Entanglement of humpback whales in artisanal fishing gear in Ecuador

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ABSTRACT

Southeastern Pacific humpback whales (Breeding Stock G) congregate along the northwest coast of South America during the austral winter (July–October). Information collected from stranded animals for more than a decade in Ecuador and Colombia indicates that entanglement in fishing gear is a major threat for this population during the breeding season. Twelve new cases are reported here of live individual whales entangled in artisanal gillnets on the central coast of Ecuador from 2004 to 2007. The varying severity of the entanglement and the behaviour of the animals involved indicated that they had differing chances of survival. The findings confirm that the problem persists, although the impact on the population is unknown. The necessity of taking conservation measures to reduce the current level of entanglement is reiterated. Creation and training of rescue teams seems an appropriate alternative in the short-term, but in the long-term it will be necessary to design and implement actions with a wider regional scope, since the problem extends also to at least other two neighbouring countries.

KEYWORDS: INCIDENTAL CATCHES; GILLNETS; HUMPBACK WHALE; BREEDING GROUNDS; SOUTH AMERICA; SOUTHERN HEMISPHERE

INTRODUCTION

Cetacean bycatch in fishing gear is a conservation issue of increasing concern (Northridge, 1985; Perrin *et al.*, 1994; Read *et al.*, 2006; Reeves *et al.*, 2003). Interactions with fisheries occur mainly with artisanal and industrial fishing gillnets and both small and large cetaceans are involved. Global bycatch of cetaceans is estimated to be in the hundreds of thousands, although in most regions information is still fragmentary (Read *et al.*, 2006). Due to its coastal distribution, the humpback whale (*Megaptera novaeangliae*) is one of the most threatened large cetacean species. A few attempts to assess the impact of bycatch on humpback whales have been made at feeding grounds (e.g. Baird, 2003; Johnson *et al.*, 2005; Lien, 1994; Robbins and Mattila, 2001), but much less is known from the breeding grounds in tropical areas where the problem could have different characteristics.

Bycatch has been identified as the major anthropogenic threat for southeastern Pacific humpback whales (Breeding Stock G) during the breeding season in Ecuadorian and Colombian waters (Alava *et al.*, 2005; Capella *et al.*, 2001; Felix and Haase, 2005; Félix *et al.*, 1997; Flórez-Gonzáles *et al.*, 2007). Most cases of bycatch in Ecuador occur in artisanal multifilament gillnets of 10–15cm wide mesh and to a lesser extent in industrial gear (Félix *et al.*, 1997). Álava *et al*. (2005) estimated that around a third (29%) of the humpback whales stranded on the coast of Ecuador during the period 1991–2004 had gillnets around their bodies or deep cuts in their appendages and tailstock. A case of a humpback whale calf that died when it became entangled in an artisanal gillnet in the north of Peru was reported in a Peruvian newspaper[1].

[1] A note with a photograph of the dead specimen on the beach was published in the newspaper 'El Comercio', 26 July 2007.

Assessing the impact of fisheries in eastern tropical Pacific countries has been considered as a priority activity in several conservation strategies and action plans such as the International Union for the Conservation of Nature (IUCN) Action Plan for cetaceans 2000–10 (Reeves *et al.*, 2003), the Conservation of Migratory Species (CMS) Workshop on Aquatic Mammals in South America (Hucke-Gaete *et al.*, 2004) and the regional strategy for the conservation of the humpback whales in the Southeast Pacific (Flórez-Gonzáles *et al.*, 2007). The case of Ecuador is of particular concern because the country has the largest artisanal fishing fleet of all the Southeast Pacific countries (CPPS, 2003). By the end of the 1990s, the artisanal fleet in Ecuador numbered approximately 15,500 boats and 56,000 fishermen; this is around 5% of the economically active population inhabiting the Ecuadorian coast (Martínez and Viteri, 2005; Solís-Coello and Mendívez, 1999).

In this paper new cases of humpback whales entangled in artisanal gillnets found off Ecuador are presented. In contrast to previously reports which focused on strandings, these new cases involve live whales. This represents a first attempt to understand the magnitude of a problem that is not restricted to Ecuador, but potentially covers the entire breeding area of this population.

METHODS

Humpback whales were recorded during the breeding season (late June–early October) aboard whalewatching boats used as research platform off Salinas, Ecuador (2°10'S, 81°00'W) (Fig. 1). These data are part of the information collected within the framework of a long-term study of this species (see Félix and Haase, 2005; 2001). As standard, whales were photographed with a Canon Rebel Digital camera (6.3 megapixels) equipped with a 70–300mm zoom lens for

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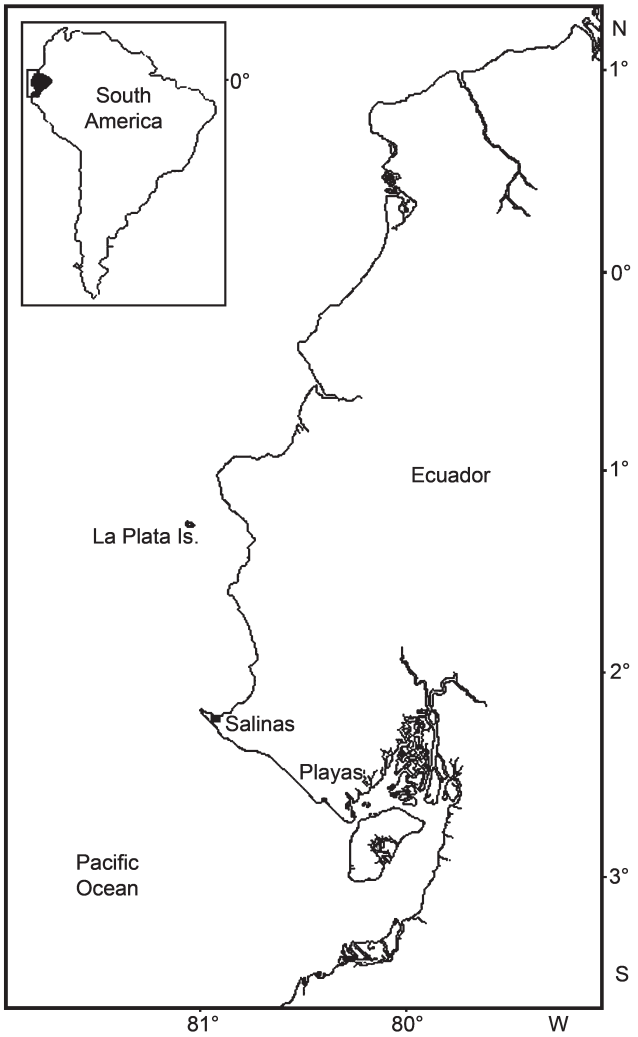

Fig. 1. The study site on the coast of Ecuador.

individual identification (dorsal fin and/or flukes). A summary of research effort can be found in Table 1.

During the seasons 2004–07, several whales were seen towing gear or ropes and these are referred to as 'entangled animals'. Some cases involved exhausted and slowly swimming animals with the flippers and tail compromised. Some less severe cases passed unnoticed in the field but were found during subsequent analysis of the photographs.

RESULTS

Case recorded in 2004

A whale observed breaching on 29 August 2004 was subsequently found to have a rope extending from head to tail along its left side (Fig. 2). The whale was escorting a mother with calf and during the sighting period breached six times. The rope was visible in three photographs taken at 12:36, 12:47 and 12:53, which indicate that the rope was tightly fastened to the body. This case of entanglement went unnoticed in the field, despite the group being followed for 48 minutes. Photographs of the whale's back and right side do not show signs of either rope or net.

Table 1

Research efforts in the period 2004–07.

	2004	2005	2006	2007	Total
Number of trips	77	74	135	104	390
Observation time (hr)	68.3	59.1	123.1	92.9	249.9
Net navigation time (hr)	136.3	94.8	301.4	167.4	533.4
Total navigation time (hr)	204.6	153.9	424.5	260.3	783.3
Total distance surveyed (km)		2,031	2,899	3,019	7,949

Fig. 2. Breaching whale with a rope hanging from the left side of the body.

Cases recorded in 2005

Three entangled whales were recorded during the 2005 season on 26 June, 10 August and 11 August (Fig. 3). All three cases involved adult animals. Since only the back of the whales was visible during the encounters, it was not possible to determine the extent of entanglement in each case or whether the whales had a chance to rid themselves of the fishing gear. The whale found in June was a severe case with a net around the anterior part of the body including the head. A long strip of net with yellow floaters showed the whale was towing several meters of gear, suggesting that the tail could be also compromised. The individual found on August 10 was a female who had previously been seen with a newborn calf for a short time; there was a net along the side of the body and no calf was present on August 10. The case on August 11 appeared more serious. The photographs show that the net was wrapped around the central part of the back and the dorsal fin; most likely the tail and possibly the flippers were also compromised.

The whale found in June moved slowly and stayed around the same area. It was evident during the observation period

Fig. 3. Whales recorded entangled off Salinas during the 2005 season. The order of the photographs is according to the date of the sighting.

that the net impacted on and slowed down its movements. In contrast, the other two whales moved apparently without problems. In the first and second cases (26 June and 10 August) the whales were a few hundred meters from shore off the Salinas tip, but the third whale (11 August) was located 2–3km north of this point.

Cases recorded in 2006

Three entangled whales were recorded in 2006 on 7 July, 23 July and 26 August (Fig. 4). The first case was an adult animal with net and ropes around the tail. This animal was photographed from a long distance and the net was not noticed during the sighting. The second whale was single and immature, found close to shore. That whale swam fast and made quite regular dives (5'07", 5'02" and 4'50"), coming up for five to ten breaths. At close range it was seen that both the tail and at least the left flipper were seriously entangled in green mesh gillnet, ropes and floaters.

The third case in 2006 was similar to that of 2004. A breaching whale was seen with remains or parts of gillnets and ropes hanging from the left side of the head. The net was tied to the left flipper and the chin knobs, but the tail and right flipper were apparently free. The whale was a solitary sub-adult that moved around slowly and close to shore. During the observation period (36 min) the animal was active and executed three breaches, two tail slashes and on two occasions raised its head out of the water. The net was not noticed in the field but was detected on three frames during the photographic analysis.

Another entangled whale was recorded on 25 October 2006 at Playas, located at about 80km southeast of Salinas (02°35'S, 80°23'W). Since this last case was not recorded during a whalewatching trip it was not taken into account when estimating the entanglement rate. The whale, a 14–15m adult animal, was seen from the shore from the early morning until 14:00, when a rescue attempt was made (Fig. 5). This was a serious case of entanglement, with most of the whale's back and tail wrapped in a 15cm–wide green gillnet. The whale looked exhausted, stayed almost motionless at the surface and breathed once every four to five minutes. The whale moved up and down along the beach with the tide. A small piece of gillnet of 10m long was cut away, but the rescue was interrupted due to poor visibility and inappropriate equipment. The whale was not seen again.

Cases recorded in 2007

Four cases were recorded in 2007 (14, 27 and 29 July, and 20 August) (Fig. 6). The first case involved a solitary whale with a net around the peduncle. The rear central border looked red due to a fresh wound. After two or three low blows, the whale started long dives (up to 8 min), appearing again a few dozens of meters away. It was noted that the whale made extra effort to get enough impulse from the tail before starting the long dive.

In the second case, remains of net and ropes were seen embedded in the blubber around the peduncle and flukes of the whale. The growth of barnacles on the gear indicated that the whale had been towing it for long time. This case may have occurred during the previous season. The whale swam and dove 'normally' and it was seen together with two other whales.

In the third case, a whale was seen with a net around the right side of its head, although other parts of the body, such

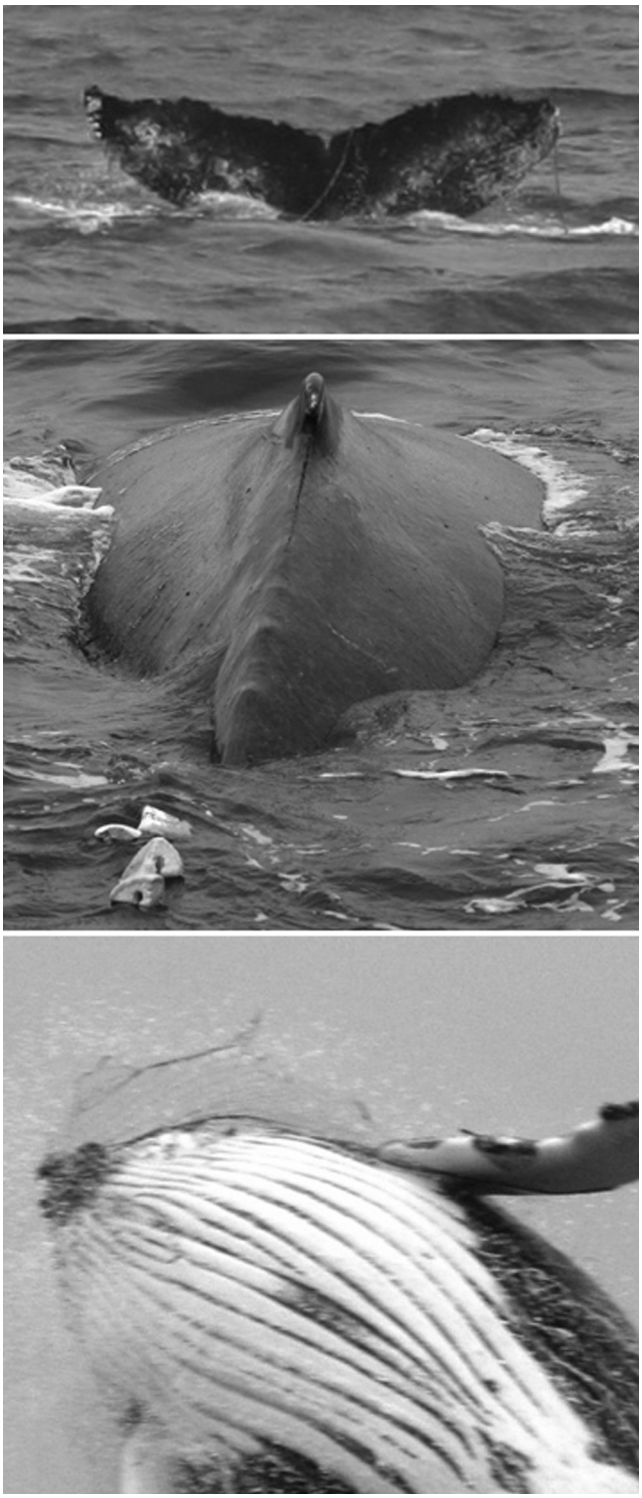

Fig. 4. Whales recorded entangled off Salinas during the 2006 season. The order of the photographs is according to the date of the sighting.

Fig. 5. A severe case of an entangled whale with a net around most of the body.

Fig. 6. Whales recorded entangled off Salinas during the 2007 season. The order of the photographs is according to the date of the sighting.

as the right flipper, may also have been compromised. This whale was accompanied by another whale, swimming together but doing short forward breaches and frequently raising its head out the water.

The final case involved a whale completely wrapped in net. A fresh wound to the tip of the dorsal fin indicated that the entanglement had occurred only a short time before.

Overview

In summary, six cases were considered severe, i.e. the whale was totally or partially wrapped in the net and/or the tail was compromised. Five cases were less severe, with just the remains of nets and ropes visible and a high probability that the whale could rid itself of them. In one case the gear was probably towed for months or even a year. In less severe cases, animals seemed to swim normally and were able to breach. More severe cases were found close to shore (five out of six cases), which may be a natural defensive reaction to the entanglement. This exposes the whales to other coastal gear and makes them also more likely to strand. Some completely entangled whales remained close to the surface. Some breathed frequently with a low blow, but others performed longer dives and breathed once when surfacing.

Photographs of the dorsal fin and/or flukes of the entangled whales indicated that all of them were different individuals and therefore there was no risk of duplication. In all cases when the net was clearly visible (n = 9, 75%), including the case when a piece of net was retrieved from a whale, the net was of the same type as used by Ecuadorian artisanal fishermen to catch large pelagic fish (a green 10–15cm width multifilament mesh).

DISCUSSION

The information obtained near Salinas during the period 2004–07 confirms previous reports which warned about the high bycatch rate of humpback whales in the Ecuadorian artisanal fishery (Table 2). Besides the twelve cases reported here, the authors knew of at least three other cases that occurred in other parts of the country involving stranded whales with gillnets around their bodies. Furthermore, sailors and naturalist guides reported to the authors additional cases of entangled whales off Salinas (not considered here) every year since whalewatching started in 2001 in this port. It is believed that the entanglement of humpback whales in artisanal gillnets in Ecuador and also in Colombia has had an upward trend in the last decade (Alava *et al.*, 2005; Capella *et al.*, 2001).

As gillnets are not fixed, it is not possible to confirm whether all cases occurred off Salinas or even in Ecuador. Most probably, entangled whales were recorded in Salinas due the concentration of research effort in the area. As no detailed data on artisanal fishing areas are available, it is difficult to assess the circumstances involved in the entanglements. It is not possible to establish the direct impact on the population since no data on survival are available. Many entangled whales presumably die of exhaustion or eventually of starvation if the entanglement lasts long enough to prevent them from migrating (e.g. the case recorded at the end of October 2006). Others may become easy prey to killer whales or sharks (see Mazzuca *et al.*, 1998). Photographs of the whales presented here show different chances of survival. Serious cases included single animals with gear compromising the tailstock and flukes, moving with limited or low speed and probably unable to free themselves. In less serious cases, only ropes or small portions of the nets were attached to the body. As four of the eleven cases (36%) remained undetected during field observations and were only noticed upon examination of photographs, the number of entanglements reported here must be considered a minimum. Several studies elsewhere indicate that true entanglement rate may be much higher than the number of cases recorded (Johnson *et al.*, 2005; Knowlton and Kraus, 2001; Robbins and Mattila, 2001). In particular, studies based on photographs of scars on the peduncle indicate that up to 65% of the humpback whales in the Gulf of Maine showed signs of previous entanglement (Robbins and Mattila, 2004) and up to 71% in Northern Southeastern Alaska (Neilson *et al.*, 2007).

Since all cases in which the fishing gear was identified involved pelagic surface gillnets, it may be concluded that such nets represent the greatest risk for humpback whales during the breeding season off Ecuador. This must be related to the behaviour of the whales in tropical waters, where humpbacks spend more time in the upper water column rather than performing deeper dives such as those when foraging (Johnson *et al.*, 2005; Robbins and Mattila, 2004). However, as humpback whales are susceptible to entanglement or entrapment in a variety of passive fishing gears (e.g. Johnson *et al.*, 2005; Lien, 1994) it cannot be ruled out that for the other three cases, when the gear were

Table 2
Number of sightings, whales and entanglement rate estimated per year (period 2004–07).

	2004	2005	2006	2007	Overall
Number of sightings	147	148	300	221	816
Number of non-entangled whales	322	346	710	551	1,929
Number of entangled whales	1	3	3	4	11
Entanglement rate	0.0031	0.0086	0.0042	0.0072	0.0057

not identified, remains of longlines or even industrial gear could have been involved. From previously reported cases of entanglement in Ecuador (including strandings) only one case was attributed to industrial gear (Alava *et al.*, 2005; Félix *et al.*, 1997). Considering that the Ecuadorian industrial fisheries are focused on small pelagic fish and tuna and that humpback whales do not feed during the breeding season, direct interaction with industrial purse seiners seems unlikely.

The data indicate that both adult and immature animals, probably of both sexes, are victims of entanglement. In the case of females accompanied by a calf (e.g. case number 2, 2005), the impact on the population would be even bigger, since calves would subsequently starve to death. Although not found off Salinas, calves occasionally do become entangled; at least two cases have been reported in Ecuador (Alava *et al.*, 2005; Scheidat *et al.*, 2000) and seven in Colombia (Capella *et al.*, 2001). Calves of the year were identified as the more affected class from entanglements in Hawaiian waters, a major breeding area of the North Pacific humpback whales (Mazzuca *et al.*, 1998).

CONCLUSION

As both fishing effort and the humpback whale population are probably increasing, it is expected that the number of entangled whales will continue to increase in the future unless counter-measures are taken. Several management actions have been proposed, including research, education programmes for artisanal fishermen, closed seasons, changes of fishing gear and ongoing disentanglement schemes (Alava *et al.*, 2005; Felix and Haase, 2005; Félix *et al.*, 1997; Félix and Samaniego, 1994). Some of these could be implemented on a temporary basis during the humpback whale breeding season or for specific areas with higher densities of whales. It is recommended that any proposal and/or decision must be agreed with relevant stakeholders including fishing authorities, artisanal fishermen associations and NGOs. Fishing and port authorities must be taken into account in the creation of rescue teams to free entangled whales. Despite the development of successful disentanglement programmes for large whales elsewhere, it has been recommended that efforts in the Ecuador area should be concentrated on trying to understand the factors involved in the entanglement rather than rescuing affected animals (Johnson *et al.*, 2005; Robbins and Mattila, 2001).

Major efforts are required to address bycatch in Ecuador and throughout the region, and the use of appropriate statistical procedures are required in order to establish the real magnitude of bycatch of humpbacks in the area. However, there is already enough information available to decision makers to start taking precautionary measures. Considering that the Southeastern Pacific humpback whale is a long-distance migrating species that occurs or disperses during the breeding season along the coast of at least five countries (Flórez-Gonzáles *et al.*, 2007; Rasmussen *et al.*, 2007), it is highly recommended that the problem be addressed in a practical regional context.

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