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# The last fluke of the trip: Preventing ship strike risk for humpback whales in Peru

Jeri, J.C.\*, Guzman, H.\*\*\*, and Leslie, A.\*

\* WWF-Peru

\*\*\* Smithsonian Tropical Research Institute

## ABSTRACT

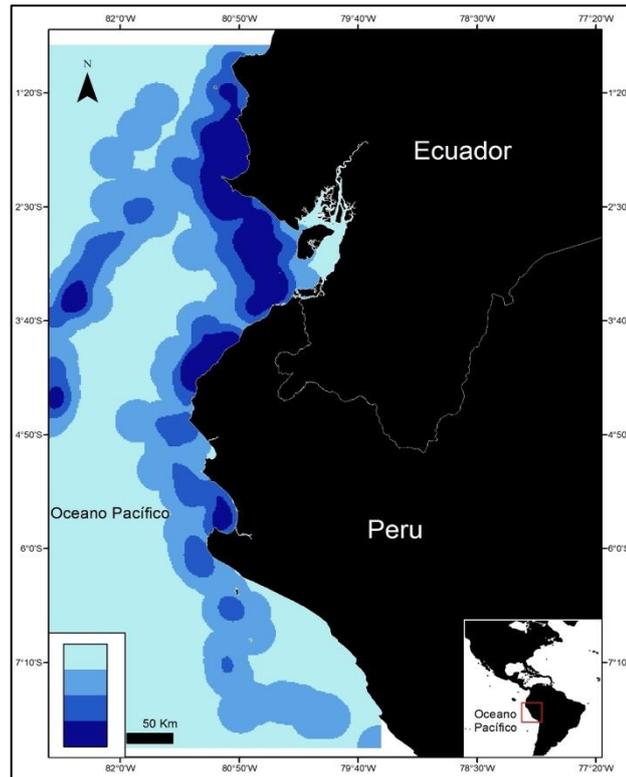
The Peruvian coastline represents the last fluke in the migration for humpback whales (*Megaptera novaeangliae*) in the Eastern South Pacific, as well as the southern limit of their breeding grounds. However, it is also a region with high risk of ship strikes, which represents a global and little understood threat for cetaceans. Female humpback whales and their calves remain a vulnerable group, as they prefer shallower coastal waters, travel at a slower speed and spend significant amounts of time resting in the surface. In that sense, marine traffic organizing measures, like speed limits, TSSs and ATBAs, have proven to be effective at reducing whale mortality associated to ship strikes. However, Peru lacks these tools for the organization of transiting shipping vessels. It is important that key countries like Peru put in practice models of marine traffic ordering, following the example of neighboring countries, such as Costa Rica and Panama, as these contribute to marine ecosystem conservation as well as safeguarding human activities such as fisheries and tourism. Finally, an evaluation of mortalities due to ship strikes along the coast of Peru is also necessary for a better understanding of this threat in local waters.

## INTRODUCTION

Peru's coastal waters serve as the southern portion of the breeding grounds for the population of humpback whales (*Megaptera novaeangliae*) that feed near the Antarctic Peninsula, and breed in the Eastern South Pacific, extending as far north as Costa Rica (IWC Breeding stock G) (Guidino *et al.*, 2014; Stevick *et al.*, 2004). As such, humpback whales off the coast of Peru are engaged both in breeding and migratory behaviours. However, these important migratory and breeding grounds are threatened by human activities, such as the expanding maritime traffic (Ávila *et al.*, 2017; Capella *et al.*, 2001; Felix *et al.*, 2005; Laist *et al.*, 2001; Redfern *et al.*, 2017).

Ship strikes represent a global threat for different whale species, as recorded in various oceans around the world (Thomas *et al.*, 2016; Kraus *et al.*, 2005). Vessel collisions can become a major threat to whale populations, as is the case for the severely endangered North Atlantic right whale (*Eubalaena glacialis*) in the eastern coast of North America (Kraus *et al.*, 2005). However, despite of the potential risk for whale populations, this issue has received little attention in the southern hemisphere (Van Waerebeek *et al.*, 2011).

Here we aim to highlight the potential threat of ship strikes for humpback whales in Peruvian waters and propose traffic separation schemes that would reduce the risk of collisions in this important transit and breeding area for the Eastern South Pacific humpback whale stock, as well as ensure safety at sea.



**Figure 1.** Density distribution of humpback whales in Peru showing home range core areas of high density (dark blue) between Manta (Ecuador) and Isla Lobos (Peru). Data from Santillan 2011; Pacheco et al., 2013; Guidino et al., 2014; and the Smithsonian Tropical Research Institute.

## HUMPBAC WHALE DISTRIBUTION

The northern coast of Peru constitutes a corridor of seasonal migration of humpback whales towards the equatorial region of reproduction and breeding, according to the Permanent Commission for the South Pacific. Humpback whales are observed from May to December, but more frequently between September and November. Cow-calf pairs have been observed in the shallow waters, close to the shore along Los Órganos (~ 4 ° S) and Sechura Bay (~ 5, 6 ° S). Approximately 98% of the observed humpback whales were in the neritic zone, where the water depths are less than 200 m.

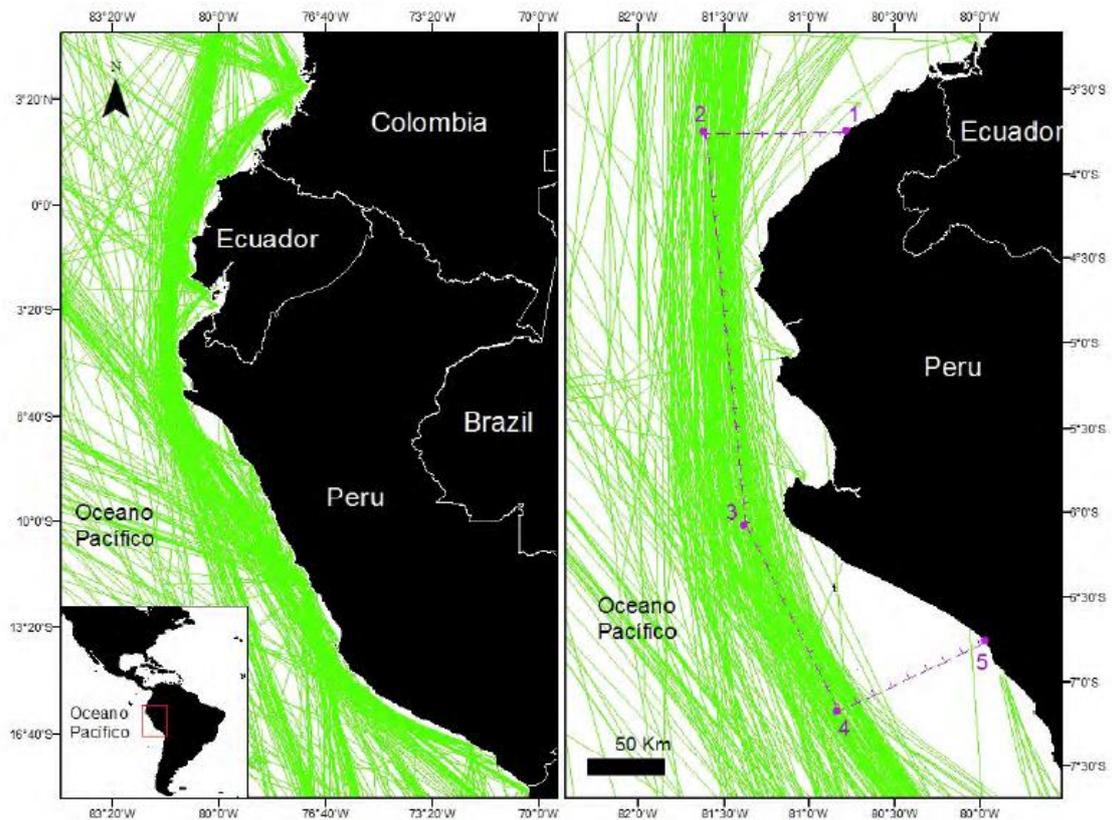
Recent studies have mainly focused on the southern limit of humpback whale breeding grounds, in northern Peru. Within their breeding grounds, whales mostly used neritic waters, less than 200 m deep (Fig 1.) (Pacheco *et al.*, 2009; Guidino *et al.*, 2014; Guzman & Félix, 2017). However, density was specific to depth ranges depending on group composition, with mother-calf pairs preferring shallower waters less than 50 m deep (Guidino *et al.*, 2014). This coastal distribution of females with calves is maintained by migrating females after leaving the breeding area (Félix & Guzman, 2014), which have been recorded travelling at a speed of 80.5-136.2 km per day (H. M. Guzman & Félix, 2017).

## SHIPPING ROUTES

Currently in Peru there is a lack of routing measures to organize shipping vessels traveling alongside the coastline. Organizing methods, such as ATBAs (Areas to Be Avoided) or TSSs (Traffic Separation Schemes), are scarce and focused in specific locations. The only ATBA is located in Paracas (S13°52'), a coastal natural protected area in southern Peru (IMO, 2002).

Meanwhile, in Peru there are 8 TSSs around the main ports, regulating the entrances and departures of vessels (IMO, 2000).

This lack of organization is concerning when one considers the economic growth that Peru and Chile have experienced in recent years, the signing of free trade agreements and the expected regional increase in marine traffic alongside their coast line. Furthermore, according to data collected by the Smithsonian Tropical Research Institute, all vessels tend to stay close to the Peruvian coast (Fig. 2). This results in the possibility of collisions between vessels and whales, as well as encounters with artisanal and industrial fishing vessels.



**Figure 2.** Long-range identification and tracking system (LRIT) data for general ships transiting from/to Peru and innocent passage for 12 months in 2013 (left panel) and detailed traffic at the most western point of South America (right panel).

### POTENTIAL SHIP STRIKE RISK

Shipping routes in the South Eastern Pacific often overlap with whale's habitat, either during the breeding season (Guzman *et al.*, 2013) or in transition areas (García-Cegarra & Pacheco, 2019). This overlap, in addition to the speed of the shipping vessels put whales in risk of harmful collisions. Although the magnitude of the impact of vessel-whale collisions in whale populations in Peru is yet unknown and has therefore received little attention for conservation actions (García-Godos, 2007); the projections of the region's trade growth with East Asian countries, for example, allow us to predict an increase in maritime traffic density in the near future, with the consequent increase in the probability of ship strikes.

Vessel-whale collisions take place along coastal areas where whales concentrate or transit seasonally for feeding or breeding (Laist *et al.*, 2001). In that sense, Peru being both a transit and breeding area for humpback whales is a region with potential risk of vessel-whale collisions. Mother-calf pairs are a particularly vulnerable group, as they devote a significant amount of time

to rest in shallow depths within reach of commercial ships, thus increasing the potential for vessel-whale collisions (Bejder et al., 2019).

Obtaining reliable estimates of mortality rates caused by collisions is challenging, as these interactions occur away from land and have different factors involved that can translate into over- or underestimations (Laist *et al.*, 2001). Lethal vessel collisions, either confirmed or not, have been documented alongside the breeding grounds of humpback whales in Costa Rica, Panama, Colombia, Ecuador and Peru (Guzman et al., 2013; Van Waerebeek et al., 2011).



**Figure 3.** The stranded cetacean corresponded to that of an adult female of a Bryde's whale (*Balenoptera edeni*) 13.2 meters long and weighing an estimated 40 tons, found in Huara, Lima. Staff of the Scientific Organization for the Conservation of Aquatic Animals (ORCA) made the identification of the body and the medical forensic part, concluding that the whale was hit on the left side of the head by a large vessel, which caused immediate death with a fracture and detachment of the tongue and severe hemorrhage. In addition, it was found that she was breastfeeding. Reported on March 2, 2014 by residents of the area.

The accident records demonstrate that in the Peruvian territory, 94 incidents have been reported since 2000, according to the database of the International Maritime Organization (IMO), mostly involving vessels engaged in the fishing industry. Of the total, 24 incidents were classified as very serious. In 2014, a report in Peruvian public media (EC, 2014) showed evidence of a probable lethal vessel collision in Paita (5.09° S). Citizens reported that a vessel arrived at port carrying an unidentified Balaenopteridae whale carcass, where it was cut by the inhabitants for their consumption.

Not too far away, around the Panama Canal, a high traffic zone has been recognized as one of the 20 most central ports of the global cargo-shipping network (Kaluza *et al.*, 2010). Guzman *et al.* (2013) evaluated the collision risk for humpback whales within the breeding grounds in Panama, finding an important overlap of whale concentration areas with shipping routes (53% of whales had close encounters with ships during their study period).

Considering those findings, they recommended a traffic separation scheme (TSS) that would channel all vessel traffic into a smaller area, and thus reduce the geographical overlap between ships and whales. They calculated that a TSS for ship routing of ca. 120 km (65 nmi) with each traffic lane being 2 nmi wide, separated by 3 nmi, would reduce the chance of whale-vessel collisions by almost 95%. They also proposed the consideration of vessel speed reduction to 10kn

within the TSS between August and December when humpback whales (particularly mothers and calves) are present (Guzman *et al.*, 2013), as speed reduction has been shown to result in reduced risk of ship strikes (Laist *et al.*, 2014).

## **DISCUSSION**

Peru is an important area for humpback whales, as it is both a transit and a breeding area for the Eastern South Pacific stock. However, the potential risk of ship strikes is still a non-evaluated threat for cetaceans within the Peruvian marine territory (García-Godos, 2007). Evidence from neighboring countries support the need for addressing this issue through preventive measures, such as the ordering of marine traffic, specially in the vicinity of breeding grounds in northern Peru (Guzman *et al.*, 2013).

Various examples of vessel traffic regulation efforts to prevent vessel-whale collisions exist mostly in the northern hemisphere. In the Atlantic coast of North America, tools like SMAs and ATBAs have proven to be effective at reducing whale mortality associated to vessel-whale collisions (Laist *et al.*, 2014; Vanderlaan & Taggart, 2009). Similarly, ATBAs, TSSs and speed limits have already been adopted by the International Maritime Organization (IMO) in Costa Rica and Panama (IMO, 2016; IMO, 2013), recognizing the threat of collisions within the breeding grounds of humpback whales; initiatives that should be replicated alongside the migratory route of the species.

The International Maritime Organization (IMO) is the competent body to address ship strikes with cetaceans (IMO document MEPC 55/23, paragraph 22.15). "The data shows that almost all species of cetaceans are susceptible to collisions with ships. In addition to mortality, collisions with ships can cause various injuries to cetaceans, such as broken bones and lacerations caused by the helices" (circular MEPC.1 / Circ.674). On the other hand, collisions with large whales can also cause considerable damage to ships. It is considered that "collisions between vessels and cetaceans have had serious consequences on the economy, humans and the environment on a global scale" (document MPC 57/18/2).

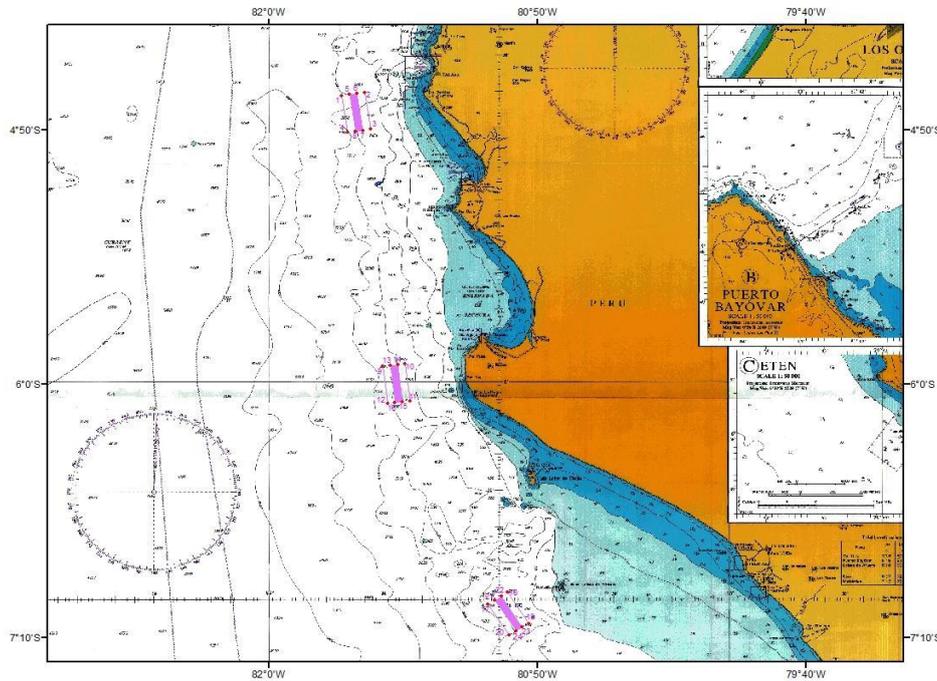
The importance of taking measures in the Peruvian Coastline is emphasized especially when considering that this region is habitat for 8 species of big cetaceans (Reyes-Robles, 2009). These include blue whales (*Balaenoptera musculus*), fin whales (*Balaenoptera physalus*), sperm whales (*Physeter macrocephalus*), southern right whales (*Eubalaena australis*), among others. Being the latter of particular concern, as the Chile-Peru subpopulation of southern right whales is critically endangered according to the IUCN, with less than 60 remaining adults and whose main threat is mortality due to ship collisions (Cooke, 2018).

### *Recommendations*

With the understanding of the importance of the Peruvian coastline in the seasonal migration of humpback whales and the potential risk of human activities on their breeding grounds, the implementation of routing measures for large cetacean conservation is necessary. Tools for the organization of maritime traffic such as Traffic Separation Schemes (TSS) could prevent whale collisions as well as provide safeguards for artisanal and industrial fisheries, natural protected areas, whale watching tourism and oil exploration activities.

A TSS is a means to organize maritime traffic for the safety of vessels transiting through Peruvian territorial waters near the coastal zones, and to maintain a safe distance between large merchant ships and artisanal and industrial fishing vessels, but without imposing restrictions on navigation. This measure can also be used to keep vessels away, and at a safe distance, from places where whale populations breed, feed or follow their migratory route. The TSS are important for preventing incidents near convergence areas where there are activities related to the exploration and exploitation of hydrocarbons and tourism, as well as natural protected areas and reserve areas for the conservation of species and ecosystems in Peru. As a result, the TSS will increase the

safety of navigation and reduce the degradation of the marine environment due to possible maritime accidents involving ships. The TSS do not have negative consequences in the maritime space available for navigation, rather they help to order the shipping traffic, facilitating the development of the activity.



**Figure 4.** Description of the three TSS proposed in the Pacific Coast of Peru.

The area bounded by the TSS connects the following geographical positions:

- (1) 03° 44'.60 S 080° 47'.00 W
- (2) 03° 44'.90 S 081° 37'.30 W
- (3) 06° 04'.80 S 081° 23'.20 W
- (4) 07° 10'.00 S 080° 50'.30 W
- (5) 06° 45'.30 S 079° 58'.20 W

The proposed route system, through the three TSS, is located within the jurisdictional waters of Peru. This system would be recommended for use by all vessels, after being adopted by the IMO, with the exception of national vessels engaged in fishing, hydrocarbon and tourism activities that have the corresponding permit granted by the Government of Peru, through its competent entity, and areas established for the activity.

In addition to this, an evaluation of the mortalities due to ship strikes alongside the coast of Peru is necessary. Despite the efforts of local scientists, most strandings can't be properly assessed and therefore mortality causes remain unknown. Nonetheless, this issue should not be underestimated due to the lack of local information, as the states are called to take preventive actions in order to ensure the health of their living systems.

Article 54 of the Political Constitution of Peru establishes that its maritime domain includes the sea adjacent to its coast, as well as its bed and subsoil, up to the distance of two hundred nautical miles measured from the baselines established by its law. In its maritime domain, the Peruvian State exercises sovereignty and jurisdiction, without prejudice to the freedoms of international communication, in accordance with the law and with the treaties ratified by the Peruvian State. The proposed traffic organization system (TSS) is located in the territorial sea of Peru.

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