while those of direct human interactions included physical attack, intentional capture, and collision with a navigation vessel. Given the high frequency of live cetaceans getting stranded due to direct fisheries interaction, this study suggests the plausibility of considerable human-induced cetacean strandings in Philippine waters. As demonstrated, stranding events are practical opportunities to investigate the impacts of human interactions on cetaceans, and offer the chance to trace the links to fisheries even in animals that strand for any other reason. Future efforts should consider systematically assessing local cetacean stranding events for signs of HI and associating findings on parameters of fishing pressure. Likewise, blast-induced trauma, as well as marine debris ingestion or entanglement, need immediate research attention. All of these have important management implications for conserving the country's diverse cetaceans in relation to resource-use conflicts with humans.

1. Introduction

The Philippines is host to a diverse assemblage of cetaceans including 22 odontocetes and six mysticetes (Aragones, 2013). Like other marine mammals in several parts of the world, their

* Corresponding author. Institute of Biology, College of Science, University of the Philippines, Diliman, Quezon City, 1101, Philippines.
E-mail address: christine.obusan@gmail.com (M.C.M. Obusan).

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populations may be at risk due to unprecedented changes in marine environments brought about by natural and anthropogenic factors (Moore, 2008: O'Shea and Odell, 2008). Specifically quantifying or qualifying the threats faced by these animals is imperative as the conditions of marine ecosystems in the country are challenged by human activities (Aragones et al., 2013; Green et al., 2003; White et al., 2000). In particular, human interactions are known to cause cetacean mortalities; a very significant source of which is fishery operations (IWC, 1994; Northridge, 1991; 1984; Read et al., 2006; Reeves et al., 2005; Reeves et al., 2013; and others). There are mainly two types of interactions with marine mammals involving fisheries: (1) direct (also known as operational or technical) fishery interactions in which marine mammals usually come into physical contact with fish catching devices resulting in negative effects for both these animals and the fishery; and (2) indirect (also known as biological or ecological) fishery interactions in which marine mammals and the fishery compete for target fish species and their geographical sources (Northridge, 1984; Plaganyi and Butterworth, 2005; Read, 2008). In this paper, we take the position to refer to human-induced mortalities or injuries in cetaceans generally as human interaction (HI), with those confirmed to be emanating from fisheries as direct fishery interactions based on the above differentiation and as supported by clear evidence from the methodology conducted.

As the most common form of HI, fishery interactions involving marine mammals are expected to rise in frequency as fishing intensity increases (Anticamara et al., 2011; Green et al., 2003; Kemper et al., 2005; Leeney et al., 2008; Muallil et al., 2011). While the negative effects of cetacean-fishery interactions have been recognized (Bearzi, 2002; Lopez et al., 2002; Lopez, 2006; Mangel et al., 2010; Morizur et al., 1999; and others), baseline information on human-induced cetacean mortality is lacking in many regions of the world (Reeves et al., 2003). Cetacean-fishery conflicts were reported in some parts of the Philippines (Dolar et al., 1994, 1997, 1994) and some local cetacean species were listed as global priorities for bycatch: e.g.spinner dolphins and Fraser's dolphins for large-mesh driftnet and purse seine fisheries, and Irrawaddy dolphins for crab net/trap fishery in Malampaya Sound (Reeves et al., 2005). Read (2008) also asserted the absence of a system for assessing bycatch effects among local cetacean populations. Aragones et al. (2010) suggested the possible linkage of high percentages of marine mammal live strandings (65%) to dynamite fishing and fisheries interactions, and noted that most of the provinces identified as stranding hotspots are considered very heavily exploited fishing grounds based on delineated fishing efforts by Green et al. (2003).

While bycatch events have been widely used to assess the serious threats of fisheries to cetacean populations (Bertozzi and Zerbini, 2002; Cappozzo et al., 2007; Di Beneditto, 2003; Franco-Trecu et al., 2009; Iñíguez et al., 2003; Morizur et al., 1999; Read et al., 2006; Secchi et al., 2004), stranding events were also studied to determine the impacts of HI, especially of direct fisheries interactions, to cetaceans (Danil et al., 2010; Leeney et al., 2008; Lopez et al., 2002; Mangel et al., 2010; McFee et al., 2006; Netto and Barbosa, 2003; Parsons and Jefferson, 2000; Sequeira et al., 1997). Stranding events are practical occasions to observe different forms of HI in both live and dead animals, regardless of the cause of their stranding. Frequencies of cetacean stranding events in the Philippines have been reported as increasing in recent years (Aragones et al., 2010), and this, coupled with the growing involvement of stranding networks, provides an opportunity to look into the threats posed by human activities to local cetaceans. This study aimed to: (1) investigate the impacts of HI in local cetacean stranding events that occurred from July 1998–March 2013; (2) classify these events based on HI involvement; (3) analyze seasonal and geographical trends of these classified events; and (4) determine specific forms of HI in well-documented stranding cases.

2. Materials and methods

2.1. Stranding events

Cetaceans and their strandings in Philippine waters are under the authority of the Department of Agriculture - Bureau of Fisheries and Aquatic Resources (DA-BFAR). With the limitations in government resources, DA-BFAR is often assisted by local government units (LGUs) and Philippine Marine Mammal Stranding Network (PMMSN) in responding to cetacean stranding events. Strandings documented from July 1998–March 2013 were investigated for the involvement of HI. Included in this dataset are cetacean strandings collated by PMMSN from July 1998–December 2012 and those attended by the researchers from January 2012–March 2013 using a protocol for examining HI in stranded cetaceans.

2.2. Data collection and analysis

Beginning in 2008, strandings that were given appropriate response in coordination with PMMSN have been providing relevant information about cetaceans. A stranding response form initially developed by Aragones and Laule (2008) and revised by Aragones et al. (2013) gathers data on: (1) initial observation – animal size, age class, and condition; (2) stranding site address and description; (3) type of stranding; (4) morphological data; (5) involvement of human activity; (6) condition and disposition of stranded animal when alive; (7) whole carcass status; and (8) detail of the necropsy done in case of animal mortality (the latest version of the form is available from www.pmmsndatabase.upd.edu.ph). From January 2012–March 2013, the protocol "Examining Stranded Cetaceans for Signs of Human Interaction (HI)" was employed. This was adapted and modified from two earlier works: (1) "Protocol for Evaluating Marine Mammals for Signs of Direct Human Interaction" developed by the Cape Cod Stranding Network and Virginia Aquarium & Marine Science Center (Geraci and Lounsbury, 2005); and (2) "Evaluation of Human Interaction with Small Cetaceans" (Read and Murray, 2000).

The employed protocol has five parts. The first part (General Information) collected data on sampling history (e.g. site, date, examiner, documentation, etc.) morphometrics, sex, weight, and condition code (based on Smithsonian classification) of the strander. The second part (Initial Observation) solicited first- or second-hand accounts of the original location of the animal in relation to the presence of fish catching devices (e.g. traps, nets, gears) in the stranding site. The third part (External Examination) obtained details about the integument (i.e. appearance and percentage coverage), body condition (based on degree of emaciation), mutilation, predation or scavenger damage, external bruising, presence of fishing debris or gear, and suspected HI lesions. Human interaction lesions were further examined per anatomical area as to type and probable origins. Predation or scavenger damage was checked on the same anatomical areas examined for lesions. The fourth part (Internal Examination) aimed to find indications of HI in inside body parts (i.e. subdermis, bones, lungs, bronchi, stomach, and other major organs). The fifth part (Final Evaluation) assessed the likelihood that HI caused the stranding event. A supplementary guide is also provided (the protocol will be made available for access at www.pmmsndatabase.upd.edu.ph).

Immediately after a stranding report is made, the researchers travelled to the stranding sites or coordinated with trained members of PMMSN to carry out the protocol. The archipelagic nature of the Philippines poses many challenges to stranding response. The