Entanglements of Large Cetaceans in Peru: Few Records but High Risk[1]

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Abstract: Entanglements of large cetaceans with fishing gears were only recorded four times in Peru before 1995, despite the intensive use of gill nets and longlines. This work compiles recent events of large cetacean entanglement in Peru, from direct observations, local news, and online graphical evidence. A total of 15 confirmed entanglements was recorded between 1995 and 2012, involving humpback whales, *Megaptera novaeangliae* ($n = 10$); sperm whales, *Physeter macrocephalus* ($n = 3$); an Antarctic minke whale, *Balaenoptera bonaerensis*; and an unidentified balaenopterid. Gill nets were involved in 80% of the entanglements, followed by longlines. Prevalence of humpback whale entanglements may be associated with the neritic location of the majority of gill net fishing sets, interfering with the whale's migratory routes and reproductive habitat in northern Peru. Intensive use of gill nets and increasing use of longlines in artisanal fisheries represent serious threats to conservation of large cetaceans in Peru and the Southeast Pacific and need to be addressed by national and regional conservation authorities.

The rapid growth of fisheries in the past decades has impacted the conservation status of many cetacean species due to the increase in incidental captures in fishing gears. This is especially prevalent in areas where the distributions of these species overlap with areas of intensive fishing effort (Northridge 1991, 2002, International Whaling Commission 1994, Clapham et al. 1999, Reeves et al. 2003).

The highly productive Humboldt Current ecosystem off Peru is home to some of the most intensive fisheries operations in the world (Bertrand et al. 2004, Bakun and Weeks 2008). That same productivity also supports a large diversity of cetacean species in the region (reviewed by Reyes 2009), some of whose populations experience elevated levels of fishery-related mortality (Van Waerebeek and Reyes 1994*a*, Van Waerebeek et al. 1997, García-Godos 2007, Mangel et al. 2010, Tzika et al. 2010).

In the past decades, cetacean conservation in Peru has been focused mainly on the mortality of small cetaceans during fishing operations, which was estimated to range from 10,000 to 17,000 individuals landed annually between 1988 to 1994 (Read et al. 1988, Van Waerebeek and Reyes 1994*a*, Van Waerebeek et al. 1997). Now, more than 20 yr after the first report of a cetacean-targeted fishery, high incidental and intentional takes of these species are still a conservation issue in Peru, mainly due to the sustained use of coastal gill nets (Van Waerebeek and Reyes 1994*a*, García-Godos 2007, Mangel et al. 2010), the most extensively deployed fishing gear in the country (Estrella et al. 2010, Alfaro-Shigueto et al. 2010).

Unlike the situation with small cetaceans, however, interactions of large cetaceans with fisheries have seldom been reported in Peru, and there is almost no published information

[1] Manuscript accepted 31 January 2013.

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[3] J.C.M. and J.A.S. are supported by the Darwin Sustainable Artisanal Fisheries Initiative in Peru and Whitley Fund for Nature. University of Exeter, Cornwall Campus, Penryn, Cornwall, TR10 9EZ, United Kingdom, and Pro Delphinus, Enrique Palacios 630-204, Lima 18, Peru.

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Pacific Science (2013), vol. 67, no. 4:523–532
doi:10.2984/67.4.3

on this subject. However, because the level of entanglements of small cetaceans in Peru is very high and distributions of both large and small cetaceans roughly overlap, it is reasonable to conclude that large cetaceans are affected by fishing gears to some extent, as occurs in other countries of the region, such as Ecuador (Alava et al. 2005, Félix et al. 2007, 2011), Colombia (Capella et al. 2007), and Chile (Aguayo-Lobo 1999, Galletti and Cabrera 2007). However, only four large cetacean entanglements have been reported in Peru. The first was the entanglement and subsequent death of a humpback whale calf (*Megaptera novaeangliae*) in August 1979, off Callao, central Peru (Valdivia and Ramírez 1981). The second recorded entanglement occurred in October 1988 in San Juan de Marcona, southern Peru, when an adult humpback whale became entangled in a gill net and was subsequently towed alive to port, resulting in its successful release with assistance from the community and compensation of the fishermen (Majluf and Reyes 1989). Another two records involved the bycatch in drift gill nets and butchering of two juvenile Antarctic minke whales (*Balaenoptera bonaerensis*) in Pucusana port, central Peru, in 1991 (Van Waerebeek and Reyes 1994*b*).

Here we present a compilation of new records of fishing gear entanglements of large cetaceans in Peruvian waters. This document can be a first step toward focusing attention on their conservation and on the need to implement effective entanglement mitigation measures in one of the world's most intensively exploited marine ecosystems and complements information gathered in other countries of the Southeast Pacific.

MATERIALS AND METHODS

This review includes only large cetaceans (mysticetes and sperm whales). Only confirmed records of entanglement were taken into account (that is, when the fishing gear was observed or definitive signs of its presence were demonstrated [characteristic wounds of nets or longlines]). Records comprise original data we collected (sightings at sea and examination of stranded whale carcasses) and documented information from third parties, including reports obtained from the local news media (newspapers, Internet, and TV) from 1995 onward. Four historical published records are also included. The maturity status of whales was classified as calf, juvenile, or adult, estimated from body size from either photographs or direct field observations.

RESULTS AND DISCUSSION

There were 15 newly documented records of large cetacean entanglements in Peruvian waters between 1995 and 2012, thus 19 records in total reported since 1979 (Table 1, Figure 1). Humpback whales accounted for 66.7% ($n = 10$), followed by sperm whales, *Physeter macrocephalus* (20.0%, $n = 3$); one Antarctic minke whale (6.7%, $n = 1$); and an unidentified balaenopterid. It is noteworthy that no interactions with other pelagic whale species common in Peruvian waters (e.g., Bryde's whale, *Balaenoptera edeni;* and blue whale, *B. musculus* [Majluf and Reyes 1989, Reyes 2009, Navarro Pardo et al. 2011]) were recorded and that the three confirmed records of Antarctic minke whales in Peru are known from fishery interactions (Van Waerebeek and Reyes 1994*b*; this article).

Humpback whale entanglements were concentrated in central (Figure 2) and northern Peru (Figure 1), and interactions with Antarctic minke whales occurred in two localities (Pucusana and Puerto Morin). Sperm whales stranded in southern Peru (Moquegua Region [Figure 3]) and northern Peru, where another single record involved a multiple entanglement and partial release of at least three individuals that caused the loss of a part of the fishing gear (Table 1). Humpback whale entanglements off central Peru (Lima) occurred between June and December. Of 10 humpback whales of known maturity status, five were adults, three were juveniles, and one was a calf (Table 1). Entanglements of lactating females would also produce the subsequent death of associated calves, as likely happened with the event reported on 19 September 2009 (Table 1). The concentration of humpback whale entanglements in Tumbes, Peru's

northernmost province, reflects the southern extent of the large Southeast Pacific breeding ground centered in the shelf waters off northern Peru, Ecuador, and Colombia (Flórez-González et al. 2007, Pacheco et al. 2009). This stock has been severely affected by fishery interactions, with an estimated rate of 32 net entanglements per year in the period 2004–2006 in Ecuador (Félix et al. 2007) and a mean of 2.8 entanglements per year between 1996 and 2006 in Colombia (Capella et al. 2007). The wide spatial and temporal distribution of entanglements documented in Peru suggests that both breeding and migrating humpback whales are affected, underscoring the high level of threats in coastal waters to the conservation status of the Southeast Pacific stock of the species.

Sperm whales affected by fishing gears in southern Peru may be part of the stock shared with Chile (García-Godos 2007), where fishery-related mortality has seldom been recorded but fishery interactions through predation on the catch of the longline fishery are known to occur (Aguayo-Lobo 1999, Galletti and Cabrera 2007). However, in two of three cases reported here gill nets were involved in the entanglements. Sperm whales entangled off northern Peru may be part of the Ecuador–northern Peru stock, as suggested by previous sightings (García-Godos 2007).

All the fishing gears involved had been set for a variety of target fish species by the Peruvian small-scale artisanal fishery, which is composed mainly of wooden boats up to 10 m length and with limited storage capacity. The estimated number of fishing boats operating in 2009 was 10,385 (Estrella et al. 2010). Gill nets were used more frequently than any other fishing gear (33%), and longlines ranked fourth in gear use frequency (8% [Estrella et al. 2010]). Gill nets were by far (80%) the main cause of entanglements of large cetaceans in Peru, and longlines were positively linked to only two large cetacean strandings. In addition, encounters of humpback whales with diving lines and ropes of scallop harvesters were described around Lobos de Tierra Island, northern Peru, with no mortality reported (García-Godos 2007).

Despite the small size of the fishing boats involved in whale entanglements, the high numbers of boats and gill nets set per year in Peru have raised concerns regarding the sustainability of this fishery and the high levels of bycatch of threatened species associated with its operation (Alfaro-Shigueto et al. 2010). Gill nets have been identified worldwide as the main threat to cetaceans due to their low cost and flexible use both in coastal and offshore waters (International Whaling Commission 1994). The total length of gill nets set in Peru was estimated at >100,000 km per year (Alfaro-Shigueto et al. 2010), with almost 90% of fishing operations occurring less than 10 nautical miles (18.5 km) from shore (Estrella et al. 2010). This situation represents a risk for the more neritic large cetacean species, including humpback whales and southern right whales, *Eubalaena australis* (Van Waerebeek et al. 2009), and perhaps some balaenopterids such as Bryde's whales and Antarctic minke whales. Although no southern right whales have so far been found entangled in Peru, the species is known to be vulnerable to net entanglement in Chile (Aguayo-Lobo 1999), raising our concern for the Critically Endangered Peru-Chile subpopulation (Reilly et al. 2008). In addition, the longline fishery for elasmobranchs and dolphinfish (*Coryphaena hippurus*) is the fastest growing component of Peru's small-scale fishing fleet and typically operates beyond 10 nautical miles (18.5 km) from shore (Alfaro-Shigueto et al. 2010, Estrella Arellano and Swartzman 2010). This fishery conceivably could affect more pelagic species, such as sperm whales, rorquals, and ziphiids.

The small number of cases of large cetacean bycatch reported in Peru, when compared with the well-documented small cetacean bycatch (Read et al. 1988, Van Waerebeek and Reyes 1994*a*, Van Waerebeek et al. 1997, Mangel et al. 2010), may in part be a consequence of low levels of awareness among fishermen and local port authorities regarding the conservation of large cetaceans, leading to severe underreporting of whale entanglements. In general, a false perception exists that with the end of the commercial whaling operations in Peru in 1986

TABLE 1

Records of Large Cetaceans Entangled in Fishing Gears in Peru, Including Four Published Cases before 1995

No.	Species	Date	Locality	Position	Reproductive Status[a]	Condition	Gear Involved[a]	Source	Observations
1	*Megaptera novaeangliae*	Aug. 1979	Callao	12° 3.435′ S, 75° 9.724′ W	Calf	Dead	Gill net	Valdivia and Ramírez (1981)	
2	*Megaptera novaeangliae*	Oct. 1988	San Juan	15° 21.314′ S, 77° 09.690′ W	ND	Alive, at sea	Gill net	Majluf and Reyes (1989)	Whale was released by fishermen by cutting net after compensation was guaranteed
3	*Balaenoptera bonaerensis*	27 Sep. 1991	Pucusana	12° 28.992′ S, 76° 48.056′ W	Juvenile	Landed dead	Gill net	Van Waerebeek and Reyes (1994*b*)	Landed by artisanal fishermen at Pucusana port. Animal entangled in net some 20 nautical miles (37 km) offshore. Used for human consumption
4	*Balaenoptera bonaerensis*	30 Oct. 1991	Pucusana	12° 28.992′ S, 76° 48.056′ W	Calf	Landed dead	Gill net	Van Waerebeek and Reyes (1994*b*)	Landed by artisanal fishermen at Pucusana port. Reportedly captured near shore. Used for human consumption
5	*Megaptera novaeangliae*	1 Dec. 1995	Chancay	11° 35.000′ S, 77° 16.310′ W	Juvenile	Dead	Gill net	Instituto del Mar del Perú (unpubl. report)	Voucher data: photos archived at CEPEC
6	*Balaenoptera bonaerensis*	1 Jun 2002	Pto. Morin	8° 24.987′ S, 78° 54.306′ W	Juvenile	Dead	Gill net	I.G.G., this work	Incidental catch, butchered by fishermen
7	*Megaptera novaeangliae*	23 Nov. 2005	El Bendito	3° 28.654′ S, 80° 21.965′ W	Adult	Dead	Gill net	*Diario Correo*, Tumbes, 23 Nov. 2005	Gill net wrapped around entire body of whale
8	*Megaptera novaeangliae*	27 Jun 2007	Punta Mero	3° 53.887′ S, 80° 52.138′ W	Adult	Dead	Gill net	*Somos* magazine No. 553, year 11:32–35, Lima.	Incidentally entangled. Whale hauled on beach by fishermen on 27 June 1997, died 30 June
9	*Megaptera novaeangliae*	24 Jul 2007	Tumbes	3° 38.104′ S, 80° 34.9705′ W	Calf	Alive	Gill net	América TV News, broadcasted 27 July 2007	

10	*Megaptera novaeangliae*	9 Jun 2009	Paramonga	10° 48.805′ S, 77° 57.642′ W	Adult	Alive	Gill net	I.G.G., on board survey vessel, this work	A gill net around the head, thorax, and flippers. Tired swimming, raised the head above water for breathing
11	*Physeter macrocephalus*	5 Jul 2009	Ilo: Pozo de Lizas beach	17° 41.571′ S, 71° 21.6291′ W	Adult	Alive	Gill net	J.A.S., this work	Whale beached with gill net around the body (Figure 3)
12	*Megaptera novaeangliae*	30 Aug. 2009	Huarmey	10° 23.008′ S, 78° 32.611′ W	Adult	Alive, at sea	Gill net	I.G.G., on board survey vessel, this work	A gill net around the body, calm swimming, long dives
13	*Megaptera novaeangliae*	8 Aug. 2009	Pucusana	12° 28.992′ S, 76° 48.056′ W	Juvenile	Alive, at sea	Gill net	K.V.W., this work	Gill net wrapped around tailstock and flukes; K.V.W. partially cut floatline but failed to release animal due to onset of darkness (Figure 2)
14	*Megaptera novaeangliae*	19 Sep. 2009	Canoas	3° 52.060′ S, 80° 51.775′ W	Adult	Dead	Longline	América TV News, broadcasted 21 Sep. 2009	A calf stranded a few days later close to Canoas, likely the calf of this whale
15	*Megaptera novaeangliae*	27 Oct. 2010	Los Órganos	4° 10.391′ S, 81° 07.673′ W	Juvenile	Dead	Gill net	Diario El Comercio, Lima, 27 Oct. 2010	Signs of emaciation, sighted at sea several days before
16	*Balaenoptera* sp.	20 Jan. 2012	Punta Sal	3° 58.871′ S, 80° 58.872′ W	ND	Dead	ND	RPP news/ ReporteroW.com, published online 20 Jan. 2012	A rope tangled around tailstock
17	*Physeter macrocephalus*	15 Feb. 2012	Mollendo	17° 02.470′ S, 71° 59.772′ W	Calf	Dead	Longline	Amateur video posted on YouTube.com on 3 March 2012	Evident marks of lines around the body
18	*Physeter macrocephalus*	24 Jun 2012	Lambayeque	6° 58.500′ S, 81° 07.100′ W	Two adults and a juvenile	Alive, at sea	Gill net	Video taken on board fishing vessel, sent to J.A.S. by fishermen involved, published on YouTube.com	Fishermen cut a part of the net and let the whales go with it. The extent of entanglement is unknown
19	*Megaptera novaeangliae*	1 Jul 2012	Eten	6° 59.900′ S, 79° 48.270′ W	Juvenile	Dead	Gill net	RPP news, published online 2 July 2012	Slight marks on the back indicating gill net entanglement

[a] ND, not determined.

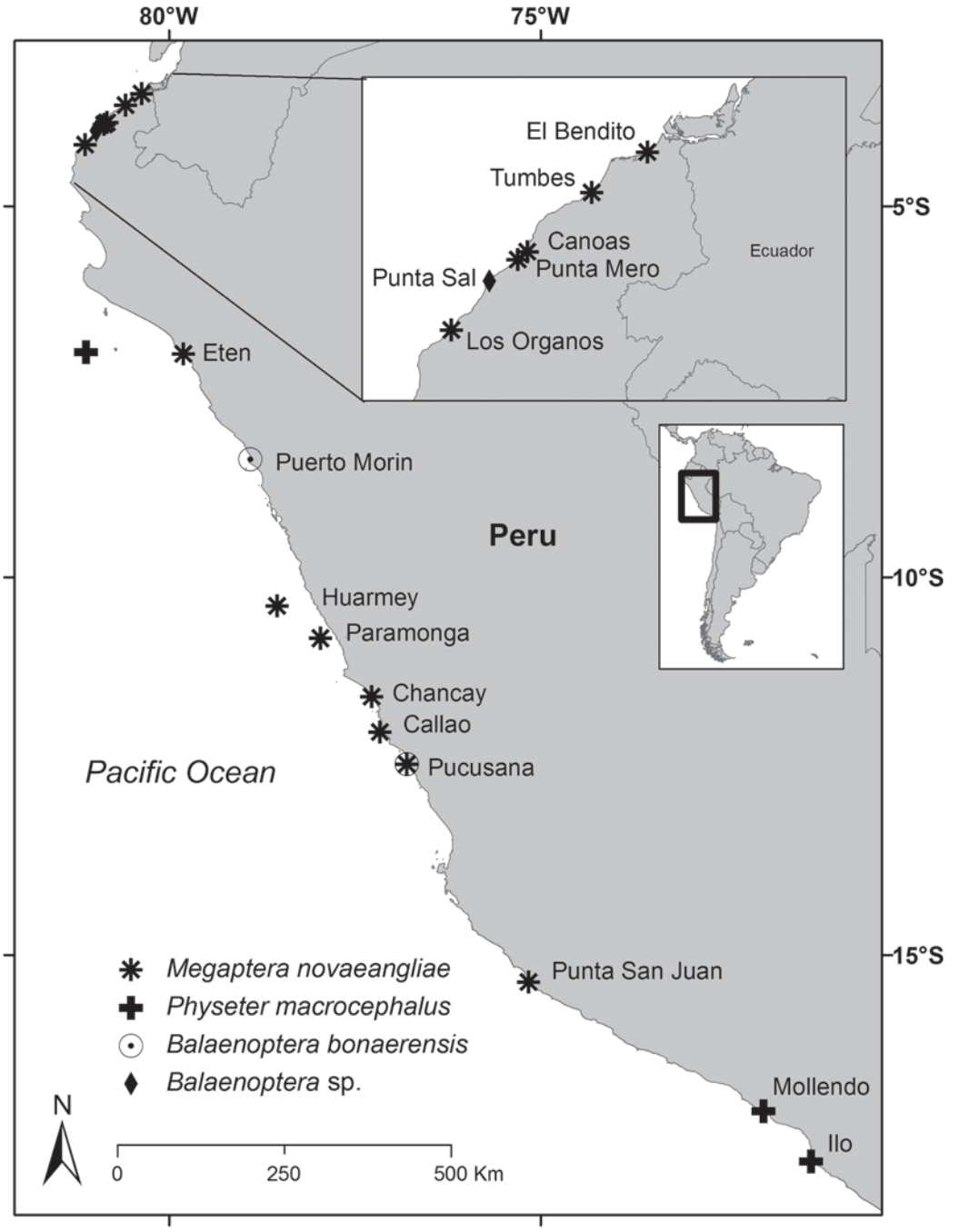

Figure 1. Location of large cetacean entanglements in fishing gears in Peru.

FIGURE 2. Humpback whale entangled off Pucusana, central Peru, towing the gill net corkline. (Photograph by Koen Van Waerebeek.)

FIGURE 3. Sperm whale entangled in a gill net and stranded alive in Pozo de Lisas beach, Ilo, southern Peru. (Photograph by Francisco Bernedo and Pro Delphinus.)

the conservation of large cetaceans was assured (García-Godos 2007); in consequence, other threats such as fishery interactions, ship collisions, pollution, and other human impacts have not been considered a conservation priority in the country.

The intensive use of gill nets and longlines along the Peruvian coast and within the exclusive economic zone represents a threat to the conservation of large cetaceans in Peru and the Southeast Pacific. Given the results reported here, the humpback whale is the most

vulnerable species to entanglements in Peru and the region, but attention should also be paid to resident species such as Bryde's whales and other species that would use migration corridors in Peruvian waters, namely sperm whales, southern right whales, Antarctic minke whales, blue whales, fin whales (*Balaenoptera physalus*), and sei whales (*B. borealis*).

The entanglement records presented here likely represent only a small fraction of the total entanglements that have occurred in Peruvian waters, because it is not possible to determine the real number of cases and the data-collection methodology applied was largely opportunistic. Some records in institutional databases remain unpublished. However, preliminary information taken from poll surveys suggests that interactions are frequent in northern Peru (Balducci et al. 2012), and artisanal fishermen from Pucusana, central Peru, indicated the same in interviews (pers. comm. to K.V.W., 9 and 10 September 2009). In contrast, the loss of gears following whale entanglements, although not an infrequent incident, is seldom reported to port authorities because no reimbursement policy and no reporting obligations exist.

To improve information gathering regarding large cetacean entanglements as well as mortality from ship strikes (Van Waerebeek et al. 2007), the implementation of a national stranding network along the Peruvian coast, integrated at the national and regional level, is necessary. Such a network should be capable of monitoring the impacts of fisheries and shipping on populations of large cetaceans off Peru. Useful information may also be gleaned from fishermen if reporting of whale entanglements and associated gear loss is encouraged. Finally, efforts should be made to raise awareness among fishermen and coastal communities of the impacts of whale entanglements, potential preventive and mitigation measures, and reporting duties. The first public attempts to implement this network are already on course.

ACKNOWLEDGMENTS

We are thankful to Julio C. Reyes (Áreas Costeras y Recursos Marinos [ACOREMA]), who provided useful information and comments on strandings presented in this article. Francisco Bernedo and Pro Delphinus provided Figure 3.

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