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SHORT COMMUNICATION

Position, swimming direction and group size of fin whales (*Balaenoptera physalus*) in the presence of a fast-ferry in the Bay of Biscay☆

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Summary We analyze group size, swimming direction and the orientation of fin whales relative to a fast ferry in the Bay of Biscay. Fin whale groups (≥3 individuals) were on average closer to the vessel than single individuals and pairs ($F_{1,114} = 4.94$, $p = 0.028$) and were more often observed within a high-risk angle ahead of the ferry (binomial probability: $p = 7.60 \times 10^{-11}$). Also, small groups tend to swim in the opposite direction (heading of 180°) of the ferry at the starboard side (binomial test: $p = 6.86 \times 10^{-5}$) and at the portside (binomial test: $p = 0.0156$). These findings provide valuable information to improve shipping management procedures in areas at high risk for collisions.

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1. Introduction

During recent decades there has been a rapid expansion in shipping traffic with a corresponding increased impact to biodiversity at a global scale (Flagella and Abdulla, 2005; IUCN, 2009; Panigada et al., 2008). For large vertebrates, such as cetaceans, ships pose a risk in terms of discharges that may release contaminants into the ocean, noise pollution that can affect marine mammal distributions and behavior, and direct physical harm caused by collisions (Evans, 2003; Laist et al., 2001; Mayol et al., 2008; McGilivary et al., 2009; Panigada and Leaper, 2010). Previous studies have shown the impact of ship-related events on the distribution and behavior of many cetacean species, including North Atlantic right whales (*Eubalaena glacialis*), fin whales (*Balaenoptera physalus*) and sperm whales (*Physeter macrocephalus*) (Evans, 2003; Laist et al., 2001; Mayol et al., 2008; McGilivary et al., 2009; Panigada and Leaper, 2010; Panigada et al., 2008).

The vulnerability of a given species to ship traffic mainly depends on their behavior and on the spatial-temporal characteristics of shipping traffic in a given area (David, 2002; Evans, 2003). For North Atlantic right whales, mortalities due to ship collisions have led to a significant decline in their populations (Jensen and Silber, 2004; Kraus et al., 2005; Laist et al., 2001; Nowacek et al., 2004). It has been hypothesized that the observed slow recovery in population numbers for these whales is due to the cumulative effects of several anthropogenic factors (Jensen and Silber, 2004; Kraus et al., 2005; Laist et al., 2001; Nowacek et al., 2004).

On a global scale, the fin whale is the most commonly recorded species to collide with ships (David, 2002; Laist et al., 2001). Yet contrary to other baleen whales, fin whales are fast swimmers (Laist et al., 2001; Panigada et al., 2006). This suggests that fin whales have the physical capability to avoid colliding with ships; albeit, if the vessel is detected in sufficient time for the whale to change course and/or swim away from the vessel. The high occurrence of these accidents may be related to aspects of this species' behavior rather than swimming speed. For example, cetaceans engaging in activities such as feeding or breeding have been shown to be less responsive to vessel approach (Dolman et al., 2006; Richardson et al., 1995).

The Bay of Biscay is navigated by fast ferries that connect England, France and Spain (Kiszka et al., 2007; ORCA, 2013). We performed a monthly monitoring program in the Bay of Biscay on board a commercial fast ferry in order to understand behavioral patterns of fin whales in relation to ships. Our aim was to identify factors that affect the risk of collisions between fin whales and fast ferries, considering that fin whales are the most recorded species hit by ships (David, 2002; Laist et al., 2001).

The Bay of Biscay is an ideal location for this study because it is an area with both high diversity and abundance of cetacean species and heavy ship traffic. Fin whales are present in the Bay mainly during the spring and summer months. In this study, groups of four observers performed monthly monitoring of fin whales (group size, swimming direction, orientation and positions) from a 21 m high steering house. Through this assessment of the data collected during the surveys, we examine the behavior of fin whales and evaluate the implications for future management decisions in relation to ship collisions.

2. Material and methods

We study group size, swimming direction, orientation and positions of 228 fin whales relative to a commercial fast ferry with routine operations in the Bay of Biscay. Opportunistic observations were made on board of the *Brittany Ferries*' largest ferryboat – *MV Pont-Aven* (184.60 m) during the Portsmouth & Plymouth to Santander crossing (Fig. 1). No observations were performed during crossings over the English Channel given the low abundance of fin whales in those areas (ORCA, 2013). Given an average travel speed of 25 knots and the large size of the ship, the *MV Pont-Aven* ferry is among the group of vessels that has a high probability of involvement in severe or fatal ship–whale strike events (Laist et al., 2001; Panigada et al., 2006; Vanderlaan and Taggart, 2007).

Data on group size, swimming direction, orientation and positions was collected during monthly surveys from August 2006 to October 2008. Each monthly survey was conducted for 3 consecutive days (representing a return trip Plymouth-Santander-Portsmouth). Surveys were carried out from dawn to dusk from a 21.75 m high steering house, in sea states of 4 or less (based on the Beaufort Sea State table). Observations collected during winter months (November to March) were not analyzed due to the scarcity of data. In winter, fin whales are not present in the Bay of Biscay as they migrate to more southern locations. The study generated data for a total of 39 survey days.

Groups of fin whales were highly conspicuous even at a far distance. The data recorded for each sighting of an individual or group of whales included date, time of the day (GMT), GPS coordinates, distance, group size, angle at which animals were spotted and their heading (using an angle board – 0° to 360°) (see for example Littaye et al., 2004). Observations were recorded along a linear transect between 45°56.3′N–4°29.6′W and 43°41.2′N–3°49.4′W. Following the suggestions of Weinrich et al. (2010), in that detection of cetaceans is enhanced by the presence of trained and dedicated observers, the observation team consisted of four trained observers positioned on the navigation bridge. No observations were collected between 90° and 270° due to access restrictions on the navigation bridge. The search for cetaceans was therefore limited to scanning ahead of the ship (9° to either side of the bow). Scanning was performed using the naked eye and binoculars while species identification and distance measurements were performed with binoculars (Steiner® reticle binoculars of 7x50).

Perception bias (bias due to observer's inability to detect an animal when it is present) can influence the amount of data acquired during surveys. Perception bias by observers is due, for example, to long observation times and insufficient training. Although bias by observers cannot be ruled out completely in studies of marine mammals, several precautions were taken in the present study to minimize it. Firstly, all observations were made within a 4 km distance of the ship. Given the height of the navigation bridge, this distance was also the visible range to the horizon, which was estimated to be around 10 km (ORCA, 2013). In addition,