Second Report of the IWC Vessel Strike Data Standardisation Working Group

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Background
Beyond increased research in a few northern hemisphere whale populations (e.g. fin whales, ACCOBAMS, 2008), a general lack of understanding of the circumstances and factors that cause vessels to collide with cetaceans can be traced back partly to a shortage of sufficiently documented events. Information about the type, speed and other operational factors of vessels involved in collisions is rarely available. Reporting from large areas of the world oceans including the Southern Hemisphere is opportunistic, or absent. A large proportion of incidents are not reported, particularly also for smaller cetaceans, although for a few fluviatile and coastal populations ship strikes may directly compromise long-term survival (Van Waerebeek *et al.*, 2007).

An IWC standardised global database of collisions between vessels and whales combining biological and vessel data and one that clearly identifies the level of uncertainty for individual records was proposed. This is expected to lead to more accurate estimates of the incidence of mortality and injuries, help detect trends, allow better modelling of risk factors (e.g. vessel type, speed, size), point to causative or predisposing factors and reveal unsuspected problem areas. The relational database consists of five separate data tables[4], varied and detailed enough to function as a global standard for archiving all types of collisions between vessels and cetaceans (including reported near miss events).

At IWC/59 (May 2007) a database template draft was proposed by the Vessel strike Data Standardization Working Group (Van Waerebeek and Leaper, 2007) acting under the general supervision of the Bycatch and other human-induced mortality Subcommittee and was agreed upon with minor modifications. The SC, the Conservation Committee (CC) and the Commission endorsed that decision. The CC in particular emphasized that it be populated with data as soon as possible. This was initiated after IWC/59 and is ongoing. We provide here an overview of the contents of a first data-rich database (Appendix).

Progress
Information on vessel collision events with whales and smaller cetaceans were searched in the published primary literature, unpublished (grey) literature, selected internet sources, IWC National Progress Reports, other reports, conference abstracts and personal communications. They were critically reviewed and where possible and necessary, verified at source. G. Lauriano (Italy) kindly provided a summary listing of collisions in the Mediteranean Sea, with references, for the period 1897-2004.

The original design utilised a single database in Microsoft Access. However, it soon became apparent that it would be necessary to allow multiple users to enter data independently in separate locations using the same basic template. The current design uses the replication facility in Access which allows multiple versions of the same database to be combined. This allows separate research teams to maintain their own databases but using a compatible format that can be combined at a later date. One advantage of this approach over a single web-based design is that there is no need for data sharing agreements from the outset. Nevertheless, there are many advantages in maintaining a single web-based database, and it is hoped to develop this option, while maintaining the flexibility of allowing for additional replica databases in other locations.

As of April 2008, the database contained 763 records mostly from published ('historical') sources. A summary of the composition of the database is presented in Appendix.

The ACCOBAMS Fin Whale Steering group (ACCOBAMS, 2008) has acknowledged the importance of linking with the work of this group and the IWC Ship Strikes Working Group (SSWG). Data entry on ship strikes in the Mediterranean will be designed to be compatible with data fields of the global database.

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[4] including a Record Manager, Specimen on Shore, Specimen at Sea, Incident at Sea and Whale Stuck on Bow.

Problems encountered

i) Many collision events are poorly researched, documented or reported and there are a limited number of fully documented cases. Availability of voucher material (e.g. photos, samples) seems to be scarcer still.

ii) The precise identity of primary sources, such as field data collectors, frequently remain obscure, cannot be reached or fail to reply. Retrospective ship strike data verification is an exceedingly inefficient way of proceeding and should be avoided in future by an ongoing effort to try and investigate all new reports as soon as possible.

iii) The level of uncertainty in the original data is often unclear, misrepresented or grossly underestimated. Alleged records (possible collisions) where the probability of being a true collision case was considered too low were not entered in the database.

iv) A few descriptive fields in our database template will benefit from being converted to categorical data fields for easier qualitative analysis. Eamples are 'Type of vessel', 'Damage to vessel' and 'Injuries or death of crew/passengers' [needs to be added].

v) Many variables which describe data of greater detail remained empty as this information has rarely been collected or reported, however it is hoped that with increased awareness more detailed documentation will become available when recording future events.

vi) Typically information provided in the IWC National Progress Reports is incomplete and often too vague to be of much use for any but a general assessment.

vii) Holders of unpublished data often were not forthcoming with original (raw) data, even when solicited.

Possible solutions for wider acceptance

(a) The decision by ACCOBAMS (2008) to utilize the global database format for Mediterranean records is considered an encouraging break-through towards improved standardisation, adding the option of straightforward future database integration.

(b) There seems to exist wide support that the IWC Secretariat may be considered the most appropriate entity to act as data repository for the global database. This might encourage Parties to more readily contribute with full data records in the agreed format of ship strike events in their waters or by ships registered under their flags.

Recommended follow-up

(1) Prepare paper datasheets for use by mariners and ship-based observers to submit new records in a format that can then be screened and validated before being entered in the database. Considering that ship strikes at individual ship level are rare events, the risk that filling out full paper forms would be considered excessive work should be minimal.

(2) Continue improving database design (e.g. more categorical data fields) while maintaining compatiblity between versions. Add a simple, user-friendly, database 'front-end'. This can be used to record events directly on ships or as a home page for a dedicated website to enter data on-line.

(3) Continue enriching the global database with new and historic collision records. Follow up on any new information from around the world (particularly in countries where awareness for the need of full documentation is still low) to try to bring the database up to date and ensure events are not missed.

References

ACCOBAMS. 2008. Fin whales and ship strikes in ACCOBAMS area: work programme and protocols to assess human-induced mortality. Document SC5-Doc13/24, Fifth Meeting of the Scientific Committee, Rome, 17-19 April 2008.

Van Waerebeek, K. and Leaper, R. (compilers). 2007. Report from the IWC Vessel strike Data Standardization Group. Document SC/59/BC12**,** Anchorage, May-June 2007.

Van Waerebeek, K., Baker, A.N., Félix, F., Gedamke, J., Iñiguez, M., Sanino, G.P., Secchi, E., Sutaria, D., van Helden, A. and Wang, Y. 2007. Vessel collisions with small cetaceans worldwide and with large whales in the Southern Hemisphere, an initial assessment. *Latin American Journal of Aquatic Mammals* 6(1): 43-69.

Summary of IWC global database of collision incidents between vessels and cetaceans

Number of events and breakdown by verification status, nature of observation, and event type.

The IWC global database now contains 763 records, mainly from published sources. Data from incidents in the last few years and unpublished sources are still being gathered. Of these 68% were confirmed definite collisions while 22% were probable collisions (Table 1).

Table 1. Number of records in database by verification status.

Verification status of collision records	**N (%)**
Confirmed definite collision	519 (68)
Unconfirmed but probable collision	166 (22)
Possible collision	47 (6)
Near miss event	8 (1.0)
Definitely hit by ship but may be post-mortem collision	14 (1.8)
Blank or unknown code (to be verified)	9 (1.2)
Total	763 (100)

The nature of the reports of the incidents in the database are listed in Table 2. Collisions are recorded as Incidents at Sea, Specimen on Shore, Specimen at Sea or Whale stuck on bow. Each event can only have one Incident at sea or Specimen on shore record, but there may be multiple observations of Specimen (carcasses) at Sea that could potentially be linked with a number of records. The majority of reports were of Incidents at Sea, closely followed by Specimens (carcasses) found or examined on shore. There were only 20 cases where an incident at sea was linked to a carcass on shore excluding cases where whales were recovered off the bows of ships for examination. Of 144 whales observed at sea, 57 (40%) were reported alive with injuries attributed to vessel collisions while the remaining 87 were observed as carcasses in various states of decomposition. Although the database allows for the recording of multiple observations of a carcass at sea this was relatively rare in the current dataset (many of these multiple records would have already been filtered by authors of published papers).

Table 2. Nature of report of incidents.

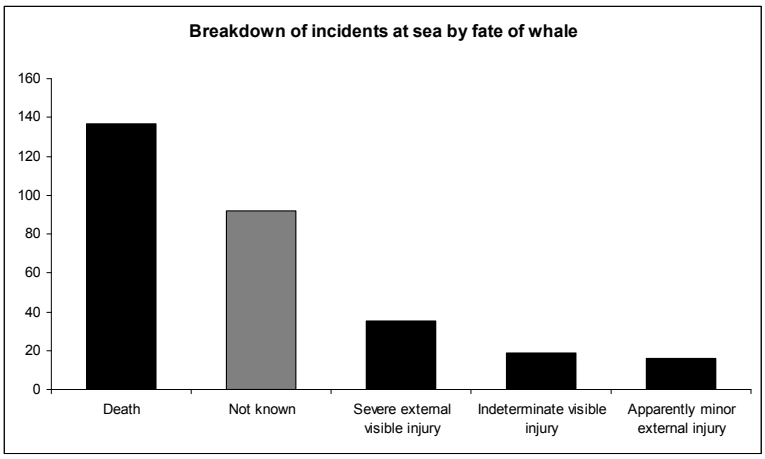
Category of collision report	**N**
Incident at Sea (only)	275
Specimen on Shore (only)	262
Whale stuck on bow	82
Incident at sea linked to specimen on shore (but not stuck on bow)	20
Whale stuck on bow linked to specimen on shore	21
Specimen at sea (can include multiple observations of the same whale)	144

The number of incidents at sea where the fate of the whale was reported is shown in Table 3 and Figure 1. Death was the most commonly reported fate (44 %) and minor injury was the least common (5.2%). Up to one third of incidents have no information associated, mostly because the cetacean was not seen again or because no one looked. If death and severe injury (likely to result in death) are combined, a minimum of 55% of animals almost certainly perished. Many of the unknowns will also include death on impact.

Table 3. Breakdown of incidents at sea by fate of the cetacean involved.

Fate of cetacean after collision	**N (%)**
Death	142 (44.0)
Not known	106 (32.8)
Severe external visible injury	37 (11.5)
Indeterminate visible injury	21 (6.5)
Apparently minor external injury	17 (5.2)
Total	323 (100)

Figure 1. Breakdown of incidents at sea by fate of whale.



Information on vessel size, type and speed

Of 358 incidents at sea, vessel name was recorded in 285 (80%) of cases. This should in principle allow vessel details to be identified with further work, possibly with collaboration from national registry institutions where ships are registered or, in the future, the International Maritime Organization (IMO). Currently vessel dimensions such as length were recorded in 136 (38%) of cases and vessel speed in 83 (23%) of cases, but few other technical characteristics of vessels were reported. The number of records with data on speed and the proportion where death or serious injury was reported is shown in Figure 2. The length distribution of vessels is shown in Figure 3. Although there is a preponderance of vessels of 50m length or less, the proportion of fatal incidents is much greater for larger vessels.

In the current version, the information on vessel type is a descriptive field rather than defined categories. Further work is needed to convert the descriptions into categories that could be used for summary statistics.

Figure 2. Frequency distribution of fate of cetacean after vessel collision, *versus* vessel speed.

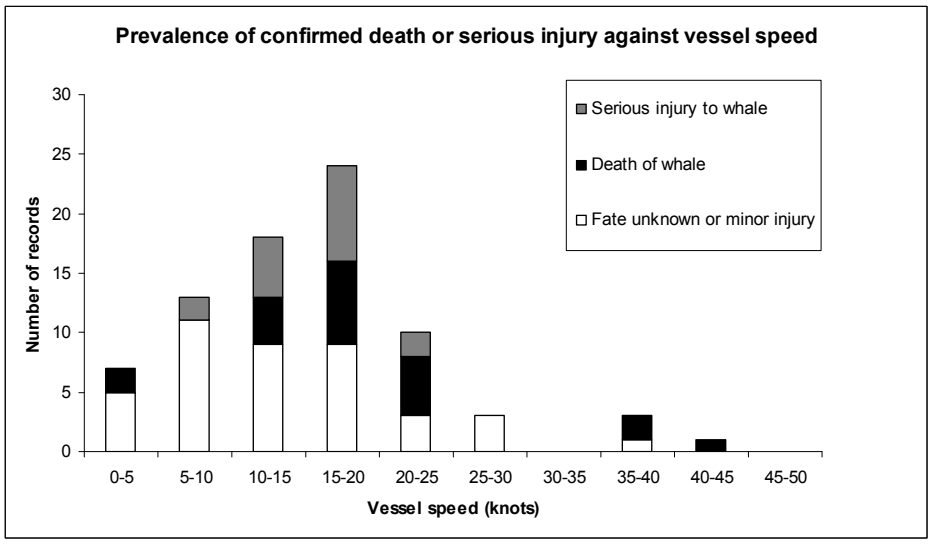
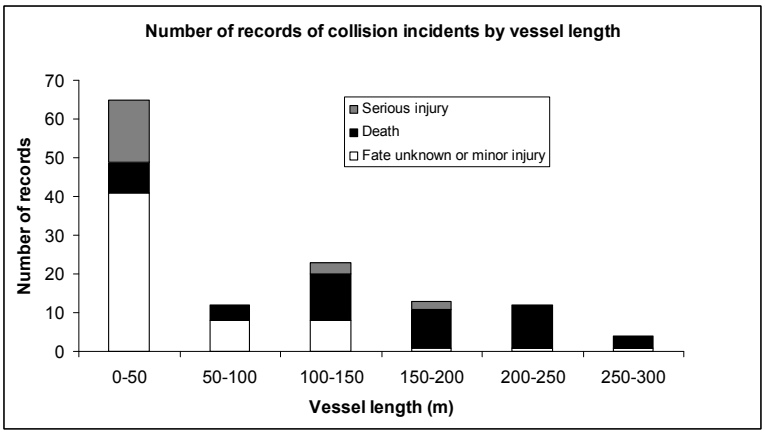


Figure 3. Frequency distribution of the fate of cetaceans after vessel collision *versus* vessel length (in metres).



Changes in reported incidents over time

There has been a dramatic, exponential increase in the number of incidents per decade since the 1950s (Figure 4). The figures for 2000 onwards show a higher annual rate for the years 2000-2003 than during the 1990s and so would also be expected to be higher again. Much of this increase can be explained by improved reporting. However, the rate of whales becoming stuck on the bows of vessels also shows an exponential increase although at about half the rate (Figure 5). Whales becoming stuck on the bow of vessels are much more likely to be reported and so this may be closer to a true reflection of changes in collision rates.

Figure 4. Number of vessel collision records by decade for all incidents. Exponential increase is thought to be a combination of higher collision incidence and improved reporting in more recent years.

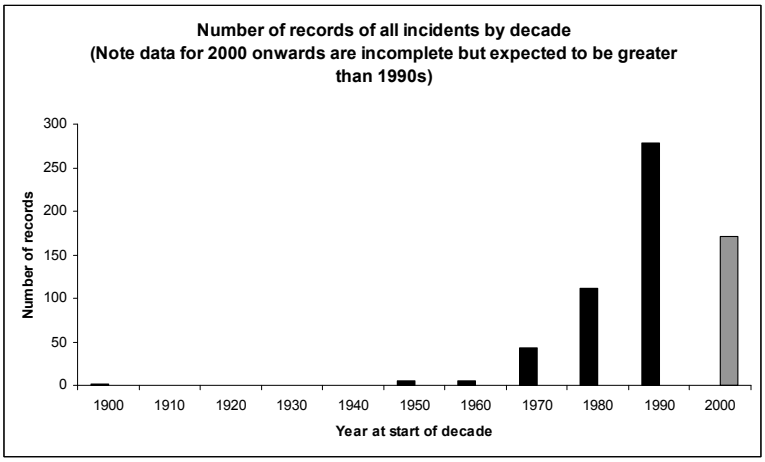
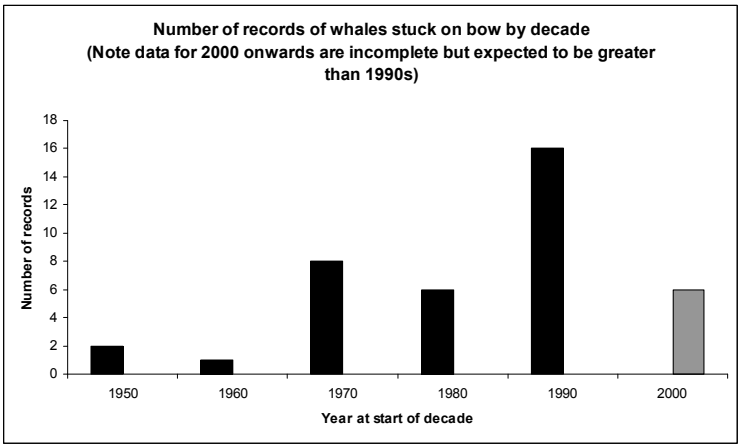


Figure 5. Frequency of whales reported stuck on vessel bows by decade.



For whales stuck on the bow of the vessel the slowest speed at which this occurred was 14 knots with 9 out of 11 records in the 17-23 knots speed range.

Whale species involved in collisions

The overall list of large whale and odontocete species identified as involved in collisions is given in Table 4. Where species was positively identified (N=572) the relative proportions are shown in Figure 6. Fin whales were the most commonly reported (29.2%), followed by humpback whales (21.2%) and North Atlantic right whales (16.0%). A limited number of species have been reported stuck on the bows of vessels (Table 5). These are listed in order of the proportion of total records for that species that have stuck on the bow. It can be seen that the large rorqual whales are most susceptible to this type of incident. No right whales (*Eubalaena* spp.) have been reported stuck on the bow and only a small (<5%) proportion of humpback and sperm whales were found wedged across the bow.

Table 4. Frequencies of collision records identified for each species or group category (e.g. unidentified large whale). Beware that numbers provide only an approximate value of true incidence as they also include probable but unconfirmed cases.

Common name	Scientific name	N
Bowhead whale	*Balaena mysticetus*	3
common minke whale	*Balaenoptera acutorostrata*	31
dwarf minke whale	*Balaenoptera acutorostrata* subsp.	1
Antarctic minke whale	*Balaenoptera bonaerensis*	1
sei whale	*Balaenoptera borealis*	10
ordinary Bryde's whale	*Balaenoptera brydei*	13
Eden's whale (small-form Bryde's)	*Balaenoptera edeni*	2
blue whale (any subspecies)	*Balaenoptera musculus*	16
pygmy blue whale	*Balaenoptera musculus brevicauda*	2
fin whale	*Balaenoptera physalus*	220
Hector's dolphin	*Cephalorhynchus hectori*	10
short-beaked common dolphin	*Delphinus delphis*	1
gray whale	*Eschrichtius robustus*	27
Southern right whale	*Eubalaena australis*	36
North Atlantic right whale	*Eubalaena glacialis*	99
short-finned pilot whale	*Globicephala macrorhynchus*	3
pygmy sperm whale	*Kogia breviceps*	6
humpback whale	*Megaptera novaeangliae*	143
Andrew's beaked whale	*Mesoplodon bowdoini*	1
Gray's beaked whale	*Mesoplodon grayi*	1
Hector's beaked whale	*Mesoplodon hectori*	1
Cuvier's beaked whale	*Ziphius cavirostris*	2
Irrawaddy dolphin	*Orcaella brevirostris*	2
killer whale	*Orcinus orca*	14
sperm whale	*Physeter macrocephalus*	47
Indo-Pacific humpback dolphin	*Sousa chinensis*	11
striped dolphin	*Stenella coeruleoalba*	8
Atlantic spotted dolphin	*Stenella frontalis*	1
Pantropical spinner dolphin	*Stenella longirostris*	1
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	1
common bottlenose dolphin [5]	*Tursiops truncatus*	12
Unidentified balaenopterid whale	Unidentified balaenopterid whale	5
Unidentified baleen whale	Unidentified baleen whale	2
Unidentified cetacean	Unidentified cetacean	34
Unidentified large whale	Unidentified large whale	52
Unidentified small cetacean	Unidentified small cetacean	3
Unidentified small whale	Unidentified small whale	5

Regional prevalence of collision reports

The database provides several fields for recording location; large area, small area, EEZ nation and Latitude and Longitude. Further work is needed to collate all the available location information into a form that can be easily summarised. The records are dominated by data from four basic areas. 75% of incidents were reported from the NW Atlantic, NE Atlantic, NE Pacific and the Mediterranean (Figure 7). It seems very likely that the geographical distribution of published ('historical') records is heavily affected by reporting bias. This was

[5] most common bottlenose dolphins affected are of the inshore form.

concluded also from a precursory study that examined whale collision cases in the Southern Hemisphere, considering that most reports there were recent (Van Waerebeek *et al.*, 2007).

Table 5. Species identification of whales stuck on bow. The category '*Balaenoptera edeni*' refers to the reported species identification but it may in fact relate to ordinary Bryde's whales *B. brydei*.

Species		Number of records 'stuck on bow'	Proportion of total collision records for that species
Balaenoptera brydei	Bryde's whale	4	0.50
Balaenoptera edeni	Bryde's whale	1	0.50
Balaenoptera musculus	Blue whale	3	0.27
Balaenoptera borealis	Sei whale	1	0.14
Balaenoptera physalus	Fin whale	21	0.13
Physeter macrocephalus	Sperm whale	2	0.05
Balaenoptera acutorostrata	Minke whale	1	0.04
Megaptera novaeangliae	Humpback whale	5	0.04
Eschrichtius robustus	Gray whale	1	0.04

Figure 6. Collisions where the species was identified.

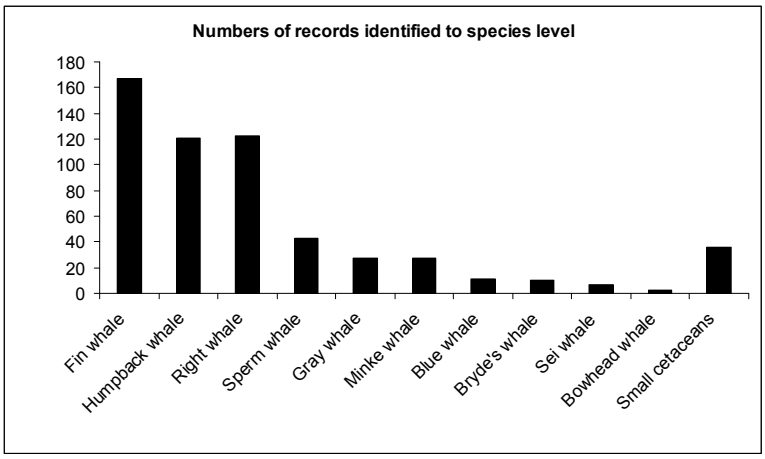
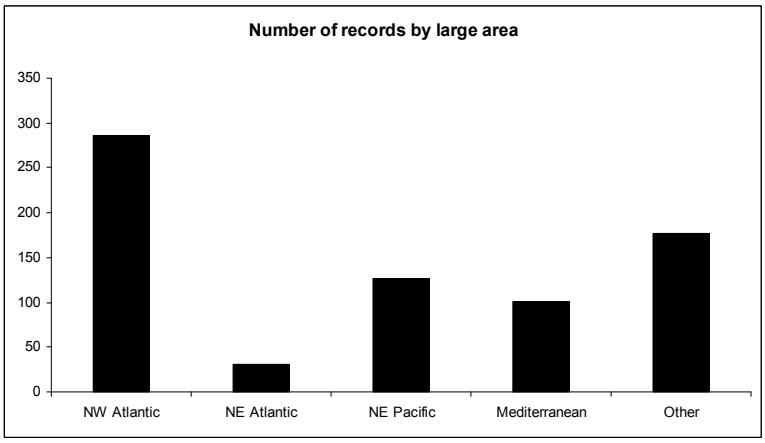


Figure 7. Distribution of collision records by 'Large Area'. By far the highest number of cases are reported from the NW Atlantic.



Damage to vessels and human injuries

Damage to the vessel was reported in only 46 (13%) of the Incidents at Sea. However, this is likely to be a considerable underestimate since most of the records came from published sources related to whales and may have ignored damage to vessel information. Details of the type of damage reported, as well as human deaths and injuries, where this information was available, are given in Table 6. Damage was reported most frequently

for vessels less than 50m (80%) with 10% of vessels reporting damage in the 50m -100m category and 10% in the 100m-150m category.

Table 6. Descriptive details of damage to vessels plus cases of human deaths and injuries, the result of vessels colliding with cetaceans.

Vessel type	Damage and injuries
Navy	Severe damage to vessel
Bayliner	Hull cracked
Skiff	Boat turned over
Sailing yacht	10.24m yacht had to be towed
Cargo ship	A four-foot hole in the ship's bow
Destroyer	Severe damage to the sonar dome, necessitating dry docking in Boston.
Passenger ship	Damage to the stem bar protecting the rudder. The bar was twisted to port about two feet out of plumb
Whale catcher boat	The starboard propeller was bent necessitating dry dock repair.
Hydrofoil	The vessel came to a dead stop within about 30 m, but no injuries to the 18-member crew were reported. The vessel sustained considerable damage to its rear struts.
Navy Frigate	Increase of vibration in the aft part of the ship and increased noise astern noted. Significant damage (a 1.6-m tear) in the leading edge of a propeller blade. The propeller had to be replaced at a cost of $125,000.
Hydrofoil	US$ 1 million in damages. Hull warped, both aft strut actuators damaged, both steering arms broke, flooding of gas turbine, starboard engine shifted forward off its mounts.
Sport Fishing	The vessel's propeller, propeller shaft, and rudder were damaged.
Ferry	A passenger death resulted
Whale-watching	Hull damage was suspected and passengers were asked to don life vests. The port stabilizer was subsequently found to have been lost in the collision.
High-speed ferry	A T-foil on the vessel was broken and the ferry arrived in Nice harbour two hours late as a result of the collision.
Whale-watching	At least one propeller was damaged.
Whale-watching	Cracked hull.
Fast Catamaran	Damage to the hull
Whale watching	Propeller had to be straightened
Whale watching vessel	The boat's rudder was bent by the collision, and divers went underwater to attend to the damage after the boat berthed and passengers disembarked
Yacht	Badly damaged. Crew had to abandon the ship
Whale watching Jet boat	The front of the boat was lifted to the left. Passenger Kimberly Kanago to fall. She sustained a head injury.
Fishing vessel	Not described, but the whale lifted the boat out of the water momentarily
Whale-watching	The motor stalled as the propellers dug into the whale. Collision damaged the boat's propellers and steering mechanism, rigging temporary steering system to get the boat back to shore
Sailing yacht	The yacht was dismasted when a whale surfaced into the yacht's bow. The yacht was towed back to Airlie beach to repair. One person was treated for shock.
Trimaran yacht	A metre square hole in the hull. The yacht took on a lot of water and lost electrical power. A distress beacon was activated and sailor stayed on the stricken craft for five hours until winched to safety aboard a rescue helicopter.
Sport fishing	Boat sunk, black smoke billowing from the starboard motor as the boat slowed. Waves crashed over the deck. Water in engine room. Seven people onboard abandoned the boat and used the life raft to survive. People were rescued by coast guard helicopter.
Ferry	A 75-year-old South Korean woman died of a cerebral haemorrhage while 27 people were taken to hospital after the accident. No information regarding ship's condition offered.
Fishing vessel	Pilot house crash, a person death
Maxy Catamaran	Some delamination across thirty centimetres of the leading edge of the port rudder. Port daggerboard and rudder damaged.
High Speed Ferry	Six passengers injured
Sailing vessel	Crew injured, a crew member was tossed off the fore ship into the water, port-side steering wheel broken, starboard helm pillar broken. Grinder handles broken
Trimaran yacht	Almost sunk.

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