The effectiveness of dedicated observers in reducing risks of marine mammal collisions with ferries: A test of the technique

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Abstract

Collisions between whales and ferry boats are known to have taken place for decades. Concern about these incidents, however, has grown with the increased use of high-speed ferries (those that typically cruise at over 25 knots) in many areas. One common suggestion to reduce collision risk has been to place dedicated spotters on those vessels in order to increase the chance of a whale being detected, with appropriate avoidance maneuvers taking place if deemed necessary. We placed an experienced, dedicated observer on a high-speed ferry operating between Boston and Cape Cod, MA from 2002-2006. Whales were sighted on 39.7% of the 2,053 transits. Sightings included three endangered species (humpback, fin, and North Atlantic right whales), all of which are known to be vulnerable to collisions. The dedicated observer was the first to spot the whale in 56.4% of cases, significantly more often than any other crew member ($P<0.001$). Observers spotted whales at distances of more than 400 m significantly more often than the vessel's captain ($P=0.021$). There was no significant difference between the observer categories based on the target species or its general size (large vs. small cetaceans). No collisions took place aboard the ferry when observers were present; however, another high speed ferry that transited the same route but did not have a dedicated observer was seen to collide with a fin whale. Our findings suggest that experienced dedicated observers could play an important role in detecting marine mammals and reducing the risk of collision with them.

Introduction

Collisions between cetaceans and ships are a threat to cetaceans throughout the world today. Large ship collisions with whales are known from widespread areas where shipping takes place (Laist *et al*. 2001; Jensen and Silber 2003; Van Waerbeek 2006). While in many cases the frequency of collisions does not represent a threat at a population level, mortality from ship strikes needs to be understood and incorporated into population models (ACCOBAMS 2006). In at least some cases (e.g. the North Atlantic right whale, *Eubalaena glacialis*) ship collisions could threaten the continued existence of a population or species (Knowlton *et al*. 2004; Knowlton *et al*. 2007).

While many fatal collisions involve large commercial or military ships (Wiley *et al*. 1995, Laist *et al*. 2001), many different kinds of ships can be involved in collisions with whales. Other categories of vessels that have been implicated in ship collisions include whale watch vessels (Laist *et al*. 2001; Weinrich 2005), recreational vessels (Ford *et al*. 1994), and ferries (Laist *et al*. 2001; Weinrich 2004; Jensen and Silber 2004; Panigada *et al*. 2006).

As the use of ferry routes continues to increase, the risk of ferry collisions with coastal whale species can not be ignored. Ferry collisions with whales are almost certainly under-reported; however, ferry collisions are known to have taken place with humpback whales (*Megaptera novaeangliae*) in Hawaii, New Caledonia, and western Australia; with fin whales (*Balaenoptera physalus*) in the Mediterranean Sea (largely in the Pelagos Marine Mammal Sanctuary) and British Columbia; with killer whales (*Orcinus orca*) in British Columbia; with sperm (*Physeter catadon*) and short-finned pilot whales (*Globicephela machorhyncus*) in the Canary Islands; with

southern right whales (*Eubalaena australis*) in South Australia; with gray whales (*Eschrichtus robustus*) in the Pacific Northwest; and with humpback dolphins (*Sousa chinensis*) in Hong Kong harbor (Weinrich 2005). In addition, there are reports of ferry collisions with whales from the Sea of Japan (IWC, 2007[1]). While the role of speed in the risk of ferry collision remains unknown, it is known that the number of fast ferries in coastal routes where whales live is increasing rapidly (Weinrich 2004).

While it is impossible to totally mitigate the risk of ferries colliding with whales, it has been suggested that having a dedicated and trained observer on board may help reduce this risk. Theoretically, dedicated observers who are experienced in sighting whales would be more likely to see whales than the other crew members, including the captain, because of both their experience and their lack of distractions from other factors involved with the operation of the vessel. However, the effectiveness of such observers has rarely been tested.

In this paper, we report on the results of a five year study, in which dedicated observers were placed aboard a fast ferry that operated in southern New England off the United States East Coast.

Methods

Starting in 2002, a fast ferry service was established between Boston, MA, and Provincetown, MA, from mid-May to mid-October (Fig. 1). The route is approximately 65 km each way, and transits through Massachusetts Bay. The waters traversed routinely are to the west of the Stellwagen Bank National Marine Sanctuary, which is a seasonal feeding ground for humpback, fin, minke (*Balaenoptera acutorostrata*), and northern right whales, as well as several smaller odontocete species.

Ferry transits were conducted using one of three twin-hull catamarans that ranged in length from 35 to 41 m with a 10 m beam (Fig. 2). They are propelled by 3-4 diesel-engine driven jet drives, and cruise at between 30 and 38 kts. Transits took 90-100 min during regular conditions. Each vessel has three decks above the waterline, with the pilot house at the front of the second deck (height of eye above the water of approximately 8 m). Vessels typically left Boston at 9 AM (0900 hrs) and departed from Provincetown at 4 PM (1600 hrs); during June, July, and August additional transits departed Provincetown at 11 AM (1100 hrs) and Boston at 2 PM (1400 hrs). During this summer period there was a third, evening/night transit (departing Boston at 6:30 PM (1830 hrs) and Provincetown at 8:30 PM (2030 hrs), but dedicated observers were not present during these cruises.

Two crew members were on watch in the pilot house at all times: the captain of the vessel and the dedicated observer. Because the ferry company also runs whale watching tours on a regular basis, the captains of the ferry service were familiar with looking for and spotting whales. However, they were also responsible for piloting the vessel, supervising the crew, and other routine functions that pertained to the vessel's transit. The dedicated observer was a staff member of The Whale Center of New England, with extensive experience in looking for and collecting data on whales in New England waters. While both parties were able to move freely around the wheelhouse, the captain most often steered from the mid-ship area, and the observer had a designated seat just to the side of the captain. Often a third crew member or deck hand was present in the pilot house as well.

The observer recorded the vessel's position (using GPS), heading, and speed (as read from the GPS) at 15 minute intervals. Whale sightings were recorded to investigate whether there was legitimate concern for the possibility of a collision along the ferry route. Whenever a whale was sighted, the time, species seen (where known), and whether the animal was within 450 m (or approximately ¼ nautical mile) of the vessel (visually estimated) was recorded. If it was not within 450 m, the bearing and distance to the animal (visually estimated) were recorded in order to determine the animal's actual location. In order to determine whether observers were an effective aide in detecting the presence of whales, during 2005 and 2006 the observer also determined and recorded who initially spotted the whale (observer, captain, or another crew member). If two or more observers

[1] International Whaling Commission. 2006. Report of the Scientific Committee, IWC/58/Rep1, Annex J - Report of the Sub-Committee on Estimation of Bycatch and Other Human-Induced Mortality. 12 pp.

initially saw the whale during the same surfacing, the initial sighting was considered to be "simultaneous" between them. Crew members other than the observer were aware that this information was being recorded, but were unaware of any reasons for its use. Any whale sighting was reported to the captain immediately. The captain and the observer would then consult about whether there was a need for the vessel to take precautionary maneuvers to avoid a potential collision, based on the animal's proximity, apparent swimming course, and other environmental cues (e.g. presence of birds over the location of the whale indicating it may be feeding and, therefore, stationary). If precautionary action was deemed necessary, the vessel would either slow its speed in accordance with the National Marine Fisheries Service whale watch guidelines for the Northeastern U.S. region (Carlson, 2005), or change its course to move away from the whale and/or its swimming path.

All data were stored in Microsoft Access, Excel, and SPSS data files, and analyzed using SPSS V. 15.0 statistical software.

Results

Whale sightings

Whales were seen on 816 of the 2,053 transits (39.7%) on which observers were aboard, with 1,238 recorded sightings (a mean of 0.60 sightings/trip). When broken down by species, 370 of these sightings were of fin whales (29.9%), 368 were humpback whales (29.8%), 336 were minke whales (27.2%), 67 (5.4%) were unidentified whale species , 31 were Atlantic white-sided dolphins (*Lagenorhynchus acutus*; 2.5%), 27 were harbor seals (*Phoca vitulina*; 2.1%), 25 were harbor porpoises (*Phocena phocena*; 2.0%), 5 were long-finned pilot whales (*Globicephela melaena;* 0.4%), 5 were beluga whales (*Delphinaptera leucas*; 0.4%), and 4 were North Atlantic right whales (0.3%; Fig. 3). Sightings of most species showed relatively little annual variability, although humpback whale sightings increased sharply through the period (from 0.04 whales/trip in 2002 to 0.372 whales/trip in 2006, a trend reflected in the abundance of humpback whales throughout the Stellwagen Bank system; unpublished data); and fin whales increased from 2002-2003 (0.09 whales/trip) to 2004-2006 (0.23 whales/trip).

Effectiveness of the observer

We recorded who initially spotted the whale in 629 cases. Of these, the whale was initially seen by the observer in 355 cases (56.4%), by the captain in 231cases (36.7%), and another crew member first saw the whale in 16 cases (2.5%). The captain and observer sighted the animal simultaneously in 27 cases (4.2%), and there were no cases where a third crew member sighted whales simultaneously with either the captain or the observer. The values of these four categories were significantly different from random (X^2=546.95, d.f.=4, P<0.001). When only the observer and the captain were directly compared (since they comprised 92.7% of the initial sightings), the observer made the initial sighting significantly more often than the captain (X^2=26.23, d.f.=1, P<0.001).

We further analyzed the total number of sightings made by each observer category for animals within and beyond 400 m of the boat (Table 1). When all four categories were compared, there was no significant difference between them (X^2=7.63, d.f.=3, P=0.054). Between only the observer and the captain, however, the difference was significant (X^2=5.29, d.f.=1, P=0.021) with observers having a higher relative number of sightings beyond 400 m. There was no significant difference when initial sightings by observers and captains were broken down by species either within 400 m (X^2=14.21, d.f.=9, P=0.115) or beyond 400 m (X^2=8.64, d.f.=9, P=0.471). We also grouped species by size as large (fin, humpback, North Atlantic right, and unidentified whales) or small (minke whales, beluga, Atlantic white-sided dolphin, harbor porpoise, and harbor seal). Again, we found no significant difference whether the observer or captain made the initial sighting based on size class either within 400 m (X^2=0.124, d.f.=1, P=0.725) or beyond 400 m (X^2=1.91, d.f.=1, P=0.167). Hence, it appears that observers saw whales initially more often than captains, especially at distances greater than 400 m, but this trend could not be further pinpointed either by individual species or general size.

Effectiveness of the mitigation

No whales were struck in the five years of the study. However, even with the dedicated observer, 20.8 % of the initial sightings occurred within 400m of the vessel. At a speed of 38 knots (19.5 m/sec), an animal at 400 m

would be reached in 20 seconds and at 200 m in 10 seconds, requiring both immediate action and a responsive vessel for collision avoidance.

Discussion

Our results show that the ferry route on which observers were placed is commonly used by a variety of marine mammal species. Whales were seen consistently, across years, on almost 40% of transits, and fin and humpback whales were seen with increasing frequency during the period. Of the species seen, three are classified as endangered (fin, humpback, and North Atlantic right), and two of these are the most frequently sighted species. All three of these endangered species are vulnerable to ship collisions (Laist *et al* 2001; Jensen and Silber 2003; Weinrich 2005). Hence, there is valid concern regarding the risk of collision with whales along the ferry route.

Further, our data indicates that the dedicated observer could be effective in reducing the risk of colliding with a whale. Observers made significantly more sightings than captains, especially at a distance of greater than 400 m. This makes some inherent sense. Captains are often looking at the waters immediately around and in the immediate path of their vessel for any hazard to navigation, such as floating logs, fishing buoys, and/or small boats which might be difficult to detect from greater distances. Hence, the captain would be less focused on seeing anything, including whales, at a great distance. However, if the animal came into close range (less than 400 m) without being previously detected, the chance of detection by the captain would likely increase. Table 1 shows that the number of detections within the close range was almost identical between the observer and the captain (58 and 56 initial detections, respectively).

Intuitively, it would seem that it is more important to detect animals that are close to the vessel in order to avoid a collision. However, the sighting of more distant animals may be of greater importance than regularly thought. In a review of the detailed circumstances around strikes, Weinrich (2005) concluded that in the great majority of cases where collisions took place, the whale had not been seen prior to the surfacing during which the strike took place. Hence, by becoming aware of the presence of animals even if they are further away from the vessel, the vessel can be maneuvered so that the collision risk is minimized. This is particularly important, given the high transit speeds used by ferries and the associated short reaction times provided to operators for avoiding collisions.

Although we did not place observers on evening transits, crews reported to us that no collisions took place during those cruises. While this might be taken as a suggestion that observers were not actually required to help avoid collisions, captains did report that they often altered their planned course to avoid areas where whales had been seen during earlier daylight transits, especially in the case of aggregated whales. Hence, the input from the observers was important in planning the safest routes even at times where last minute avoidance maneuvers would be limited by a lack of visibility.

Because there were no actual collisions it is hard to determine the observer's contribution in avoiding strikes. However, during the same time we observed a ferry from another company using the same route (using a slightly smaller (25 m) twin-hull jet driven catamaran vessel traveling at similar speeds) collide with a fin whale during a transit from Provincetown to Boston. The collision was not immediately fatal to the whale, but did result in a scar on the animal's caudal peduncle. This provides further evidence of the observer's effectiveness. However, the other ferry line did not also conduct whale-watching tours, and their captains may have been less familiar with whale sighting and maneuvering to avoid collisions.

Because concerns over cetacean collisions with many vessels of the type of the ferry service used in this study is likely to increase throughout the world, this model case suggests that detection of cetaceans is enhanced by the presence of a trained and dedicated observer. In areas where the relative abundance of cetaceans is unknown, this example suggests that data collected by observers can be used to gather a baseline to determine whether concern is warranted. However, even with the observers, many animals were first sighted relatively close to the vessel (< 400 m) providing operators with reaction times measured in seconds, rather than minutes. Therefore,

particularly in high use habitats, collisions between cetaceans and high speed vessels would remain a concern even with the use of dedicated and experienced observers aboard the vessels. In addition, to be of conservation value, the use of observers would require subsequent actions, when appropriate, on the part of operators to react to the information provided by them.

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Table 1. Number of sightings made by different crew members within and beyond 400 m, 2005-2006.

	Within 400 m	Beyond 400 m
Observer	58	271
Captain	56	161
Other Crew	8	18
Captain and Observer Simultaneous	2	15

Figure 1. Ferry Route between Boston, MA and Provincetown, MA, USA.

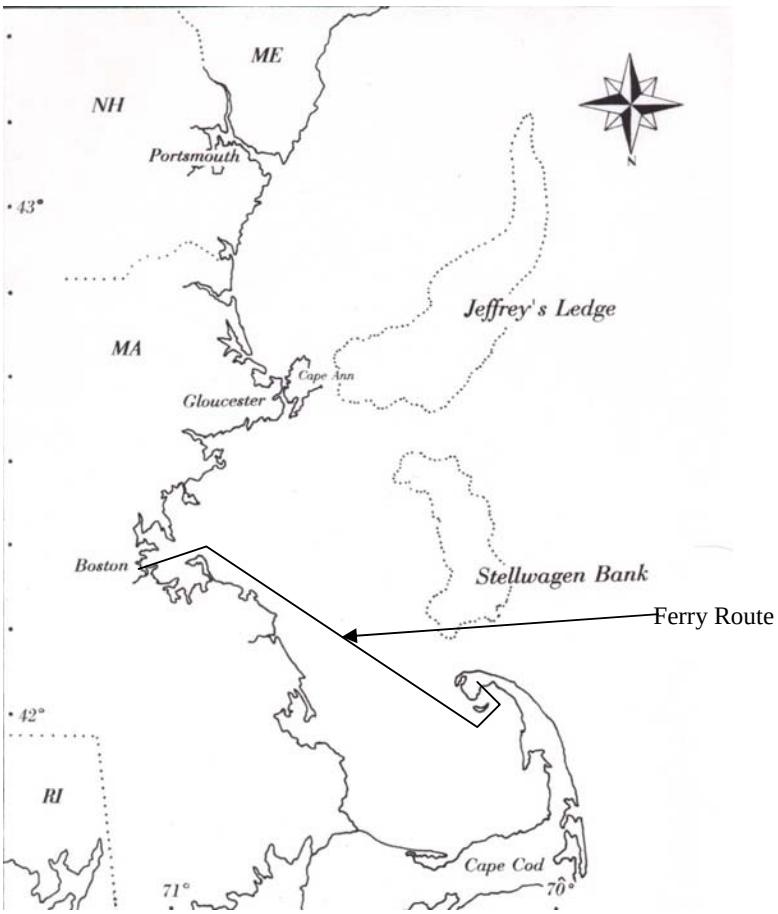

Figure 2. An example of the vessels used for the ferry transit.
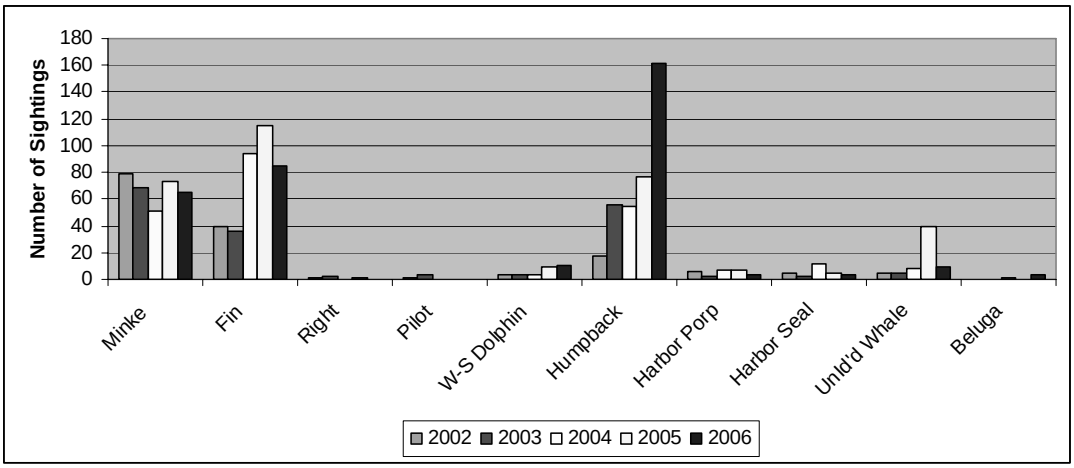
Figure 3. Sightings of whale species by year.