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Short Note

Sperm Whale (*Physeter macrocephalus*) Collision with a Research Vessel: Accidental Collision or Deliberate Ramming?

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No maritime story has fascinated people more than Herman Melville's (1851) classic, *Moby Dick*. This fictional story of a "rogue" sperm whale (*Physeter macrocephalus*) sinking the *Pequod* and killing its Captain is engrained in maritime legend, in part, because it was loosely based on the true story of a Nantucket whaling ship, the *Essex*. The firsthand account of the 1820 sinking of the *Essex* and the harrowing ordeals of its crew, as told by Owen Chase (1821/1972) and later retold by Nathaniel Philbrick (2000), was the best known of several such incidents documented from whaling history.

Commercial and recreational ships frequently collide with large whales by accident (International Whaling Commission [IWC], 2010), and the "staving" of small, light whaleboats by whales was apparently common during 18th- and 19th-century Yankee whaling (Chase, 1821/1972), although intentional ramming of ships by whales would appear to be rare. To our knowledge, such ramming events have not been previously described by scientific observers, and a recent review by Panagiotopoulou et al. (2016) also found no evidence of any such events. We describe herein a 2007 event in which a male sperm whale collided with the research vessel *M/V Kahana*.

During the U.S. Navy-funded Mariana Islands Sea Turtle Cetacean Survey (MISTCS; Fulling et al., 2011), on 21 February 2007, the *M/V Kahana* (56.4 m) was conducting a systematic line-transect survey in waters near Saipan and Tinian (Commonwealth of the Northern Mariana Islands) in the western North Pacific Ocean. The visual observers sighted a group of sperm whales approximately 6.5 km from the ship (Figure 1), consisting of at least one mother/calf pair and three mature males. Approximate size of the males was 12 to 14 m relative to size of the vessel. Upon approaching the animals, ship speed was reduced to steerage (decreased from 1.5 to 0.2 kts), and a single, large male with numerous fresh scars below the blowhole passed the ship on the port side at a distance of ~50 m and was not seen again. As the ship continued, the focal group of whales was approached, and the two remaining large males (Whales A and B) turned and began swimming rapidly toward the ship, with the lead whale (Whale A) actually colliding with the ship on the port bow (Figure 2a and b). The whale appeared unhurt and did not behave abnormally after the collision. The entire sequence was recorded on video (see "Supplementary Material" page, *Aquatic Mammals* website: www.aquaticmammalsjournal.org/index.php?option=com_content&view=article&id=10&Itemid=147) and is described in detail both in Table 1 and Appendix A.

Although there are many records of sperm whales having destroyed small, light whaling chase boats by hitting them with their bodies and flukes, as well as biting at the boats with their mouths (and many of these are reflected on old prints and scrimshaw scenes inscribed on whale teeth), there are fewer reports of ramming of large ships by sperm whales. Herein, we consider

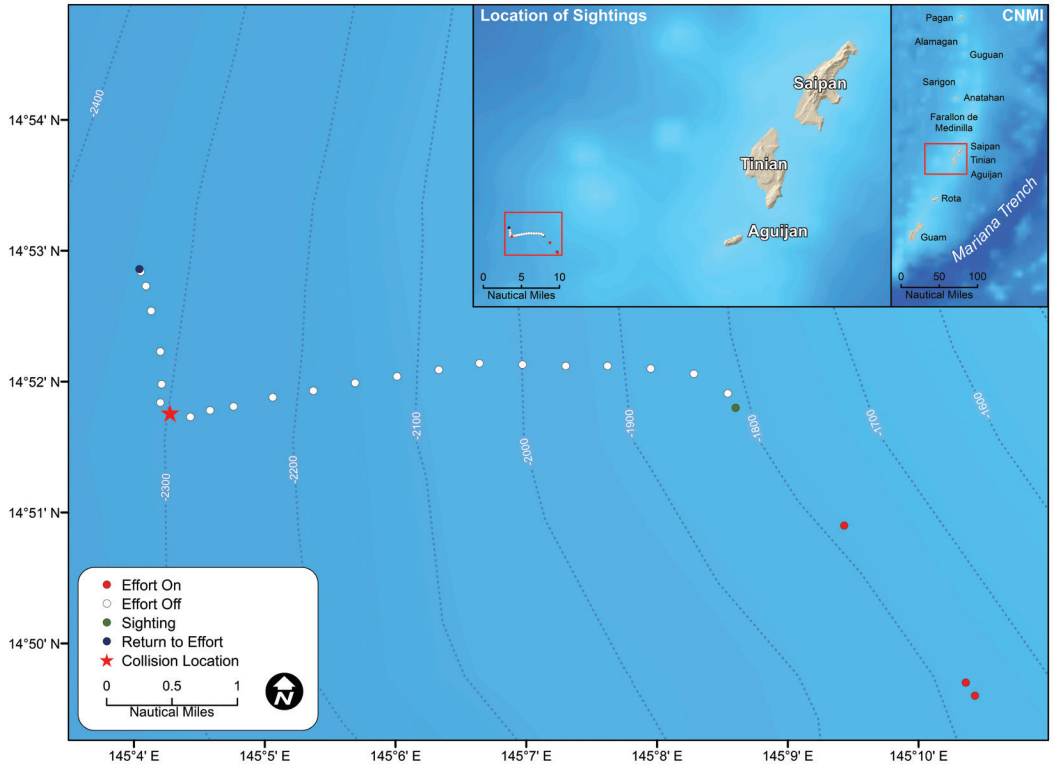

Figure 1. Trackline of the survey vessel during the entire encounter with the group of sperm whales. Dots indicate the ship's location and effort status of the observers at 2-min intervals (red – actively looking for animals, white – tracking the sperm whale sighting, and blue – return to actively searching for animals), as well as the location of the initial sighting (green dot) of the sperm whale group. The location of the sperm whale collision is indicated by the red star.

"hitting" a vessel as unintentional behavior and "ramming" as intentional behavior. A number of ramming incidents can be found in various old whaling accounts; however, most of these are not well-documented and, therefore, not considered reliable. A literature search found only four previous such instances that can be considered well-documented (Table 2). Additionally, the search also located one video-documented incident of a sperm whale ramming a fishing vessel off the coast of Chile (Table 2).

These five instances suggest that, at times, sperm whales deliberately target large ships in an aggressive manner. Our encounter is the first that we know of to be scientifically documented and recorded on video, and it lends some credence to the older reports of ramming of whaling vessels, which have often been viewed skeptically. Ours is apparently also one of two incidents to involve a vessel that was not involved in whaling activities.

While the exact motivation for the ramming event in the Mariana Islands cannot be known, the following are several possible explanations: (1) the whale collided with the ship by accident; (2) the collision was perhaps deliberate as the ship was seen by the whale as a physical threat; and (3) the collision was a deliberate act of displacement behavior.

Whale/vessel collisions are in some instances suggested to be the result of whales becoming distracted while engaged in certain activities, such as feeding or social behavior (Laist et al., 2001), and being unaware of a nearby vessel. As the ship approached during our encounter, the group of sperm whales was observed to be milling and logging at the surface. The series of parallel rake marks on the heads of all three male whales in this encounter suggested that the individuals may have recently been competing with one another or with other males for access to females (Caldwell et al., 1966; Clarke & Paliza, 1988; Whitehead, 1993, 2003). If these whales were competing, the increased hormone levels in these whales may have caused them to be distracted (Vu et al.,

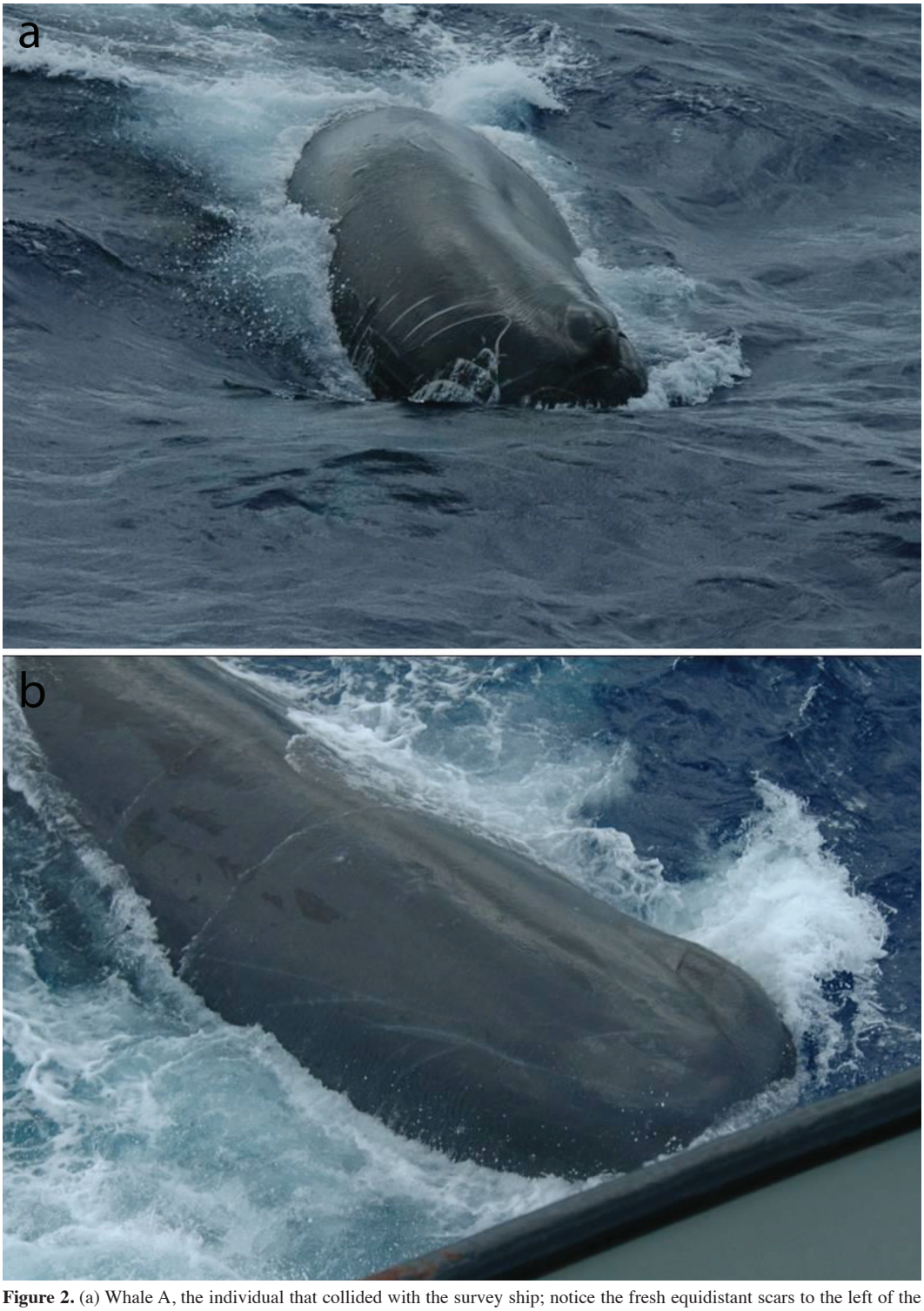

Figure 2. (a) Whale A, the individual that collided with the survey ship; notice the fresh equidistant scars to the left of the blowhole. (b) Whale A just prior to impact; the ship's rail is seen in the foreground. (Photos taken by C. Oedekoven, courtesy of U.S. Navy)

Table 1. Detailed chronology of the incident as gleaned from analysis of the video recording

Video clock (minutes/ decimal seconds)	Notable event	Comments
0:00-0:36	Two sperm whales (Whales A and B) are logging off the port side of the ship facing away from the ship.	Camera is zoomed in on the two whales (Whales A and B) and then focuses on Whale B. Notes indicate ~150 m; ship is drifting at < 4 kts.
0:37-0:48	Whale A shifts its tail and within a few seconds is broadside to the camera, logging at the surface.	Whales in the view are repositioning themselves relative to the ship.
0:52-1:21	Whale A (colliding whale) and other sperm whales are shown in the view and are followed.	
1:22-1:29	Calf is crossing bow. Mother can be seen between the ship and the calf under water and just ahead of the calf.	Camera is still zoomed-in on the whale, so distance is difficult to judge. Notes indicate 100 m; ship is drifting at < 4 kts.
1:30-1:35	Whale A is turning toward the ship. Scars on melon are clear on Whale A.	Whale A appears to be increasing speed.
1:35-1:38	Whale A is coming straight toward the ship.	Ship is drifting at around 1 kt.
1:39-1:43	Whale B is perpendicular and about to collide with the primary whale.	
1:44-1:47	Whale A is within 10 m of the ship; crew member is on bow with the whale in the view.	Ship is drifting at about 0.5 kt.
1:47.30	Whale A hits the ship.	Observers indicated that Whale A defecated when it rammed the ship.
1:48-1:53	Whale B is perpendicular to Whale A.	Very difficult to see what happens below the port bow of the ship. At this point, the video camera was turned off.
1:53 to end of video	Whales are shown off the starboard bow of the ship.	The video camera was stopped immediately following the collision at ~1:53 of the video.

2015). However, as seen in the video, Whale A swam at least 150 m to collide with the ship and was seen increasing speed and fluking (1:35.30 to 1:38.30). From the video, it also appears that the whales were aware of our presence and that Whale A intentionally targeted the ship, making it unlikely the collision was accidental.

It is possible that Whale A deliberately collided with the vessel because he viewed it to be a threat. Whaling accounts reveal that sperm whales were often aggressive toward whaling boats, ramming them with their heads and with open jaws (Starbuck, 1878; Berzin, 1972; Philbrick, 2000), and this extended sometimes to large ships (Table 2).

Whaling in the Mariana Islands took place as recently as the mid-1970s (Ohsumi & Masaki, 1975). There are documented accounts of several species of whales tagged with Discovery-mark tags in the western Pacific as far south as Guam (Masaki, 1972). These tags were later recovered during flensing by the Japanese whaling fleets (Ohsumi & Masaki, 1975). It is also believed that sperm whales possess communal knowledge (Whitehead, 2003; Whitehead & Rendell, 2015). Sperm whales have long life spans (approaching 60 to 70 y or more; Whitehead, 2003), travel great distances to feed and breed (Rice, 1989; Whitehead et al., 2008), and have been shown to have complex social structure (Whitehead, 2003; Whitehead et al., 2012). The fact that whaling has occurred in the recent past in the western Pacific, possibly within the life span of the individuals encountered here, supports the notion that older sperm whales were/are aware of the threat ships can pose and remain aggressive toward them, especially during times of increased agitation (e.g., male-male competition) (Whitehead & Rendell, 2015).

Table 2. Well-documented records of deliberate ramming of large vessels by sperm whales

Year	Vessel name	Description	References
1820	*Essex*	Nantucket-based whaling ship is rammed several times by large male sperm whale and sunk.	Chase, 1821; Philbrick, 2000
1850	*Parker Cook*	Provincetown whaling vessel is rammed twice by sperm whale and damaged but not sunk.	Starbuck, 1878
1851	*Ann Alexander*	New Bedford-based whaling ship is rammed several times by large male sperm whale and sunk.	Starbuck, 1878; Sawtell, 1962
1866	*Osceola*	Whaling ship is rammed but not sunk by sperm whale, which suffered a fractured skull as a result.	Brown, 1887
2007	*M/V Kahana*	Marine mammal research vessel is rammed but not sunk by sperm whale (video of event).	This paper
2015	Not known	Fishing vessel is rammed but not sunk by sperm whale (video of event).	https://www.youtube.com/watch?v=OPmqESZVDn4

It is also possible that this mature sperm whale recalled memories (either his own or through "cultural memory") of past whale ship attacks. Evidence of long-term memory was recently presented by Gero et al. (2015) who hypothesized that female sperm whales are likely able to recognize individuals and social units, recall their interaction histories, and accumulate social knowledge over long periods. Gero et al. defined "long periods" as confirmed co-occurrence for at least two seasons from 2005 to 2010 and discussed a group of whales with known association for at least 15 y. Therefore, it would not be unreasonable to suggest that a repository of information occurs for old male sperm whales (Whitehead & Rendell, 2015).

It is also valid to consider that the sperm whale acted to protect the group, which included a mother/calf pair. Communal defense of sperm whale calves by adults is documented in numerous studies (see Whitehead, 2003). Sperm whales are known to configure sometimes in marguerite formations to protect calves (Best, 1979; Jefferson et al., 1991; Whitehead, 1996; Pitman et al., 2001) from predators such as killer whales (*Orcinus orca*). This behavior was not seen during our encounter, but our presence alone may have elicited a "predator response."

Complicating the situation is the potential for male-male competition for mates. Aggressive competition between male sperm whales is known to occur and has been documented by several investigators (e.g., Hopkins, 1922; Berzin, 1972; Whitehead, 2003). Whitehead (2003) discussed an encounter in Chilean waters in which a group of male sperm whales were "jousting" with their lower jaws as a form of competition for receptive females. The fresh scars on the melons of the three males in our account suggest that recent, intraspecific competition may have occurred (Whitehead, 2003). Panagiotopoulou et al. (2016) provided an excellent review of the use of the head by sperm whale as a battering ram and highlighted one such incident in which two male whales rammed each other head-on. In the Mariana Islands encounter, Whale B is seen swimming perpendicular to and attempting to ram Whale A just before Whale A collided with the ship. Dudzinski (1996, 1998) and Herzing (1996) both suggested that direct (perpendicular) approaches by conspecifics is associated with aggression and threats in Atlantic spotted dolphins (*Stenella frontalis*) and bottlenose dolphins (*Tursiops truncatus*).

As noted earlier, during our encounter, the three largest animals (assumed to be males) were seen with fresh scars on their melons. Given that there was a mother/calf pair close to Whales A and B, it is conceivable that these males viewed our ship as a new challenger. It is plausible that in this encounter, Whale A saw our ship as a competitor or potential threat to the mother/calf pair because (1) the ship moved into the immediate area of the group and (2) Whale A left the proximity of the mother/calf pair to engage the ship. However, while this may seem plausible, it assumes the unlikely event that the whale confused the ship with another whale. This also leads to another possible explanation: displacement behavior.

Animals sometimes redirect their aggression if they have been frustrated in encounters with more aggressive animals (Thierry, 2000). Redirected aggression is thought to reduce the frustration that may result from an unpleasant encounter with a conspecific (McFarland, 1966; Levine et al., 1989). It may also decrease the chance of being

attacked again by the more dominant conspecific (Aureli & van Schaik, 1991; see Whitehead, 2003, for sperm whale-specific discussion). Displacement behavior is documented in cetaceans (Amundin, 1974). Dominance is a component of sperm whale social structure, and this is a polygynous species in which males compete directly for mating access (Whitehead, 2003). We speculate that in the case of the sperm whale collision, the individual was displacing its aggression and/or was frustrated and directed that frustration at the research vessel.

Although it is not possible to know for certain the intentions and motivation of the whale that hit our research vessel, we believe that the most likely explanation is that the whale deliberately rammed the vessel because it saw it as a threat. The suggestion that male sperm whales sometimes use their enormous heads as battering rams (and that this may have been one of the evolutionary forces leading to the natural selection of this strange structure) makes this explanation seem more likely (Carrier et al., 2002; Panagiotopoulou et al., 2016). The main evidence supporting the sperm whale head as a battering ram comes in three forms: (1) *Behavioral* – sperm whales have been seen to ram various objects and each other in aggressive encounters; (2) *Anatomical* – the structure of the reinforced junk and spermaceti organ facilitates their use in ramming, and their adaptation helps the animals avoid injury; and (3) *Forensic* – scarring on the heads of male sperm whales is suggestive of regular ramming of objects.

In addition to the well-accepted fact that the enormous head and unusual anatomical structures of the sperm whale are used for production of echolocation clicks, there are also more controversial hypotheses that the sperm whale forehead functions in acoustic sexual selection (Cranford, 1999), prey debilitation (Norris & Mohl, 1983), and buoyancy control (Clarke, 1970, 1978). These alternative hypotheses lend credence to the idea that there were multiple evolutionary mechanisms shaping the development of the sperm whale head with its odd structures: the junk (or melon) and the spermaceti organ. Our observation of a large bull sperm whale apparently using its head as a battering ram to hit our research vessel fits well into our emerging understanding of the sophisticated anatomy and behavior of sperm whale societies (see Whitehead, 2003; Whitehead et al., 2012). While we will never know the explanation for certain, we hope that this report will help further our understanding.

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Appendix A

Detailed Narrative of the Event

On 21 February 2007, at 1338 h local time (LT) (Coordinated Universal Time +10), a group of sperm whales was sighted at 45° to port at a distance of approximately 6.5 km. The ship was diverted toward the animals to confirm species identification, group size, and composition. The initial sighting location, trackline effort, and the exact location of the sperm whale encounter are shown in Figure 1. While transiting, the observers continued to monitor the position and movement of the whales, and they collected information on group size and composition. The group consisted of three males (determined by size; the largest of which left before the main group was encountered) and a mother/calf pair (n = 4 for the main encounter). As the ship approached the whales (1400 h LT; distance of ~500 m from the animals), it was apparent that they were logging at the surface, and the ship's speed was reduced to steerage to drift toward the group (~4 kts and slowing; depth sounder was operational, and the hydrophone array was in the water). Around 1402 h, a large sperm whale (assumed to be a male based on size—at least 15 m in length—and extensive rake marks on the melon) passed along the port side of the ship within approximately 50 m. This whale was not seen again. This male had numerous parallel fresh tooth "rake" marks on the head, presumably received while contesting other male sperm whales (e.g., Kato, 1984; Whitehead, 1993). As the ship continued drifting, the whales were approximately 300 to 400 m ahead of the ship. The animals appeared to be logging at the surface. This focal group contained two adult males and at least one mother/calf pair. As we approached, the mother/calf started crossing the bow from port to starboard perpendicular to the ship.

One of us (JCS) began recording the whales within a few minutes of the ship drifting within 400 m of the animals (1405 h LT) using a digital video camera (unknown make/model). It is important to note that the video was started and stopped on several occasions. The time stamp within the video was added in post-processing to aid in analysis and does not capture the entire encounter. Chronologies of the events captured in the video are given in Table 1.

As the ship approached the group, we could see that two adult whales (presumed males based on size relative to the research vessel) at approximately 20° to port (0:00.00 to 0:36.00) had "rake-mark" scarring on their melons. As the ship drifted closer to the group (within 200 m), JCS focused on the two adult males (Whales A and B) facing away from the ship, and then Whale A started turning toward the ship (0:37.00 to 0:48.00). The videographer continued to focus on Whales A and B (0:48.00 to 1:21.30) logging at the surface. Then, the mother/calf pair was recorded moving across the path of the ship—port to starboard (1:22.00 to 1:29.30). The mother can be seen subsurface between the ship and the calf. It is at this point that the whale (Whale A) that eventually collided with the ship began turning so strongly that a flexion in the spine was visible. Scars on the melon are easily seen in the video (1:30.00 to 1:35.00) and the photograph (Figure 2a). Whale A then increased speed and headed directly toward the ship (1:35.30 to 1:38.30). The other large male (Whale B) was also moving to intercept the ship or Whale A (1:39.00 to 1:43.30). As Whale A headed toward the port side of the ship's bow at considerable speed (3 to 4 kts), Whale A arched its back slightly and continued moving forward with a forceful thrust of the tail. Shortly after (1:44.00 to 1:47.00), Whale A hit the ship just aft of the bow (Figure 2a), defecated, dove under the ship, and reappeared within ~50 m on the starboard side. Another male (Whale B) was approximately 1 m behind Whale A, swimming at similar speed (1:47.30 to 1:52.30); however, Whale B did not collide with the ship. Instead, when less than 10 m from the ship, Whale B dove and reappeared on the starboard side of the ship near Whale A. At this point, the video camera was turned off (~1:53)—video ends here—but the whales reappeared on the starboard side of the vessel.

After impact, Whale A appeared unhurt; there was no blood in the water, and the animal continued swimming unimpeded to join the mother/calf pair. Within 5 min, all the whales (Whales A and B, as well as the mother/calf) had coalesced ~150 m off the starboard bow. We did not follow the group further but continued to observe the animals as they began to swim away.